KIPS

SERIES

PRACTICE BOOK

CHEMISTRY

NATIONAL MDCAT

- Topic-wise Practice MCQs
- Answer Keys
- Explanatory Notes

MDCAT SOCIETY FOR FUTURE DOCTORS

A Kitab Dost Publication

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TOPIC NO.		PAGE
1	Introduction to Fundamental Concepts of Chemistry	1
2	Atomic Structure.....	15
3	Gases.....	26
4	Liquids.....	38
5	Solids.....	49
6	Chemical Equilibrium.....	59
7	Reaction Kinetics.....	74
8	Thermochemistry and Energetics of Chemical reactions...	88
9	Electrochemistry.....	100
10	Chemical Bonding	114
11	s and p Block Elements.....	126
12	Transition Elements	137
13	Fundamental Concepts of Organic Chemistry.....	149
14	Chemistry Hydrocarbons.....	162
15	Alkyl Halides.....	177
16	Alcohols and Phenols.....	190
17	Aldehydes and Ketones.....	204
18	Carboxylic Acids.....	219
19	Macromolecules.....	231
20	Environmental Chemistry.....	241

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Topic 1 INTRODUCTION TO FUNDAMENTAL CONCEPTS OF CHEMISTRY

PRACTICE EXERCISE

INTRODUCTION AND ATOMIC MASS

Q.1 Haemoglobin molecule is how many times heavier than helium atom

A) 68000 times
B) 17000 times
C) 34000 times
D) 1700 times

Q.2 Which is a molecular ion

A) NH_4^+
B) H_3O^+
C) NH_3^+
D) SO_4^{-2}

Q.3 Which one is mono isotopic element

A) Chlorine
B) Hydrogen
C) Fluorine
D) Cadmium

Q.4 How many isotopes are present in palladium

A) Two
B) Six
C) Four
D) Nine

Q.5 Atoms having same mass number but different atomic numbers are called

A) Isotopes
B) Isobars
C) Isotones
D) Isomers

Q.6 How many unstable radioactive isotopes have been produced through artificial disintegration

A) 280
B) 40
C) 300
D) 154

Q.7 The total types of fundamental nuclear sub-atomic particles are there in an atom

A) More than 100
B) 2
C) 3
D) Equal to 100

Q.8 Isotopes are

A) Chemically similar
B) Physically dissimilar
C) Chemically dissimilar
D) Both 'A' and 'B'

Q.9 Correct representation of element with atomic number and atomic mass is

A) ${}^{\wedge}_{Z}X$
B) ${}^{\wedge}X^{\prime}$
C) ${}^{\prime}_{\wedge}X$
D) ${}^{\prime}X^{\wedge}$

Q.10 Molecular ions are formed by passing

A) High energy electron beam
B) X-rays
C) α -particle
D) All of the above

Q.11 Which one is true about isotope

A) Same number of neutrons
B) Same physical properties
C) Same mass number
D) Same chemical properties

CONCEPT OF MOLE AND AVOGADRO'S NUMBERS

Q.12 Number of moles present in 0.6 gram of silica is (Atomic mass Si = 28, O = 16)

A) 0.01 mole
B) 0.064 mole
C) 0.044 mole
D) 0.054 mole

Q.13 Volume occupied by 4.4g of CO_2 at STP is

A) $2.24dm^3$
B) $112cm^3$
C) $22.4dm^3$
D) $1.12\ dm^3$

Q.14 Which one is the molar volume of the gas at STP?

A) $24dm^3$
B) $22.4dm^3$
C) $80dm^3$
D) $40dm^3$

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Q.15 Number of H^+ ions when 0.1 mole of sulfuric acid is completely ionized in water:

A) $4 \times 6.022 \times 10^{23}$
B) $1 \times 6.022 \times 10^{23}$
C) $2 \times 6.022 \times 10^{23}$
D) $2 \times 6.022 \times 10^{22}$

Q.16 How many electrons have to be removed to ionize 1.0×10^{-6} moles of Ne atoms to Ne^+ ions in a neon advertising tube

A) $\frac{6.02 \times 10^{23}}{1.0 \times 10^{-6}}$
B) $\frac{1.0 \times 10^{-6} \times 6.02 \times 10^{23}}{20.2}$
C) $1.0 \times 10^{-6} \times 6.02 \times 10^{23}$
D) $\frac{1.0 \times 10^{-6} \times 6.02 \times 10^{23}}{9.65 \times 10^{-1}}$

Q.17 When 0.5 moles of $Al_2(SO_4)_3$ are dissolved in water, total number of particles produced

A) 1.2×10^{23}
B) 3.0×10^{23}
C) 1.5×10^{24}
D) 2.5×10^{23}

Q.18 Which of the following contains 1 mole of the stated particles

A) Chlorine molecules in 35.5 g of chlorine gas
B) Electrons in 1g of hydrogen gas
C) Hydrogen ions in $1 dm^3$ of $1 mol\ dm^{-3}$ aqueous sulphuric acid
D) Oxygen atoms in $22.4\ dm^3$ of oxygen gas at STP

Q.19 The number of moles of CO_2 which contain 16g of oxygen

A) 0.25
B) 1.00
C) 0.50
D) 1.50

Q.20 The mass of one molecule of O_2 is

A) $\frac{6.02 \times 10^{23}}{32}$
B) 32g
C) 0.32g
D) $\frac{32}{6.02 \times 10^{23}}$

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Q.21 Amount of oxygen in grams which contains 1.5×10^{22} molecules

A) 0.08
B) 0.80
C) 80
D) 1280

Q.22 Number of electrons in half mole of Na^+

A) 10
B) $5.5N_A$
C) 5
D) $5N_A$

Q.23 3×10^{-21} moles of an amino acid having molecular mass 200 g mol^{-1}, would have molecules

A) 200
B) 1800
C) 300
D) 36000

Q.24 The relative atomic mass of oxygen is 16amu. What is the mass of 2 mole of oxygen gas?

A) 64g
B) 32g
C) 100g
D) 71g

Q.25 Which of the following has maximum mass

A) 25g of iodine
B) 25g atom of oxygen
C) 25g mole of water
D) 25g of nitrogen gas

Q.26 Mass of one mole of chlorine gas is

A) 32g
B) 71g
C) 35.5g
D) 46g

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Q.27 Which of the following is not true for a mole?

A) It is counting unit
B) It is the gram atomic or gram formula mass of a substance
C) It contains 6.023×10^{23} particles
D) It contains different number of particles for different substances

EMPIRICAL AND MOLECULAR FORMULAE

Q.28 During combustion analysis, which one is used for absorbing carbon dioxide

A) 50 % KOH solution
B) $Mg(ClO_4)_2$
C) 5% KOH
D) Silica gel

Q.29 Absorption of CO_2 in KOH solution during combustion analysis is

A) Chemical change
B) Neither chemical nor physical change
C) Physical change
D) CO_2 absorbed in $Mg(ClO_4)_2$

Q.30 Which of the following compounds has highest percentage of oxygen by weight

A) CH_3OH
B) C_2H_5OH
C) HCOOH
D) H_2O

Q.31 Which of the following compound have empirical formula, but no molecular formula

A) H_2O
B) H_2O_2
C) C_6H_6
D) NaCl

Q.32 The sole products of combustion analysis are

A) CO_2 and NH_3
B) CO_2 and KOH
C) H_2O and $Mg(ClO_4)_2$
D) CO_2 and H_2O

Q.33 An acid with molecular mass 104 contain 34.6%C, 3.85% H and rest is O. The molecular formula of acid is

A) $C_3H_4O_4$
B) C_2H_2O
C) $C_2H_2O_4$
D) C_2HO_2

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STOICHIOMETRIC CALCULATIONS

Q.34 $6Na + Fe_2O_3 \longrightarrow 3Na_2O + 2Fe$

For above reaction, if you are provided with 230g Na and 320g Fe_2O_3, then limiting reactant is

A) Na
B) Fe_2O_3
C) Na_2O
D) None of these

Q.35 Mg reacts with HCl as per the following reaction

$Mg_{(s)} + 2HCl_{(aq)} \rightarrow MgCl_{2(aq)} + H_{2(g)}$

Given that; Mg = 21g and HCl=21g, the excess reactant is;

A) Mg
B) Both are in stoichiometric amounts
C) HCl
D) None of these

Q.36 What volume of oxygen is required for complete combustion of $5cm^3$ C_2H_2

A) $2cm^3$
B) $12.5cm^3$
C) $5cm^3$
D) $13.5cm^3$

Q.37 $11.207dm^3$ of methane at STP has _____ moles of hydrogen atoms

A) 4
B) 8
C) 2
D) 16

Q.38 How much Al is required to form alumina with 12g of oxygen

A) 27g
C) 54g
C) 13.5g
D) 24g

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Q.39 The actual yield is always less than the theoretical yield due to

A) Side reaction
B) mechanical loss
C) Reversible nature
D) All of these

Q.40 Indicate the incorrect statement from the following

A) A limiting reactant is consumed at the end of reaction
B) Actual yield is always greater than theoretical yield
C) Stochiometric calculation can be only done if no side reaction happens
D) The empirical formula and molecular formula of some of compounds are same

Q.41 The calculation of the efficiency of a chemical reaction can be checked by knowing the amount of

A) The limiting reactant
B) The product formed
C) The access reagent
D) The substance left unused

Q.42 When one mole of each of the following is completely burnt in oxygen, which will give the largest mass of CO_2

A) CO
B) Diamond
C) Ethane
D) Methane

CONCENTRATION UNITS OF SOLUTIONS

Q.43 When liquid solute is dissolved in liquid solvent, then the best unit of concentration is

A) $\%\,{}^{w}/_{w}$
B) $\%\,{}^{w}/_{v}$
C) $\%\,{}^{v}/_{v}$
D) $\%\,{}^{v}/_{w}$

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Q.44 The molarity of 2% w/v NaOH solution is

A) 2M
B) 0.05M
C) 0.25M
D) 0.5M

Q.45 What is the molarity of a solution when 45g of glucose is present in 500cm^3 of solution

A) 5M
B) 2.5M
C) 0.5M
D) 4M

Q.46 Which of the following concentration unit will change with temperature

A) Molality
B) %w/v
C) Mole fraction
D) %w/w

Q.47 In a mixture of 7g nitrogen and 8g oxygen, mole fraction of nitrogen is

A) 0.3
B) 0.25
C) 0.1
D) 0.50

Q.48 The mass of glucose required to prepare 1dm^3 of 20% glucose solution is

A) 18g
B) 180g
C) 36g
D) 200g

Q.49 Molarity of pure water is

A) 1M
B) 18M
C) 55.5M
D) 6M

Q.50 Solution contains 1 mole of alcohol and 4 moles of H_2O. The mole fraction of H_2O and alcohol will be

A) 4/5 and 4/1
B) 4/1 and 1/4
C) 1/5 and 4/5
D) 4/5 and 1/5

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PAST PAPER QUESTIONS

Q.1 The relative abundance of the isotopes of elements can be determined by

A) X-rays
B) Mass spectrometry
C) Solvent extraction
D) Chromatography

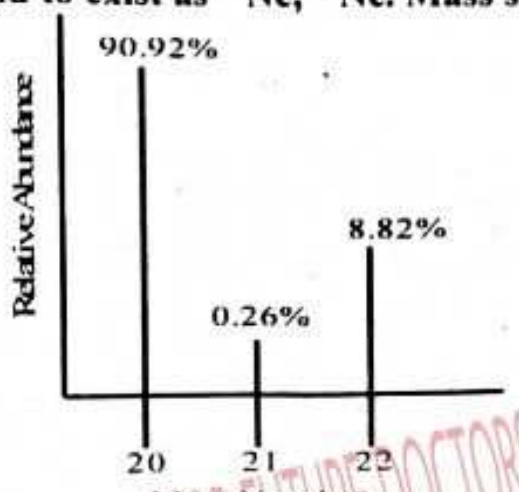
Q.2 If we know the mass of one substance, we can calculate the volume of other substance and vice versa with the help of chemical equation is called

A) Mass-mass relationship
B) Mass-mole relationship
C) Mass-volume relationship
D) Mole-volume relationship

Q.3 In the mass spectrometer ; detector or collector measures the

A) Masses of isotopes
B) Relative abundances of isotopes
C) Percentages of isotopes
D) Mass numbers of isotopes

Q.4 A sample of Neon is found to exist as ^{20}Ne, ^{21}Ne. Mass spectrum of 'Ne' is as follows



What is the relative atomic mass (A_r value) of Neon?

A) 20.18
B) 20.28
C) 20.10
D) 20.22

Q.5 With the help of spectral data given calculate the mass of Neon and encircle the best option. (Percentage of $^{20}_{10}Ne$, $^{21}_{10}Ne$ and $^{22}_{10}Ne$ are 90.92%, 0.26% and 8.82% respectively)

A) 22.18 amu
B) 21.18amu
C) 20.18amu
D) 22.20amu

Q.6 While finding the relative atomic mass, which of the following standard is used to compare the atomic mass of chlorine (35.5amu)

A) Neon-20
B) Carbon-13
C) Nucleon number
D) Carbon -12

Q.7 The average atomic mass of Boron is 10.8. It has two isotopes of masses 10 and 11 respectively. What is the percentage of isotope with the average mass of 10?

A) 80%
B) 50%
C) 60%
D) 20%

Q.8 Which two elements are isotopes?

A) $^{12}_{6}X$ and $^{12}_{7}Y$
B) $^{18}_{9}X$ and $^{20}_{10}Y$
C) $^{16}_{8}X$ and $^{16}_{8}Y$
D) $^{14}_{8}X$ and $^{15}_{8}Y$

Q.9 The best standard for the calculation of relative atomic mass

A) H-1.008
B) Carbon-13
C) Carbon -12
D) Oxygen -16

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Q.10 How many chlorine atoms are in 2 moles of Cl

A) $2\times6.022\times10^{23}$ atoms
B) $35.5 \times 6.022\times10^{23}$ atoms
C) 2×10^{23} atoms
D) $2\times6.02\times10^{22}$ atoms

Q.11 Choose the correct option regarding number of particles associated with one mole of a substance

A) 6.03×10^{23}
C) 6.02×10^{-23}
B) 6.01×10^{-19}
D) 6.02×10^{23}

Q.12 A piece of diamond embedded in a gold ring weighs 6.0 gram. How many number of moles of Carbon does it contain?

A) 6.0 mole
C) 0.5 mole
B) 1.0 mole
D)1.5 mole

Q.13 Iron is manufactured industrially in Blast furnace using Hematite, an ore of iron and a reducing agent Carbon monoxide. $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ **Calculate the mass of iron ore used to manufacture 56g of iron with excess carbon monoxide. Assume that the process gives 100% yield.**

A) 160g
C) 112g
B) 280g
D) 80g

Q.14 An organic compound has empirical formula C_3H_3O if molar mass of the compound is 110.15 molecular formula of this organic compound is (A, of C = 12, H = 1.008 and O = 16)

A) $C_6H_6O_2$
C) $C_8H_9O_3$
B) C_2H_2O
D) $C_6H_6O_3$

Q.15 A polymer of simplest formula CH_2 has molar mass of 28000 $gmol^{-1}$. Its molecular formula will be

A) 100 times that of its empirical formula
C) 500 times of its empirical formula
B) 200 times that of its empirical formula
D) 2000 times that of its empirical formula

Q.16 An organic sample consisting of carbon, hydrogen and oxygen was subjected to combustion analysis. 0.5439 g of this compound gave 1.039g carbon dioxide, 0.6369g of water vapors. The empirical formula of this compound is

A) CH_3O
C) C_2H_6O
B) $C_4H_{12}H_2O$
D) CH_4O

Q.17 The formula which shows the simplest whole number ratio for the atoms of different elements in compound

A) Ionic formula
C) Empirical formula
B) Structural formula
D) Molecular formula

Q.18 One mole of any gas at STP occupies a volume of

A) $22.414dm^3$
C) $23.414dm^3$
B) $22.414cm^3$
D) $20.414dm^3$

Q.19 When 8 grams (4 moles) of H_2 react with 2 moles of O_2, how many moles of water will be formed

A) Five
C) Six
B) Four
D) Three

Q.20 Hydrogen burns in chlorine to produce hydrogen chloride. The ratio of masses of reactants in chemical reaction $H_2 + Cl_2 \rightarrow 2HCl$ is

A) 2:35.5
C) 1:35.5
B) 1:71
D) 2:70

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Q.21 **The number of molecules in 9g of ice (H_2O) is**
A) 6.02×10^{23}
B) 3.01×10^{22}
C) 6.02×10^{22}
D) 3.01×10^{23}

Q.22 **How many moles of sodium are present in 0.1g of sodium?**
A) 4.3×10^{-3}
B) 4.03×10^{-1}
C) 4.01×10^{-2}
D) 4.3×10^{-2}

Q.23 **A researcher has prepared a sample of 1-Bromopropane from 10g of 1-propanol. After purification he had made 12g of product. Which of the following is percentage yield?**
A) 60%
B) 58%
C) 90%
D) 50%

Q.24 **Which one of the followings has same number of molecules as present in 11g of CO_2?**
A) 4g of O_2
B) 4.5 g of H_2O
C) 4g of O
D) ¼ moles of NaCl

Q.25 **Calculate the gram of H_2O formed when 8 g of CH_4 burns in excess of oxygen.**
A) 21 grams
B) 19 grams
C) 18 grams
D) 15 grams

Q.26 **3.0 mole of calcium will contain _____ g of calcium**
A) 105gm
B) 100gm
C) 80gm
D) 120gm

Q.27 **The number of moles of water in 1Kg ice are**
A) 50 moles
B) 55.5 moles
C) 1000 moles
D) 100 moles

Q.28 **How many moles of calcium carbonate are present in 1.75 kg of calcium carbonate? (Ar of Ca = 40, Ar of C = 12, Ar of O=16)**
A) 0.0175 mol
B) 17.5 mol
C) 1.75 mol
D) 1750 mol

Q.29 **During stoichiometric calculations, which of the following laws must be followed?**
A) Law of conservation of mass
B) Avogadro's law
C) Law of conservation of energy
D) Dalton's law

Q.30 **Mole fraction of any component is the ratio of moles of all components in a:**
A) Compounds
B) Molecule
C) Solution
D) Solid

Q.31 **Molarity is defined as the number of moles of solute of any substance dissolved**
A) Per dm^3 of water
B) Per m^3 of water
C) In one g of water
D) In100 ml of water

Q.32 **10.0 grams of glucose are dissolved in water to make 100 cm^3 of its solution, its molarity is**
A) 0.55
B) 0.1
C) 10
D) 1

Q.33 **Given solution contains 16.0 g of CH_3OH, 92.0g of C_2H_5OH and 36g of water. Which statement about mole fraction of the components is true?**
A) Mole fraction of CH_3OH is highest among all components
B) Mole fraction of C_2H_5OH and H_2O is the same
C) Mole fraction of CH_3OH and C_2H_5OH is the same
D) Mole fraction of H_2O is the lowest among all

Q.34 **What mass of NaOH is present in 0.5mol of sodium hydroxide?**
A) 40gm
B) 2.5gm
C) 15gm
D) 20gm

Q.35 **Solution contains 85.5 g of sucrose $(C_{12}H_{22}O_{11})$ in 250 cm^3. What is its molarity?**
A) 0.5 M
B) 2 M
C) 0.25 M
D) 1 M

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ANSWER KEY

1	B	11	D	21	B	31	D	41	B
2	C	12	A	22	D	32	D	42	A
3	C	13	A	23	B	33	A	43	C
4	B	14	B	24	A	34	A	44	D
5	B	15	D	25	C	35	A	45	C
6	C	16	C	26	B	36	B	46	B
7	A	17	C	27	D	37	C	47	C
8	A	18	B	28	A	38	C	48	D
9	A	19	C	29	A	39	D	49	C
10	D	20	B	30	D	40	B	50	D

PAST PAPER QUESTIONS

1	B	6	D	11	D	16	C	21	D	26	D	31	A
2	C	7	D	12	C	17	C	22	A	27	B	32	A
3	B	8	D	13	D	18	A	23	B	28	B	33	B
4	A	9	C	14	A	19	B	24	B	29	A	34	D
5	C	10	A	15	D	20	C	25	C	30	C	35	D

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EXPLANATORY NOTES

Q.1 Haemoglobin is 68,000 times heavier than H–atom

Hb is how many times heavier than helium atom $= \frac{\text{Mass of Hb compared to H}}{\text{Molar mass of Helium}}$

$= \frac{68000}{4} = 17000$

So Hb is 17,000 times heavier than Helium atom

Q.2 Molecule containing +ve or –ve charge is called molecular ion.
After hidding charge on ion, if it look independent individual molecule then it is called as molecular ion. If +ve charge on NH_3^{+1} is hidden by thumb then NH_3 is independent molecule of ammonia so it is cationic molecular ion.

Q.3 Number of isotopes of following elements are

Chlorine	–	2
Hydrogne	–	3
Fluorine	–	1
Cadmium	–	11

Q.4 Two isotopes are for each Cl and Br
Four isotopes are for S
Six isotopes are for each Pd and Ca
Nine isotopes are for Cd

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Q.5 Isotopes are atoms of same element having same atomic no but differnet mass number e.g. $^{12}_{6}C$, $^{13}_{7}C$, $^{14}_{8}C$

Isotones are species/ atoms having same number of neutrons e.g. $^{14}_{6}C$, $^{15}_{7}N$, $^{16}_{8}O$

Isobars are atoms having same mass number but different atomic number e.g. $^{40}_{18}Ar$, $^{40}_{19}K$

Isomer are compounds having same molecular formula but different physical and chemical properties e.g. n–Butane and iso–butane.

Q.6 280 different isotopes occur in nature including 40 radioactive isotopes as well
300 unstable radioactive isotopes produced through artificial disintegration
Among 280 natuarlly occuring isotope, 40 are radioactive isotopes
Out of 280 naturally occuring isotopes, 154 have even mass number and even atomic number

Q.7 More than 100 subatomic particles are present in nucleus of an atom, according to modern technique.

Q.8 As atomic number of different isotopes of an element is same so they have same electronic configuration hence the will show same chemical properties.

Q.9 $^{A}_{Z}X$

'A' is atomic mass and 'Z' is atomic number

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Q.10 Molecular ions are formed by passing
High energy electron beam
X-rays
Or *a* particles
Through gases

Q.11 As atomic number of different isotopes of an element is same so they have same electronic configuration hence the will show same chemical properties.

Q.12

$$SiO_2 = 28 + 32 = 60\,g\,mol^{-1}$$

$$n = \frac{m}{M} = \frac{0.6}{60} = 0.01\,moles$$

Q.13

CO_2 : Volume

$44g : 22.4dm^3$

$$1g : \frac{22.4}{44}$$

$$4.4 = \frac{22.4}{44} \times 4.4 = 2.24dm^3$$

Q.14 1 mole of any gas occupies 22.4 dm^3 volume at STP

Q.15

$$H_2SO_4 \rightleftharpoons 2H^+ + SO_4^{2-}$$

$0.1 \quad 2 \times 0.1$

$$NO.of\ H^+ ions = n \times N_A$$

$$= 0.2 \times 6.02 \times 10^{23}$$

$$= 2 \times 6.02 \times 10^{22}$$

Q.16 No. of electron

$$= n \times N_A$$

$$= 1.0 \times 10^{-16} \times 6.02 \times 10^{23}$$

Q.17

$$Al_2(SO_4)_3 \rightleftharpoons 2Al^{3+} + 3SO_4^{2-}$$

$1Al_2(SO_4)_3$ produces No.of particles $= 5N_A$

$0.5Al_2(SO_4)_3$ produces No.of particles $= 2.5N_A$

$$= 2.5 \times 6.02 \times 10^{23}$$

$$= 1.5 \times 10^{24}$$

Q.18 1g hydrogen is equal to one mole hydrogen item and each item of hydrogen contains one electron so there will be one mole electron also.

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Q.19

O_2 : mole of CO_2

32g : 1

$1g : \frac{1}{32}$

$16g : \frac{1}{32} \times 16$

$= 0.5$ mole

Q.20 Molecular mass of a molecule expressed in grams is called gram molecule or mole so 32g is the molar mass of O_2

Q.21

$$\text{Mol of oxygen} = \frac{\text{Given particles}}{\text{Avogadro's number}} = \frac{1.5\times10^{22}}{6.02\times10^{23}} = 0.025\text{mol}$$

Mass in grams = mole × molar mass of O_2
= 0.025 × 32
= 0.80g

Q.22

1mole Na^+ ion = $10N_A$ electrons

1/2moles Na^+ ion = $5N_A$ electrons

Q.23

$N = n \times N_A$

$= 3\times10^{-21} \times 6.02\times10^{23}$

$= 1800$

Q.24

Relative atomic mass means mass of atom on C–12.0000 scale that is 16 amu for oxygen. Oxygen gas means molecular oxygen (O_2)

$$\text{Mole} = \frac{\text{Mass}}{\text{M. mass of oxygen gas}}$$

$$2 = \frac{\text{Mass}}{32}$$

2×32 = Mass 64g = Mass

Q.25

A) Mass of I_2 is 25g

B) g atom means mole of atoms
Mass of O – atoms = Mole × M. mass of O – atoms
= 25 × 16
=400g

C) g mol means mole
mass of H_2O = Mole × M. mass
= 25 × 18 = 450g

D) mass of N_2 gas is 25g

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Q.26

Relative atomic mass of Cl = 35.5 amu
Relative molecular mass of Cl_2 gas = 71 amu
If molecular mass is expressed in g, then it is called mole, so
1mol of Cl_2 gas =71g

Q.27 1mole of any substance contains equal No. of particle i.e 6.02×10^{23}

Q.28

During combustion analysis, CO_2 is chemically absorbed in 50% KOH

$CO_2 + 2KOH \longrightarrow K_2CO_3 + H_2O$

While H_2O vapour are physically absorbed in Mg $(ClO_4)_2$ because $Mg(ClO_4)_2$ is hygroscopic.

Q.29 During combustion analysis, CO_2 is chemically absorbed in 50% KOH

Q.30 It can be solved theoretically but short cut is to check molecular mass of given options

A) $C_3H_4O_4 = 36 + 4 + 64 = 104\ g/mol$

B) $C_2H_2O = 24 + 2 + 16 = 42\ g/mol$

C) $C_2H_2O_4 = 24 + 2 + 64 = 90\ g/mol$

D) $C_2HO_2 = 24 + 1 + 32 = 57\ g/mol$

Q.31 Ionic compounds do not have molecule rather they have formula unit (Empirical formula) so these don't have molecular formula but have empirical formula

Q.32

In combustion analysis, only those compounds can be analyzed which contain C, H, O and O.

Organic compound $+ O_2 \xrightarrow{CuO} CO_2 + H_2O$
(C, H and O containing)

So sole product of combustion analysis are CO_2 and H_2O

Q.33

$$C_3H_4O_4 = 12\times3+1\times4+16\times4$$
$$= 104 gmol^{-1}$$

Q.34 To find limiting reactant, its short cut is

(i) Find no. of moles from given amount
(ii) Divide no. of moles by molar coefficient
(iii) Small ratio is considered as liming reactant while large ratio is excess reactant

$$n_{Na} = \frac{230}{23} = 10mol,\ n_{Fe_2O_3} = \frac{320}{160} = 2mol$$

$$6Na + Fe_2O_3 \longrightarrow 3Na_2O + 2Fe$$

$$\frac{10mol}{6} \quad \frac{2mol}{1}$$

Limiting reactant $\leftarrow 1.66$ $\qquad 2 \rightarrow$ Excess reactant

Q.35 If equal masses of reactants are given then the reactant whose larger mass is used in balance chemical equation is limiting reactant so Mg will be in excess.

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Q.36

$$CxHy + \left(x + \frac{1}{y}\right)O_2 \rightarrow xCO_2 + \frac{y}{2}H_2O$$

$$C_2H_2 + \left(2 + \frac{1}{2}\right)O_2$$

$$C_2H_2 + (2.5)O_2$$

$2.5O_2$

$1cm^3$ C_2H_2 reacts with $O_2 = 2.5\ cm^3$

$5cm^3$ C_2H_2 reacts with $O_2 = 2.5 \times 5 = 12.5\ cm^3$

Q.37 Volume: moles of 'H' atom

$22.414dm^3 = 4$

$11.2dm^3 = 2moles$

Q.38 $n_{O_2} = \frac{12}{32} = \frac{3}{8}mol$

$$4Al + 3O_2 \longrightarrow 2Al_2O_3$$

O_2	:	Al
3	:	4
1	:	$\frac{4}{3}$
$\frac{3}{8}$	:	$\frac{4}{3} \times \frac{3}{8}$

$= \frac{1}{2}$

Mass of Al = Mole × Molar mass

$= \frac{1}{2} \times 27$

$= 13.5g$

Q.41 Efficiency of chemical reaction is expressed in term of % age yield

$$\%\text{ age yield} = \frac{\text{Actual / experimental yield}}{\text{Thoretical / calculated yield}} \times 100$$

Actual yield is amount of product formed in chemical reaction while theoretical yield is amount of product obtained in balanced chemical equation.

Q.42

A) $CO + \frac{1}{2}O_2 \longrightarrow CO_2$

B) $C_{(D)} + O_2 \longrightarrow CO_2$

C) $C_2H_6 + \frac{7}{2}O_2 \longrightarrow 2CO_2 + 3H_2O$

D) $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$

1 mole of ethane give largest mol and mass of CO_2

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Q.43 If solute and solvent both are liquid then best unit of concentration is % V/V

Q.44

$$\text{Molarity(M)} = \frac{\%\text{age} \times 10}{\text{M. mass of solute}}$$

$$= \frac{2 \times 10}{40} = 0.5\text{M}$$

Q.45 Volume of solution in $dm^3 = \frac{500}{1000} = 0.5dm^3$

$$\text{molarity (M)} = \frac{\text{Mass(g)}}{\text{Molar mass of solute}} \times \frac{1}{\text{Vol. of solution}(dm^3)}$$

$$= \frac{45}{180} \times \frac{1}{0.5}$$

$$= \frac{1}{4} \times \frac{1}{0.5} = \frac{1}{2} = 0.5\text{M}$$

Q.46 Concentration unit having volume factor either in numerator or denominator is temperature dependent because volume is changed by changing temperature.

Q.47

$$n_{N_2} = \frac{7}{28} = \frac{1}{4}\text{mol}, \quad N_{O_2} = \frac{8}{32} = \frac{1}{4}\text{mol}$$

$$X_{N_2} = \frac{n_{N_2}}{n_t} = \frac{\frac{1}{4}}{\frac{1}{4} + \frac{1}{4}} = \frac{1}{1+1} = \frac{1}{2} = 0.5$$

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Q.48

$$\%w \mid v = \frac{\text{Mass of solute(g)}}{\text{Volume of solution}(cm^3)} \times 100$$

$$20 = \frac{\text{Mass of solute(g)}}{1000} \times 100$$

$$20 \times 10 = \text{Mass of solute}$$

$$200\text{g} = \text{Mass of solute}$$

Q.49 Suppose $1dm^3$ $H_2O = 1000g$

So $$n_{H_2O} = \frac{1000}{18} = 55.5\text{mol}$$

It means 55.5 mol of water is present in $1dm^3$ volume of solution.

Q.50

$n_{alcohol} = 1\text{mol}$, $n_{H_2O} = 4\text{mol}$

$$X_{H_2O} = \frac{n_{H_2O}}{n_t}, \qquad X_{alcohol} = \frac{n_{alcohol}}{n_t}$$

$$= \frac{4}{5} \qquad = \frac{1}{5}$$

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Topic 2 ATOMIC STRUCTURE

PRACTICE EXERCISE

DISCOVERY AND PROPERTIES OF ELECTRON, PROTON AND NEUTRON

Q.1 The value of $\frac{e}{m}$ for the electron is

A) 1.7588×10^{11} kg C^{-1}
B) 1.7588×10^{-11} Ckg^{-1}
C) 1.7588×10^{11} kgC^{-1}
D) 1.7588×10^{11} Ckg^{-1}

Q.2 How many times the mass of neutron is greater than mass of electron

A) $\frac{1}{1836}$
B) 1836
C) 1840
D) $\frac{1}{1840}$

Q.3 The mass of proton is

A) 9.1095×10^{-31} kg
B) 1.6726×10^{-27} kg
C) 1.602×10^{-19} kg
D) 1.6750×10^{-27} kg

Q.4 What will be the effect on proton when passed through the electric field

A) Deflection towards anode
B) Deflection towards cathode
C) Deflection perpendicular to electric field
D) Deflection downwards in electric field

Q.5 Which one is not true about cathode rays?

A) 9.11×10^{-31} Kg
B) Heat up the platinum foil
C) Cast shadow
D) Cannot ionize

Q.6 Positive rays are produced

A) By burning of gas
B) By cooling of the gas
C) By the bombardment of cathode rays on gas molecules
D) From anode like cathode rays, produced from cathode

Q.7 A fast-moving neutron can eject from nitrogen

A) γ -rays
B) β -rays
C) α -rays
D) electrons

Q.8 Pressure in gas discharge tube was kept

A) 10 torr
B) 0.1 torr
C) 1 torr
D) 0.01 torr

Q.9 Positive rays give flash on

A) $AgNO_3$ plate
B) ZnO
C) AgCl plate
D) ZnS

Q.10 Free neutron changes into proton with the emission of

A) Neutrino
B) Both A) and C)
C) Electron
D) Meson

Q.11 Charge of electron was measured by

A) J.J Thomson
B) Rutherford
C) Millikan
D) Perrin

Q.12 Bombardment of α-particles on beryllium (Be) atom emits neutron and this process is called

A) Natural radioactivity
B) Pauli exclusion principle
C) Artificial radioactivity
D) Hund's rule

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Q.13 Neutron is one of the fundamental particles of atom and carries

A) a charge of +1 unit and a mass of 1 unit
B) No charge and no mass
C) No charge and a mass of 1 unit
D) A charge –1 unit and no mass

RUTHERFORD'S MODEL OF ATOM AND X-RAYS AND ATOMIC NUMBER

Q.14 Rutherford's planet like structure was defective and unsatisfactory because

A) Moving e^- accelerate towards the nucleus
B) Behavior of electron remains unexplained
C) Continuous spectrum
D) All

Q.15 Rutherford bombarded _____particles in discovery of nucleus

A) Gamma-rays
B) Beta-rays
C) Alpha rays
D) X-rays

Q.16 When α-particles are sent through a thin metal foil, most of them go straight through the foil because

A) α-particles move with high velocity
B) Most part of atom has empty space
C) α-particles are positively charged
D) α-particles are much heavier than electrons

Q.17 Increase in atomic number is observed during

A) α-emission
B) Both A) and (b)
C) β-emission
D) Radioactivity

Q.18 When electrons collide with heavy metals, then _____ are produced

A) Beta-rays
B) X-rays
C) Alpha-rays
D) Gamma-rays

Q.19 Atom with higher atomic number produces X-rays of

A) Shorter wavelength
B) X-ray not produced
C) Larger wavelength
D) All are possible

BOHR'S ATOMIC MODEL AND PLANCK'S QUANTUM THEORY

Q.20 All of the following were theorized by Bohr in his description of the atom except

A) Angular momentum is integral multiple of $h/2\pi$
B) Electrons revolve in discrete circular orbits.
C) Energy of each electron is directly proportional to n^2.
D) Electrons radiate energy continuously in a given orbit.

Q.21 The relationship between energy of a photon of light and its frequency is given by

A) de-Broglie dual nature of matter
B) Planck's Quantum theory
C) Bohr's model
D) Rutherford's atomic model

Q.22 The velocity of the photon

A) Is independent of wavelength
B) Depends upon its frequency
C) Depends upon source
D) Equals to the square of amplitude

Q.23 Plank's theory says energy is emitted

A) In continuous manner
B) Simultaneously
C) In discontinuous manner
D) In the form of heat

Q.24 Angular momentum of an electron

A) $n^2h/2\pi$
B) $nh/4\pi$
C) $nh^2/2\pi$
D) $nh/2\pi$

Q.25 Planck's equation is

A) $E = mc^2$
B) $E = h\upsilon$
C) $mvr = nh/2\pi$
D) $\lambda = h/mv$

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SPECTRUM AND HYDROGEN SPECTRUM

Q.26 When an atom absorbs energy the lines in the spectrum will appear which are

A) Brighter
B) Colourless
C) Darker
D) Hard to locate

Q.27 Pfund series are produced in the spectrum of hydrogen atom

A) When electrons jump down to 2nd-orbit
B) When electrons jump down to 4th-orbit
C) When electrons jump down to 3rd-orbit
D) When electrons jump down to 5th-orbit

QUANTUM NUMBERS AND SHAPES OF ORBITALS

Q.28 Quantum number which is not derived from Schrodinger wave equation

A) Principal
B) Magnetic
C) Azimuthal
D) Spin

Q.29 A nodal plane in an orbital is the plane where electron density is

A) Maximum
B) Infinity
C) Zero
D) Minimum

Q.30 The number of degenerate orbitals in a sub-shell having sausage shape are

A) 1
B) 3
C) 5
D) 7

Q.31 Quantum number values for 3p orbital are

A) $n = 3, l = 0$
B) $n = 2, l = 1$
C) $n = 3, l = 1$
D) $n = 2, l = 3$

Q.32 Maximum number of electrons that can be accommodated in p-subshell

A) 2
B) 10
C) 6
D) 14

Q.33 Which sub-shell has highes: energy

A) n=5, ℓ=3, m=+1
B) n=4, ℓ=3, m=0
C) n=5, ℓ=2, m=+2
D) n=4, ℓ=0, m=+1

Q.34 Magnetic quantum number values for the d subshell are

A) 2
B) 5
C) 3
D) 7

Q.35 A p-orbital has _____ energy than the s-orbital of same principal quantum number

A) Lower
B) Equal
C) Higher
D) Variable orbit to orbit

Q.36 Which set of quantum number represents 19th electron of Cu atom

A) $n = 4, \quad \ell = 0, \quad m = 0, \quad s = +\frac{1}{2}$
B) $n = 4, \quad \ell = 1, \quad m = 0, \quad s = +\frac{1}{2}$
C) $n = 3, \quad \ell = 2, \quad m = 0, \quad s = +\frac{1}{2}$
D) $n = 3, \quad \ell = 0, \quad m = 0, \quad s = +\frac{1}{2}$

Q.37 The d-orbital which is bi-lobed with collar is represented as

A) dxy
B) dz^2
C) dyz
D) dx^2-y^2

ELECTRONIC CONFIGURATION OF ELEMENTS

Q.38 _____ is/are isoelectronic with K^+

A) P^{-3}
B) S^{-2}
C) Si^{-4}
D) All of these

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Q.39 The atomic number of an element is 26. How many electrons are present in M-Shell of this element in ground state

A) 11
B) 15
C) 14
D) 16

Q.40 The electronic configuration of an element is $1s^2, 2s^2, 2p_x^1, 2p_y^1, 2p_z^1$. This represents a/an

A) Ground state
B) Hybridized state
C) Excited state
D) Molecular state

Q.41 The correct electronic configuration of $_{29}Cu$ is

A) $[Ar]4s^2 3d_{xy}^2 3d_{yz}^2 3d_{xz}^2 3d_{x^2-y^2}^2 3d_{z^2}^1$
B) $[Ar]4s^1 3d_{xy}^2 3d_{yz}^2 3d_{xz}^2 3d_{x^2-y^2}^2 3d_{z^2}^1$
C) $[Ar]4s^1 3d_{xy}^2 3d_{yz}^2 3d_{xz}^2 3d_{x^2-y^2}^2 3d_{z^2}^2$
D) $[Ar]4s^1 3d_{xy}^2 3d_{yz}^2 3d_{xz}^2 3d_{x^2-y^2}^1 3d_{z^2}^1$

Q.42 Which one of the following ion has similar electronic configuration like Ar

A) Sc^{+2}
B) Cr^{+2}
C) Ti^{+4}
D) Mn^{+6}

Q.43 In electronic configuration of Cu and Cr which of following is true

A) 3-d is full filled
B) 7 electrons in s-orbitals
C) 3-d is half filled
D) 8 electrons in s-orbitals

Q.44 Which of the following violates Hund's rule

A) $1s^2, 2s^2, 2p_x^1, 2p_y^1, 2p_z^1$
B) $1s^2, 2s^1$
C) $1s^2, 2s^2, 2p_x^2, 2p_y^2, 2p_z^1$
D) $1s^2, 2s^2, 2p_x^2, 2p_y^0, 2p_z^0$

Q.45 Which one of the following represents most stable configuration of three electrons for ground state of an element in group VA

A) np_x^2, np_y^1, np_z^0
B) np_x^2, np_x^0, np_z^1
C) np_x^1, np_y^1, np_z^1
D) np_x^0, np_y^1, np_z^2

Q.46 Which one of following electronic configuration represents an element that form a simple ion with -3 charge

A) $1s^2, 2s^2, 2p^6, 3s^2, 3p^1$
B) $1s^2, 2s^2, 2p^6, 3s^1$
C) $1s^2, 2s^2, 2p^6, 3s^2, 3p^3$
D) $1s^2, 2s^2, 2p^1$

Q.47 A specie Z has following electronic configuration $1s^2, 2s^2, 2p_x^2, 2p_y^2, 2p_y^2, 3s^2, 3p_x^2, 3p_y^1, 3p_z^1$ What could Z be

A) Ar
B) S
C) Cl^-
D) P^{3-}

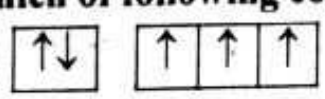
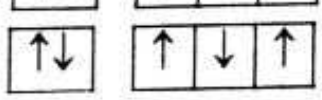
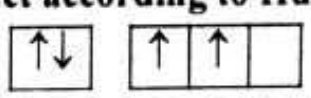
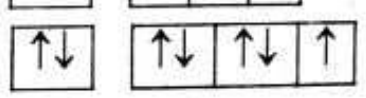
Q.48 The total number of lobes in all the orbitals of a d-subshell are

A) 2
B) 4
C) 16
D) 18

Q.49 "Two electrons in the same orbital should have opposite spins" according to

A) Aufbau's principal
B) Hund's rule
C) Pauli's exclusion rule
D) None of these

Q.50 Which of following configuration is not correct according to Hund's rule

A) 
B) 
C) 
D) 

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PAST PAPERS QUESTIONS

Q.1 **The charge of one gram of electron is**

A) 1.7588×10^{-11}C
B) 1.7588×10^{11}C
C) 1.7588×10^{8}C
D) 1.602×10^{-19}C

Q.2 **If the charge value of electron 1.7588×10^{11} coulombs Kg^{-1}, then what would be the mass of electron in grams (charge on electron is a 1.60222×10^{-19} coulombs)?**

A) 9.1095×10^{-31}g
B) 91.095×10^{-31}g
C) 9.1095×10^{-28}g
D) 0.919095×10^{-33}g

Q.3 **Number of neutrons in $^{66}_{30}Zn$ will be**

A) 30
B) 35
C) 38
D) 36

Q.4 **The charge on one proton is**

A) 1.602×10^{-31}C
B) 1.602×10^{-19}C
C) 1.602×10^{-27}C
D) 1.602×10^{-11}C

Q.5 **The e/m value for the canal rays is maximum for**

A) Hydrogen
B) Helium
C) Nitrogen
D) Argon

Q.6 **The nature of cathode rays in discharge tube :**

A) Depends upon the nature of the gas used in discharge tube
B) Depends upon the nature of the cathode used in discharge tube
C) Is independent of the nature of the gas used in discharge tube
D) Depends upon the nature of anode in the discharge tube

Q.7 **According to the number of protons, neutrons and electrons given in the table, which one of the following option is correct?**

Species	Proton	Neutron	Electron
As	33	42	30
Ga	31	39	28
Ca	20	20	20

A) As^{+3}, Ga^{+3}, Ca
B) As^{+3}, Ga^{+2}, Ca
C) $As^{+3}, Ga^{+3}, Ca^{+2}$
D) As^{+3}, Ga, Ca^{+2}

Q.8 **Modern periodic table is arranged in ascending order of?**

A) Atomic mass
B) Nucleon number
C) mass number
D) Proton number

Q.9 **Number of electrons in the outermost shell of chloride ion(Cl^-) is**

A) 17
B) 7
C) 1
D) 8

Q.10 **Number of electrons in $^{71}_{31}Ga^{3+}$ Will be**

A) 28
B) 29
C) 30
D) 34

Q.11 **Isotopic symbol of ion of Sulphur–33 is $^{33}_{16}S^{-2}$ How many numbers of protons and neutrons are present if number electrons are 18?**

A) p = 18, n = 15
B) p = 16, n = 17
C) p = 16, n = 18
D) p = 17, n = 16

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Q.12 Among the following, which contains same no. of electrons & proton but different no. of neutron:

A) Isobars
B) Isotopes
C) Isotones
D) None of the these

Q.13 Which quantum number tells us about orientation of orbitals:

A) Principal quantum number
B) Azimuthal quantum number
C) Spin quantum number
D) Magnetic quantum number

Q.14 The relative energies of 4s, 4p and 3d orbitals are in the order

A) 3d < 4p < 4s
B) 4s < 3d < 4p
C) 4p < 4s < 3d
D) 4p < 3d < 4s

Q.15 Correct order of energy in the given sub-shells is:

A) 5s > 3d > 3p > 4s
B) 5s > 3d > 4s > 3p
C) 3p > 3d > 5s > 4s
D) 3p > 3d > 4s > 5s

Q.16 There are four orbitals s, p, d and f. Which order is correct with respect to the increasing energy of the orbitals

A) 4s < 4p < 4d < 4f
B) 4p < 4s < 4f < 4d
C) 4s < 4f < 4p < 4d
D) 4f < 4s < 4d < 4p

Q.17 Maximum numbers of electron in a sub-shell is given by

A) 2(2*l*-1)
B) 2(*l*+1)
C) 2(2l+1)
D) 2*l*+1

Q.18 The order of energy level in ^{19}K is?

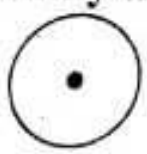
A) 4s, 4p
B) 3p, 4s
C) 4s, 3d
D) 3s, 3d

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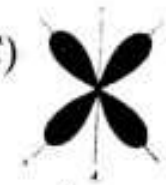
Q.19 With increase in the value of principal quantum number 'n', the shape of the s-orbitals remain same although their sizes

A) Decrease
B) Increase
C) Remain the same
D) May or may not remain the same

Q.20 Identify the correct option associated with the shape of p-orbital:

A) 

B) 

C) 

D) 

Q.21 Which of the following element in its gaseous atomic state has electrons fully occupying first two spherically symmetrical orbitals?

A) Oxygen
B) Beryllium
C) Helium
D) Carbon

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Q.22 Which one of the following pairs has the same electronic configuration as possessed by neon (Ne-10)

A) Na^+, Cl^-
B) K^+,Cl^-
C) Na^+, Mg^+
D) Na^+, F^-

Q.23 The maximum number of electrons in electronic configuration can be calculated by using formula:

A) $2l+1$
B) $2n^2+2$
C) $2n^2$
D) $2n^2+1$

Q.24 Which is the correct electronic configuration of chromium ($_{24}Cr$)?

A) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^4$
B) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^6$
C) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^5$
D) $1s^2, 2s^2, 3s^2, 3p^6, 3p^6, 4s^2, 3d^6$

Q.25 Nitrogen has the atomic mass of 7. Which of the following electronic configurations is of a Nitrogen atom in ground state?

A) $1s^2,2s^2,2px^1,2py^1,2pz^1$
B) $1s^2,2s^2,2px^2,2py^1$
C) $1s^2,2s^2,2py^2,2pz^1$
D) $1s^2,2s^2,2px^2,2pz^1$

Q.26 The ionization energy of hydrogen atom is

A) Zero
B) 13.13kJ/mole
C) 1313kJmole
D) 1313kJ/mole

Q.27 The elements for which the value of ionization energy is low can

A) Gain electrons readily
B) Lose electron less readily
C) Gain electrons with difficulty
D) Lose electron readily

Q.28 Electron affinity of the atom is the energy released when

A) Electron is added to gaseous atom
B) Covalent bond of molecule is broken
C) Electron is removed from gaseous atom
D) Covalent bond is formed between the atoms

Q.29 The shielding effect of inner electron is responsible for

A) Decreasing ionization energy
B) Increasing ionization energy
C) Having no effect on ionization energy
D) Increasing electronegativity

Q.30 Which of the following sub-shell has no degenerate orbital

A) s
B) p
C) d
D) f

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ANSWER KEY

1	C	11	C	21	B	31	C	41	C
2	C	12	C	22	A	32	C	42	C
3	B	13	C	23	C	33	A	43	A
4	B	14	D	24	D	34	B	44	D
5	D	15	C	25	B	35	C	45	C
6	C	16	B	26	C	36	A	46	C
7	C	17	C	27	D	37	B	47	B
8	D	18	B	28	D	38	D	48	D
9	D	19	A	29	D	39	C	49	C
10	B	20	D	30	C	40	A	50	B

PAST PAPER QUESTIONS

1	C	6	C	11	B	16	A	21	B	26	D
2	C	7	A	12	B	17	C	22	D	27	D
3	D	8	D	13	D	18	B	23	C	28	A
4	B	9	D	14	B	19	B	24	C	29	A
5	A	10	A	15	B	20	B	25	A	30	A

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EXPLANATORY NOTES

Q.1 Mass of one electron = 9.1095×10^{-31}kg

9.1095×10^{-31}kg = 1 electron

1 kg = $1/9.1095 \times 10^{-31}$ electron

1kg = 1.0978×10^{30} electron

Charge on 1kg electrons = number of electrons in 1 kg × charge on an electron

$= 1.0978 \times 10^{30} \times 1.602 \times 10^{-19}$

$= 1.758 \times 10^{11} Ckg^{-1}$

Q.2 α-prticle is He^{+2} or He-nulcei which is composed of two protons and two neutron. The mass of a neutron is slightly greater than the mass of proton therefore α-prticle slightly heavier than four times the mass of a proton in the same way the mass α-prticle slightly less than four times the mass of a neutron

Q.6 Positive rays are actually fast moving cations.

Q.7 ${}^{14}_{7}N + {}^{1}_{0}n \rightarrow {}^{11}_{5}B + {}^{4}_{2}He$

Q.8 Cathode rays are not produced at higher pressure due to steric hinderance.

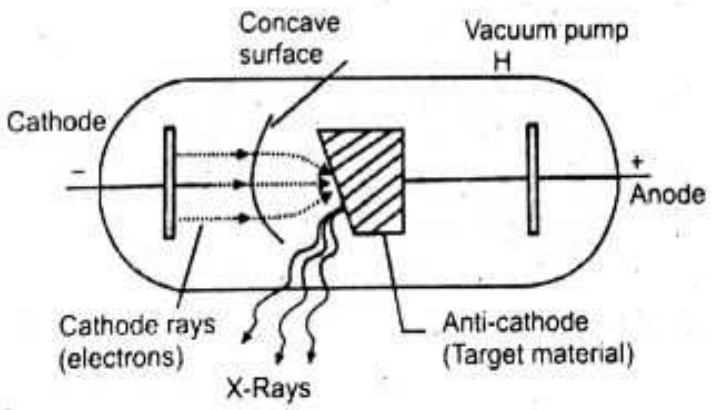
Q.10 ${}^{1}_{0}n \rightarrow {}^{1}_{+1}P + {}^{0}_{-1}e + {}^{0}_{0}n$

Q.13 There are three type of fundamental sub-atomic particles out of which only two types of fundamental sub-atomic particles (Proton and neutron) are in nucleus

These are called nuclear fundamental sub-atomic particles

Q.17 ${}^{66}_{29}Cu \rightarrow {}^{66}_{30}Zn + {}^{0}_{-1}e$

Q.18



Q.19 The X-rays of shorter wavelengths are emitted when target metal is of higher atomic number.

Q.20 Electrons do not radiate energy in a given orbit.

Q.21 $E = h\nu$

Q.23 Energy is emitted or absorbed in discontinuous manner in the form of **energy** packets. Each **packet** of **energy** is called **quantum** which have definite amount of energy. In case of light radiations quantum is called **photon**.

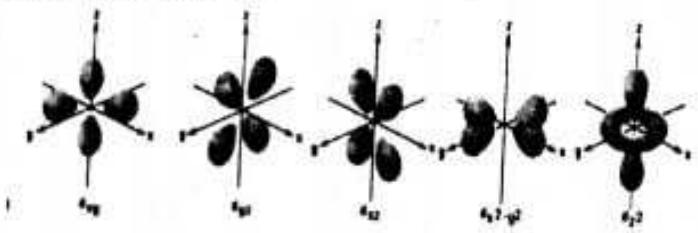
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Q.26 The spectrum of white light obtained after being absorbed while passing through gaseous element is called **atomic absorption spectrum**. It appears as dark lines against bright background.

Q.28 Quantum number which is not derived from Schrodinger wave equation is spin quantum number.

Q.30



Q. 31

Azimuthal Q. number	Sub-shell	Shapes
$\ell = 0$	s-subshell	Spherical
$\ell = 1$	p-subshell	dumbell
$\ell = 2$	d-subshell	double dumbell or sausage shape
$\ell = 3$	f-subshell	complicated

Q.32

Sub-shell	electrons
S	2
p	6
d	10
f	14

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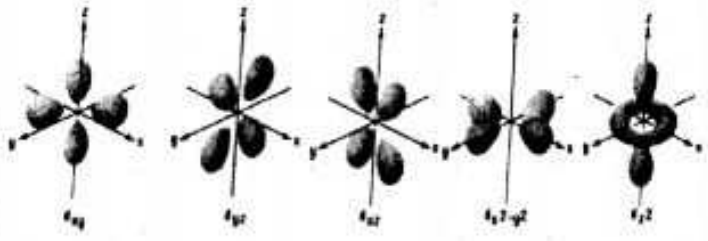
Q.33 $1s < 2s < 2p < 3s < 3p < 4s < 3d < 4p < 5s < 4d < 5p < 6s < 4f < 5d < 6p < 7s$

Q.34 $d_{xy}(m = -2)$, $d_{yz}(m = -1)$, $d_{zx}(m = +1)$, $d_{x^2-y^2}(m = +2)$ and $d_{z^2}(m = 0)$.

Q. 35 Energy Level $s < p < d < f$

Q.36 Cooper 29 $[Ar]4s^1 3d^2_{xy}\ 3d^2_{yz}\ 3d^2_{xz}\ 3d^2_{x^2-y^2}\ 3d^2_{z^2}$

Q.37



Q.38 Number of electrons = Z – charge

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Q. 39

$1s^1 2s^1 2p^6 3s^1 3p^6 4s^1 3d^6$

1 = K

2 = L

3 = M

4 = N

So number of electrons in M shell are 14.

Q.42 Argon = $[Ne]3s^1 3p_x^2 3p_y^2 3p_z^2 = T_i^{+4}$

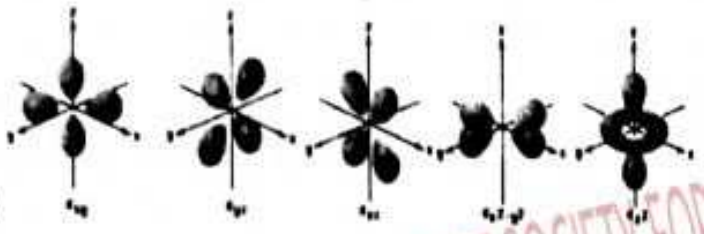
Q. 44 When more than one electrons are to be placed in degenerate orbtials, then they are placed to have maximum number of unpaired electrons possible.

Example: $C_6 = 1s^2, 2s^2, 2p_x^1, 2p_y^1, 2p_z^0$

Q.45 Half filled and completely filled orbitals are relatively more stable.

Q. 47 Sulphur 16 $[Ne]3s^2 3p_x^2 3p_y^1 3p_z^1$

Q. 48



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Q. 49 According to this principle, it is impossible for two electrons residing in the same orbital of poly-electron atom to have same values of four quantum numbers.

Q. 50 When more than one electrons are to be placed in degenerate orbtials, then they are placed to have maximum number of unpaired electrons possible.

Example: $C_6 = 1s^2, 2s^2, 2p_x^1, 2p_y^1, 2p_z^0$

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Topic 3 GASES

PRACTICE EXERCISE

PROPERTIES OF GASES AND GAS LAWS AND GENERAL GAS EQUATION

Q.1 **At constant temperature when the pressure of gas is increased three times than its volume becomes**

A) $\frac{2V}{3}$

B) $\frac{V}{3}$

C) 3V

D) 5V

Q.2 **Under what conditions the density of an ideal gas will be maximum at**

A) High temperature and low pressure

B) Low temperature and high pressure

C) Low temperature and pressure

D) When temperature and pressure are same

Q.3 **If $\frac{1}{V}$ is plotted on X-axis and pressure on Y-axis at constant temperature, what should appear**

A) Straight line parallel to x-axis

B) Straight line

C) Straight line parallel to y-axis

D) Curve

Q.4 **The general gas equation to know the volumes of the gas at various temperatures is**

A) $V_0 = \frac{273V_t}{273+t}$

B) $V_t = V_0\left(1+\frac{t}{273}\right)$

C) $V_0 = V_t\left(1-\frac{t}{273}\right)$

D) None of the above

Q.5 **Which one is the right value for R?**

A) 0.0821 atm $dm^3 K^{-1} mol^{-1}$

B) 2 cal $K^{-1} mol^{-1}$

C) 0.0821 atm $m^3 K^{-1} mol^{-1}$

D) 8.314 $Nm^2 K^{-1} mol^{-1}$

Q.6 **Two moles of an ideal gas at 273 K under 1 atm pressure has a volume of**

A) 22.414 m^3

B) 22.414 dm^3

C) 44.828 dm^3

D) 11.212 cm^3

Q.7 **A mono-atomic substance can store energy only in the form of**

A) Translational motion

B) Vibrational motion

C) Rotational motion

D) Rotational and vibrational motion

Q.8 **Which of the following is false in case of gases**

A) They diffuse easily

B) They are highly compressible

C) They have mass

D) They do not mix well

Q.9 **A graph between pressure and product of pressure and volume at constant temperature and number of moles is**

A) Straight line parallel to x-axis

B) Straight line parallel to y-axis

C) Straight line passing through the origin

D) The curve showing the maximum

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Q.10 If both temperature and volume of a gas are doubled, the pressure

A) Cannot be predicated
B) Is reduced to ½
C) Remain unchanged
D) Is doubled

Q.11 Which one is the form of general gas equation?

A) $PV = nRT$
B) $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$
C) $d = \frac{PM}{RT}$
D) All of these

Q.12 Volume of a gas at STP is 10 dm^3 at what temperature its volume will become 30dm^3, keeping pressure constant

A) 3°C
B) 819K
C) 819°C
D) 3K

Q.13 Which of the following pairs of gases possess equal volume at STP

A) 44g CO_2 and 44g CO
B) 16g O_2 and 32gCH_4
C) 3.01×10^{23} molecules of CO and 3.01×10^{23} gram molecules of H_2
D) 0.5 mole of NO and 16 g O_2

Q.14 Which is incorrect about ideal gas

A) No force of attraction between molecules
B) No example in nature
C) Can be liquefied easily
D) Obey gas laws at all conditions of temperature and pressure

Q.15 Absolute zero is

A) –273 K
B) –459.67°F
C) 0°C
D) –546 K

Q.16 A gas initially at 27°C is heated upto 327°C, its average K.E will be

A) Doubled
B) 300 times
C) Four times
D) 327 times

Q.17 The correct value of general gas constant R is

A) 8.314 atm dm^3 $mol^{-1}K^{-1}$
B) 62.4 torr cm^3 $mol^{-1}K^{-1}$
C) 0.0821 $Jmol^{-1}K^{-1}$
D) 8.314×10^7 erg $mol^{-1}K^{-1}$

Q.18 In gases and liquids, temperature is the measure of _____ kinetic energies of molecules

A) Average translational
B) Vibrational
C) Rotational
D) All of these

Q.19 Mathematically, Boyle's law can be represented as

A) $V \propto \frac{1}{P}$
B) $PV = K$
C) $P_1V_1 = P_2V_2$
D) All of these

Q.20 The molar volume of nitrogen gas is maximum at

A) 25°C and 1 atm
B) 130°C and 1 atm
C) 0°C and 2 atm
D) 100°C and 2 atm

Q.21 8g of methane and 2g of hydrogen are mixed and kept at 760 mm pressure at 273 K, the total volume occupied by the mixture will be

A) 11.2 dm^3
B) 33.6 dm^3
C) 22.4 dm^3
D) 44.8 dm^3

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Q.22 What is NOT true about gases

A) They are highly compressible
B) They have only vibrational motion
C) Sudden expansion of gases cause cooling
D) They exert pressure on the walls of the vessel

Q.23 For a definite mass of an ideal gas at constant temperature, the plot of which pair of species will give a curved graph

A) PV vs P
B) P vs V^{-1}
C) P vs V
D) PV vs P^{-1}

Q.24 A pressure of 0.101325 bar when expressed in atmosphere represents

A) 0.01 atm
B) 0.1 atm
C) 1.0 atm
D) 10.0 atm

Q.25 Dimensions of the pressure are the same as that of

A) Energy
B) Energy per unit volume
C) Force
D) Force per unit volume

KINETIC MOLECULAR THEORY OF GASES AND IDEAL GAS EQUATION

Q.26 Gases deviate from ideal behavior at high pressure. Which of the following is correct for non-ideality?

A) At high pressure, the gas molecules move in one direction only
B) At high pressure, the collision between the gas molecules are increased manifold
C) At high pressure, the volume of the gas becomes insignificant
D) At high pressure, the inter-molecular attractions become significant

Q.27 Under high pressure which of the following gas show more ideality in character

A) N_2
B) NH_3
C) CO_2
D) SO_2

Q.28 When 200cm^3 of a gas at constant pressure is heated, its volume

A) Increases
B) Decreases
C) Remains unchanged
D) First increases then decreases

Q.29 The product of PV of a gas has unit of

A) Force
B) Work
C) Entropy
D) Enthalpy

Q.30 Under what condition of temperature and pressure will a real gas behave most like an ideal gas?

A) Low temperature and low pressure
B) Low temperature and high pressure
C) Standard temperature and standard pressure
D) High temperature and low pressure

Q.31 Absolute temperature of a gas is directly proportional to average _____

A) Rotational K.E
B) Vibrational K.E
C) Translational K.E
D) None of these

Q.32 An ideal gas can't be liquefied because

A) Its critical temperature is always above 0°C
B) It solidifies before becoming a liquid
C) Its molecules are smaller in size
D) Forces between its molecules are negligible

Q.33 The compressibility factor, Z, for an ideal gas is

A) Zero
B) Greater than one
C) Less than one
D) Equal to one

Q.34 In dm^3 atm $K^{-1}mol^{-1}$ the numerical value of general gas constant R is

A) 1.989
B) 0.0821
C) 8.314
D) 62400

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Q.35 In a closed flask of one dm^3, 2.0g of hydrogen gas is heated from 27°C to 327°C. Which of the following is incorrect

A) The pressure of the gas increases
B) The kinetic energy of gas molecules increases
C) The rate of collision increases
D) The number of moles of the gas increases

Q.36 A pressure of a gas is due to

A) Rapid intermolecular collisions
B) Molecular impacts against the walls of vessel
C) Voids between the gas molecules
D) Ideal behaviour of gases

Q.37 The compressibility factor, Z i.e. the extent to which a real gas deviates from ideal behaviour is given by (for one mole)

A) $Z = \frac{PV}{RT^2}$
B) $Z = \frac{PV}{RT}$
C) $Z = \frac{RT}{PV}$
D) $Z = \frac{PT}{RV}$

Q.38 Which of the following molecule has the lowest average speed at 273 K?

A) CO
B) CO_2
C) CH_4
D) C_2H_6

Q.39 Which of the following gases has the lowest r.m.s velocity at 25°C.?

A) SO_2
B) O_2
C) N_2
D) Cl_2

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KINETIC INTERPRETATION OF TEMPERATURE AND VAN DER WAALS EQUATION

Q.40 Critical temperature for different gases is different and depends upon

A) Size of molecule
B) Intermolecular attractions
C) Shape of molecule
D) All of the above

Q.41 "a" is called co-efficient of attraction in Van der Waal's equation for real gases the unit of "a" is

A) $Nm^{-4}mol^{-2}$
B) $Nm^{+4}mol^{-2}$
C) $Nm^{+6}mol^{-2}$
D) $Nm^{+2}mol^{-2}$

Q.42 The highest temperature at which a substance can exist as a liquid is called its

A) Critical temperature
B) Absolute temperature
C) Standard temperature
D) Upper consulate temperature

Q.43 Very very small values of Van der Waal's constant in his equation for a particular gas show that

A) The molecules of the gas are big sized
B) Gas is sufficiently polar
C) Least attractive forces are present among the molecules of the gas
D) The gases are non-ideal

Q.44 Excluded volume is _____ times the actual volume of gas molecules

A) Two
B) Four
C) Three
D) Eight

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Q.45 The constant 'a' in Van der Waal's equation is maximum for

A) Helium
B) Oxygen
C) Hydrogen
D) Ammonia

Q.46 The average kinetic energy of the gas molecules is

A) Inversely proportional to its absolute temperature
B) Directly proportional to its absolute temperature
C) Equal to the square of its absolute temperature
D) Directly proportional to the square root of its absolute temperature

Q.47 The unit of Van der Waal's constant "a" is

A) atm $dm^6 mol^2$
B) atm $dm^3 mol^1$
C) atm $dm^6 mol^{-2}$
D) atm $dm^3 mol^{-1}$

Q.48 A gas is heated at constant temperature then

A) The number of molecules of the gas increases
B) The kinetic energy of the gas molecules decreases
C) The kinetic energy of the gas molecules increases
D) The kinetic energy of the gas molecules remains unaltered

Q.49 The pressure P in the ideal gas equation is replaced by

A) $P + \frac{an^2}{V^2}$
B) $P + \frac{2n^2}{V^2}$
C) $P + \frac{a^2n^2}{V^2}$
D) $P + \frac{an^2}{V}$

Q.50 Which of the following gas has highest critical temperature

A) Nitrogen
B) Helium
C) Oxygen
D) Carbondioxide

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PAST PAPER QUESTIONS

Q.1 All the collisions between the particles of gases are elastic in nature. What is meant by "Elastic Collisions"?

A) The velocity of the molecules changes

B) No change in mass during the collisions

C) No change in the kinetic energy

D) No change in potential energy during the Collisions

Q.2 Which one of the following expression represent the Avogadro law?

A) V= RnT/P (When T and n are constant)

B) V= RnT/P (When T and P are constant)

C) V= RnT/P (When P and n are constant)

D) V= RP/nT (When T, P and n are constant)

Q.3 The root mean square velocity of gases is inversely proportional to square root of their:

A) Temperature

B) Molar mass

C) Pressure

D) Volume

Q.4 The number of molecules in 22.4 dm^3 of H_2 gas at 0°C and 1 atm are

A) 60.2×10^{23}

B) 6.02×10^{23}

C) 6.02×10^{25}

D) 60.2×10^{22}

Q.5 There are four gases H_2, He, N_2 and CO_2 at 0°C. Which gas shown greater non-ideal behavior?

A) He

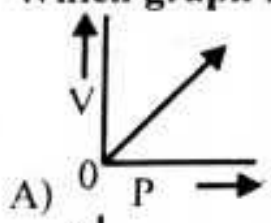
B) CO_2

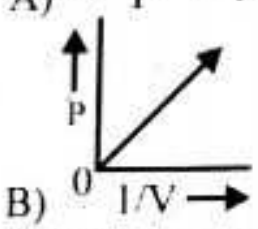
C) H_2

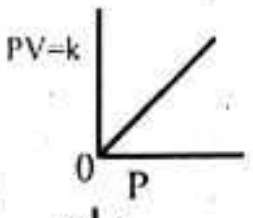
D) N_2

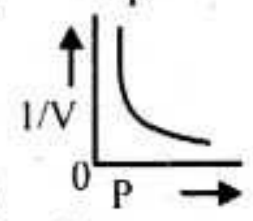
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Q.6 Which graph represents Boyle's law

A) 

B) 

C) 

D) 

Q.7 The coordination number of Na+ in NaCl crystal is

A) 8

B) 2

C) 4

D) 6

Q.8 Identify the value of R at STP

A) 8.314 atm dm^{-3} mol^{-1}

B) 0.0821 cal K^{-1} mol^{-1}

C) 0.0821 atm dm^3 K^{-1} mol^{-1}

D) 8.314 cal K^{-1} mol^{-1}

Q.9 In the equation $\left(P + \frac{n^2 a}{V^2}\right)(V - nb) = RT$, 'b' represents the

A) Excluded volume

B) Excluded pressure

C) Actual volume

D) Excluded volume per mol

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Q.10 Gas is enclosed in a container of 20cm³with the moving piston. According to kinetic theory of gases, what is the effect on freely moving molecules of the gas if temperature is increased from 20°C to 100°C?

A) Colliding capability of molecule will become lower
B) Pressure will become one half
C) Temperature has no effect on freely moving molecules
D) Volume will be increased

Q.11 Which of the following is the correct equation to calculate relative molecular mass of a gas

A) M-mPRT/V
B) M=PV/mRT
C) M = mPR/VT
D) M= mRT/PV

Q.12 Which of the statement is applicable for both ideal and real gases molecules?

A) Have no forces of attraction
B) Collisions between the molecules is elastic
C) Molecules are in random movement
D) The actual volume of gas is negligible as compared to the volume of gas

Q.13 Correct order of boiling points of the given liquids is

A) $H_2O > HF > HCl > NH_3$
B) $HF > H_2O > HCl > NH_3$
C) $H_2O > HF > NH_3 > HCl$
D) $HF > H_2O > NH_3 > HCl$

Q.14 At 1489 mmHg, water will boil at

A) 120C°
D) 100C°
C) 110C°
D) 90C°

Q.15 Ice is less dense than water at

A) 0°C
B) -4°C
C) 4°C
D) 2°C

Q.16 In crystal lattice of ice, each O-atom of water molecule is attached to

A) Four H-atoms
B) One H-atom
C) Two H-atoms
D) Three H-atoms

Q.17 What is reason that the ice at 0^0C occupies more volume then water:

A) Empty spaces
B) Ionic bond
C) Intermolecular forces
D) Debye forces

Q.18 Water has maximum density at

A) –4°C
B) 0°C
C) 1°C
D) 4°C

Q.19 In the structure of NaCl, each sodium ion is surrounded by chloride ions

A) 4
B) 5
C) 6
D) 8

Q.20 Which one the following have highest lattice energy?

A) NaCl
B) KBr
C) KCl
D) LiCl

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ANSWER KEY

1	B	11	D	21	B	31	C	41	B
2	A	12	B	22	B	32	D	42	A
3	B	13	D	23	C	33	D	43	C
4	B	14	C	24	B	34	B	44	B
5	A	15	B	25	B	35	D	45	D
6	C	16	A	26	D	36	B	46	B
7	A	17	D	27	A	37	B	47	C
8	D	18	A	28	A	38	C	48	C
9	A	19	D	29	B	39	D	49	A
10	C	20	B	30	D	40	D	50	D

PAST PAPER QUESTIONS

1	C	6	B	11	D	16	A
2	B	7	D	12	C	17	A
3	B	8	C	13	C	18	D
4	B	9	D	14	A	19	C
5	B	10	D	15	A	20	D

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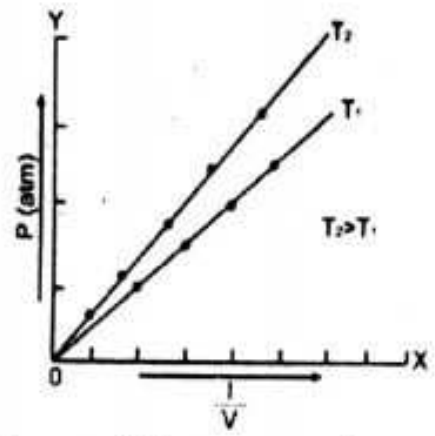
EXPLANATORY NOTES

Q.1 According to Boyle's law: The volume of a given mass of a gas is inversely proportional to the applied pressure at constant temperature.

Q.2

$$d = \frac{PM}{RT}$$

Q.3



Q.4 The equation to know the volumes of the gas at various temperatures is

$$V_o = V_t \left(1 + \frac{t^\circ C}{273}\right)$$

Where, V_t = Volume of gas at temperature t.
V_o = Volume of gas at 0°C.
t = Temperature on Celsius scale.

Q.5

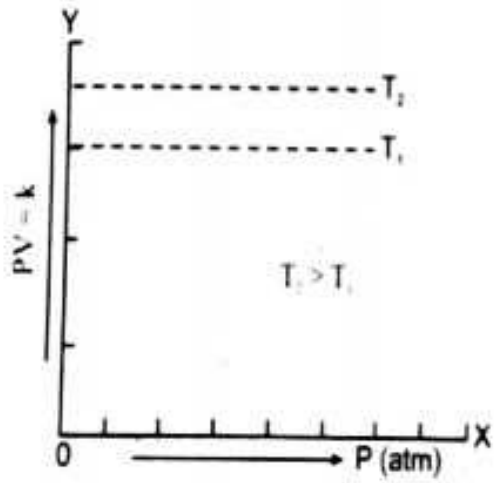
$$R = 0.0821 \text{ atm } dm^3 mol^{-1}.K^{-1}$$
$$= 0.0821 \text{ atm}.dm^3 mol^{-1} K^{-1}$$

Q.6 Molar volume of ideal gas at STP is 22.414 dm^3. In this way two moles of ideal gas will occupy 44.828 dm^3.

Q.7 A mono-atomic substance can store energy only in the form of translational motion

Q.8 Gas molecules move randomly and mix with each other to form homogeneous solution

Q.9



Q.10 If both temperature and volume of a gas are doubled, the pressure remain unchanged

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Q.11 All of the following are the form of general gas equation

- $PV = nRT$
- $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$
- $d = \frac{PM}{RT}$

Q.12 According to Charles law: The volume of the given mass of a gas is directly proportional to the absolute (Kelvin) temperature at constant pressure.

$(3 \times 273K = 819K)$

At STP the temperature is 273 K when the volume becomes 3 times (10 dm^3 $\rightarrow 30dm^3$), the temperature is also three fold $(3 \times 273K = 819K)$

Q.13 Equal volumes of all the ideal gases at same temperature and pressure contain equal number of moles and molecules.

$V \propto n$ (where P and T are constant)

$V = nk$

Both 0.5 mole of NO and 16 g (0.5 mole) O_2 have same number of moles therefore they have equal volume at STP

Q.14 Ideal gas can't be liquefied because there is no IMF

Q.15 Absolute zero = -273.15°C

= 0 K

=-459.67° F

Q.16 Average K.E is directly related to absolute temperature.

With increase in temperature from 27°C to 327°C (doubles) the average K.E will be doubled

Q.17 $R = 8.3143\ Nm.mol^{-1}.K^{-1}$

$1Nm = 10^7\ erg$

Hence $8.134 \times 10^7\ erg.\ mol^{-1}.K^{-1}$

Q.18 In gases and liquids, temperature is the measure of average translational kinetic energies of molecules

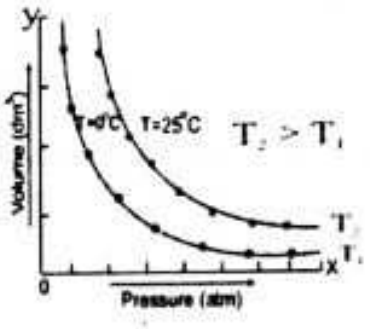
Q.19 All given mathematical form are correct for Boyle's law.

Q.20 Molar volume is maximum when temperature is high and pressure is low.

Q.21 8g of methane (0.5 mole) and 2g of hydrogen (1 mole) will occupy total volume 1.5× molar volume = $1.5 \times 22.4 = 33.6$

Q.22 Gases have translational, vibrational and also rotational motion.

Q.23



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Q.24 1.01325Bar = 1atm

0.101325Bar = 0.1 atm

Q.25 Dimensions of the pressure are the same as that of energy per unit volume

Q.26 At high pressure, molecules come closer to each other and inter-molecular attractions become significant.

Q.27 More will be ideality in character of a gas

- Less IMF
- Non-polar
- Small size
- Smaller mass
- Small values of a and b (Van der Waal's Constants)

Q.28 Volume increases with the increase in temperature at constant pressure.

Q.29 The product of PV of a gas has unit of work

Q.30 A real gas behaves like and ideal gas at high temperature and low pressure .

Q.31 Absolute temperature of a gas is directly proportional to average translational K.E

Q.32 An ideal gas can't be liquefied because forces between its molecules are negligible

Q.33 The compressibility factor, Z, for an ideal gas is equal to one

Q.34 $R = 0.0821 \text{ atm dm}^3\text{mol}^{-1}\text{K}^{-1}$

Q.35 In a closed container, there will be no change in the quantity (number of moles) of the gas.

Q.36 A pressure of a gas is due to Molecular impacts against the walls of vessel

Q.37 $Z = \dfrac{PV}{RT}$

Q.38 Not required

Q.39 $C_{rms} = \sqrt{\dfrac{3RT}{M}}$ or $\sqrt{\dfrac{3PV}{M}}$

Cl_2 as maximum molar mass therefore it has lowest r.m.s velocity.

Q.40 Critical temperature for different gases is different and depends upon size of molecule, shape of molecule and intermolecular attractions

Q.41

$$a = \frac{Nm^{-2} \times (m^3)^2}{(mol)^2}$$

$$a = Nm^{-2}.\ m^6.mol^{-2}$$

$$\mathbf{a = Nm^{+4}mol^{-2}}$$

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Q.42 The highest temperature at which a substance can exist as a liquid is called its critical temperature

Q.43 Very very small values of Van der Waal's constant in his equation for a particular gas show thatLeast attractive forces are present among the molecules of the gas.

Q.44 $b = 4\ V_m$

Where, V_m is the actual volume of gas molecules.

Q.45 'a' is a constant of proportionality and is called co-efficient of attraction or attraction per unit volume. It has a constant value for a particular real gas. Ammonia has hydrogen bonding (strong IMF)

Q.46 The average kinetic energy of the gas molecules is directly proportional to its absolute temperature

Q.47
$$a = \frac{atm \times (dm^3)^2}{(mol)^2}$$

$$\mathbf{a = atm.dm^6.mol^{-2}}$$

Q.48 Not required

Q.49
$$(P + \frac{a\,n^2}{V^2})\,(V - nb) = nRT$$

Q.50 IMF ↑ Tc ↑

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Topic 4 LIQUIDS

PRACTICE EXERCISE

PROPERTIES OF LIQUIDS AND INTERMOLECULAR FORCES

Q.1 $CHCl_3$ exist in liquid state due to

A) Dipole-dipole and London dispersion forces
B) Dipole induced dipole forces
C) Dipole–dipole forces
D) Hydrogen bonding

Q.2 The highest boiling point among the following is for

A) NH_3
B) $CHCl_3$
C) Br_2
D) Xe

Q.3 In NH_3, dominant Van der Waal's force among following is

A) London dispersion forces
B) Dipole–dipole forces
C) Dipole induced dipole forces
D) Hydrogen bonding

Q.4 Nature of bonding affects the properties like:

A) Solubility
B) Reaction kinetics
C) Melting, boiling points and isomerism
D) All of these

Q.5 Liquids have no definite shape, it is because

A) The molecules of liquid are in constant motion by sliding over each other
B) The intermolecular forces of liquids are weaker than gases
C) The liquid molecules have kinetic energy less than solids
D) All statements are correct

Q.6 Propanone is miscible in water due to

A) Both are polar molecules
B) Dipole-dipole attraction between them
C) Hydrogen bonding between them
D) All of these

Q.7 Strong dipole-dipole forces among the liquid molecules are responsible for

A) Very high heat of vaporization
B) Very low heat of vaporization
C) Very low boiling point
D) All are correct

Q.8 Which one of the following arrangements usually represents the correct order of increasing interactions?

A) Hydrogen bonding, London forces, Dipole – Dipole
B) London force, Hydrogen bonding, Dipole – Dipole
C) London forces, Dipole – Dipole, Hydrogen bonding
D) Dipole – Dipole, London forces, Hydrogen bonding

Q.9 Which of the following has strongest intermolecular forces of attraction

A) Hydrogen(H_2)
B) Iodine (I_2)
C) Chlorine (Cl_2)
D) Methane (CH_4)

Q.10 The forces which are present between the ions and water molecules are known as

A) Dipole induced dipole forces
B) Dipole-dipole forces
C) Ion dipole forces
D) London dispersion forces

Q.11 Forces of attraction, which may be present between all kinds of atoms and molecules are

A) Intramolecular
B) Van der Waal
C) Intermolecular
D) Dipole-induced dipole

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Q.12 The attractive forces between the partial positive end of one molecule and partial negative end of other molecule are called

A) Dipole-dipole forces
B) London dispersion forces
C) Ion dipole-dipole forces
D) Debye forces

Q.13 Liquid gets the shape of the container when it is poured into it. Which one of the following reason justifies it

A) Liquid do not have definite shape
B) Liquid is highly compressible
C) Liquid do not have definite volume
D) Liquid molecules can slide over each other

Q.14 The boiling point of higher alkanes are greater than those of lower alkanes due to reason that

A) Higher alkanes have greater number of atoms
B) The polarizabilities of higher alkanes are greater
C) Higher alkanes have greater hydrogen bonding
D) Higher alkanes have greater hydrogen bonding

EVAPORATION, VAPOR PRESSURE, BOILING POINT AND EXTERNAL PRESSURE

Q.15 Vapour pressure of water is 4.579 torr at 0°C and 9.209 torr at 10°C, so increase in vapour pressure from 0°C to 10°C is 4.630 torr. What will be the change in vapour pressure from 90°C to 100°C

A) 4.630 torr
B) > 4.630 torr
C) < 4.630 torr
D) V.P remain same at all Temperature

Q.16 Which of the following has highest vapour pressure

A) Water
B) Glycerol
C) Mercury
D) Isopentane

Q.17 The boiling point of water would be highest at

A) Murree
B) Mount everest
C) Gawadar
D) Siachin

Q.18 Manometric method is used to measure the vapour pressure of liquids and V.P is calculated by using _____ equation

A) $P = Pa - \Delta h$
B) $P = Pa$
C) $P = Pa + \Delta h$
D) All of these

Q.19 Which one is false for evaporation

A) Surface phenomenon
B) Exothermic
C) Continuous
D) Cause cooling

Q.20 Vapour pressure of water at 100°C is

A) 55 mm Hg
B) 355 mm Hg
C) 760 mm Hg
D) 1489 mm Hg

Q.21 The conversion of vapours back into their liquid state is called

A) Crystallization
B) Vapourization
C) Evaporization
D) Condensation

Q.22 Vapour pressure is not affected by

A) Surface area
B) Intermolecular forces
C) Temperature
D) Atmospheric pressure

Q.23 Which one of the following has highest volatility

A) Diethyl ether
B) Water
C) Ethyl alcohol
D) Ethylene glycol

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Q.24 In order to mention the boiling point of water at 110°C, the external pressure should be

A) Between 760 torr and 1200 torr
B) 765 torr
C) Between 200 torr and 760 torr
D) any value of pressure

Q.25 The boiling point increases down the zero group element due to

A) Ion dipole forces
B) Hydrogen bonding
C) London forces
D) Dipole-dipole forces

Q.26 If we provide very high amount of heat to a liquid its boiling point will

A) Increase
B) Decrease
C) Remains constant
D) There will be no boiling

Q.27 Evaporation is designated as a cooling process because of the reason

A) It is a surface phenomenon
B) It is exothermic process
C) High energy molecules leave behind the low energy molecules and cause cooling
D) All of the above

Q.28 Vapour pressure of a liquid depends upon the following

A) Surface area and temperature only
B) Volume of the liquid
C) Humidity of the liquid in the air
D) Temperature and the inter-molecular forces

Q.29 At 1atm pressure, a liquid 1 has the boiling point less than a liquid 2, what can we predict about both the liquids

A) Liquid 1 has high vapour pressure than the liquid 2
B) Liquid 1 has the weak intermolecular forces of attraction than the liquid 2
C) Liquid 1 is more volatile than the liquid 2
D) All of the above

Q.30 The distillation of a solution under reduced pressure is called

A) Fractional distillation
B) Destructive distillation
C) Distillation
D) Vacuum distillation

Q.31 A pressure cooker reduces cooking time because

A) Large flame is used
B) Heat is uniformly distributed
C) Boiling point of water rises
D) Vapour pressure of liquid decreases

Q.32 Molar heat of vapourization of water is

A) 40.6 kJ mol^{-1}
B) 14.6 kJ mol^{-1}
C) 140.6 kJ mol^{-1}
D) Zero

Q.33 Rate of evaporation of a liquid does not depend on

A) Surface area of liquid
B) Inter molecular forces
C) External pressure
D) Temperature

Q.34 Which one of the following would cause severe burning

A) Boiling water at 100°C
B) Boiling water at 80°C
C) Steam at 101°C
D) Water at 20°C

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Q.35 The boiling point of a liquid is that temperature at which

A) The vapour pressure of the liquid is equal to the atmospheric pressure
B) The vapour pressure of the liquid is less than the atmospheric pressure
C) The vapour pressure of the liquid is greater than the atmospheric pressure
D) The vapour pressure of the liquid is equal to intermolecular forces of liquid molecule

Q.36 The vapour pressure of pure water at 100°C is

A) 760 cm Hg
B) 14.7 Psi
C) 0.1 atm
D) 101.325 Pa

HYDROGEN BONDING AND PHYSICAL PROPERTIES, ANOMALOUS BEHAVIOUR OF WATER

Q.37 The strength of hydrogen bonding is

A) 20 times less than a covalent bond
B) 20 times more than a covalent bond
C) 20 times less than a ionic bond
D) 20 times more than a ionic bond

Q.38 When ammonia is dissolved in water, number of hydrogen bonds formed by ammonia are

A) 1
B) 4
C) 2
D) 3

Q.39 Lower alcohols are soluble in water because

A) Intermolecular hydrogen bonding
B) Dipole induced dipoles
C) Low electro-negativity difference between C and H
D) All of the above

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Q.40 Hydrogen bonding is maximum in

A) Diethyl ether
B) Benzene
C) Ethanol
D) Water

Q.41 The strongest H-bond is

A) F---H
B) N----H
C) O----H
D) O----F

Q.42 When two ice cubes are passed over each other, they unite to form one cube. This is due to

A) Covalent attraction
B) Hydrogen bond formation
C) Ionic bond formation
D) Metallic bond formation

Q.43 Which of the following can form hydrogen bonding among its molecules more prominently

A) CH_3OH
B) $CHCl_3$
C) $CH_3 - \overset{\overset{O}{\|}}{C} - CH_3$
D) All of these

Q.44 Hydrogen bonding is involved in

A) Solubility
B) Biological molecules
C) Cleansing action of detergents
D) All

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Q.45 Water has maximum density at

A) 0°C
B) 4°C
C) 2°C
D) 100°C

Q.46 When water freezes at 0°C its density decreases due to

A) Change of bond angles
B) Cubic structure of ice
C) Empty space present in the structure of ice
D) Change of bond length

Q.47 Ice float over water because

A) Its structure is diamond like
B) It is less dense than water
C) Its density is maximum at 4°C
D) It has no regular arrangement of molecules

Q.48 Ice occupy _____ percent more space than liquid water

A) 5
B) 17
C) 9
D) 20

Q.49 Hydrogen bonding is extensively present in proteins form the spiral. The hydrogen bond being produced is between

A) Nitrogen and hydrogen atom
B) Carbon and hydrogen atom
C) Oxygen and hydrogen atom
D) All of them are possible

Q.50 The pair likely to form the strongest hydrogen bonding

A) H_2O and HCHO
B) H_2O and CH_3COCH_3
C) H_2O and CH_4
D) H_2O and CH_3Cl

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PAST PAPER QUESTIONS

Q.1 All the collisions between the particles of gases are elastic in nature. What is meant by "Elastic Collisions"?

A) The velocity of the molecules changes

B) No change in mass during the collisions

C) No change in the kinetic energy

D) No change in potential energy during the Collisions

Q.2 Which one of the following expression represent the Avogadro law?

A) V= RnT/P (When T and n are constant)

B) V= RnT/P (When T and P are constant)

C) V= RnT/P (When P and n are constant)

D) V= RP/nT (When T, P and n are constant)

Q.3 The root mean square velocity of gases is inversely proportional to square root of their:

A) Temperature

B) Molar mass

C) Pressure

D) Volume

Q.4 The number of molecules in 22.4 dm^3 of H_2 gas at 0°C and 1 atm are

A) 60.2×10^{23}

B) 6.02×10^{23}

C) 6.02×10^{25}

D) 60.2×10^{22}

Q.5 There are four gases H_2, He, N_2 and CO_2 at 0°C. Which gas shown greater non-ideal behavior?

A) He

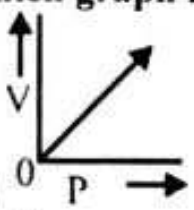
B) CO_2

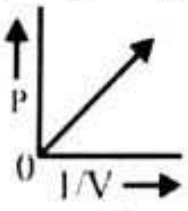
C) H_2

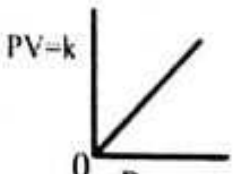
D) N_2

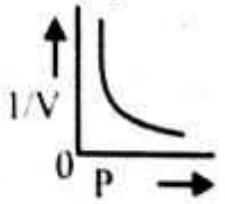
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Q.6 Which graph represents Boyle's law

A) 

B) 

C) 

D) 

Q.7 The coordination number of Na+ in NaCl crystal is

A) 8

B) 2

C) 4

D) 6

Q.8 Identify the value of R at STP

A) 8.314 atm dm^{-3} mol^{-1}

B) 0.0821 cal K^{-1} mol^{-1}

C) 0.0821 atm dm^3 K^{-1} mol^{-1}

D) 8.314 cal K^{-1} mol^{-1}

Q.9 In the equation $\left(P + \frac{n^2 a}{V^2}\right)(V - nb) = RT$, 'b' represents the

A) Excluded volume

B) Excluded pressure

C) Actual volume

D) Excluded volume per mol

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EXPLANATORY NOTES

Q.1 $CHCl_3$ is a polar molecule in have dipole - dipole forces.

Q.2 IMF ↑ V.P ↓ B.pt ↑
Br_2 has strong LDF due to greater molar mas.

Q.3 Hydrogen bonding is FON
Means when hydrogen is bonded with highly EN element like F, O and N, hydrogen is bonding is dominant in such compound.

Q.4 Nature of bounding affects the physical as well as chemical properties of compound.

Q.5 Constant state of random motion in molecules of liquids and gases do not allow a definite shape.

Q.6 Both propanone and water are polar molecules, therefore, they are miscible with each other.

Q.7 IMF ↑ V.P ↓

Q.8 Generally, the order of increasing interactions is
London forces < Debye forces < Dipole – Dipole < Hydrogen bonding

Q.9 Molar mass ↑ polarizability ↑ LDF ↑

Q.10 The forces which are present between the ions and water molecules are known as ion- dipole forces.

Q.11 Forces of attraction present between atoms and molecules are known as intermolecular forces.

Q.12 The attractive forces between the partial positive end of one molecule and partial negative end of other molecule are called dipole-dipole forces

Q.13 _____

Q.14 For higher alkanes,
Molar mass ↑ polarizability ↑ LDF ↑ Boiling point ↑

Q.15 Vapor pressure depends on temperature, at higher temperature greater vapor pressure is observed.

Q.16

Name of compound	Vapour pressure at 20°C (torr)
Isopentane	580
Ethyl ether	442.2
Chloroform	170
Carbon Tetrachloride	87
Water	17.54
Mercury	0.012
Glycerol	0.00016

).17 Boiling point of liquid ↑ External pressure ↑
The boiling point of water would be highest at Gawadar

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Q.18 Manometric method is used to measure the vapour pressure of liquids and V.P is calculated by using following equations

A) $P = Pa - \Delta h$ when vapor pressure of the liquid is less than external pressure

B) $P = Pa$ when vapor pressure of the liquid is equal to external pressure

C) $P = Pa + \Delta h$ when vapor pressure of the liquid is greater than external pressure

Q.19

Evaporation:

- is a surface phenomenon
- is a continuous process
- continues at all temperatures.
- is cooling process
- endothermic process

Q.20 Vapor pressure of water at difference temperature is given in the table

Temperature (°C)	Vapour Pressure (Torr)
0	4.579
10	9.209
20	17.54
30	31.82
37	47.07
40	55.32
50	92.51
60	149.4
70	233.7
80	355.1
90	527.0
100	760.0

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Q.21 The conversion of vapours back into their liquid state is called condensation

Q.22 Vapour pressure is not affected by

- Surface area
- Quantity of liquid
- Volume of container

Q.23 The correct option is Diethyl ether because

LDF ↓ V.P ↑ Volatility ↑

Q.24 Boiling point of liquid ↑ External pressure ↑

Q.25 Down the group

Molar mass ↑ polarizability ↑ LDF ↑ Boiling point ↑

Q.26 At boiling point, on supply of further amount of it no change in temperature is observed because extra amount of heat just change the liquid into vapor phase

Q.27 Evaporation is designated as a cooling process because of high energy molecules leave behind the low energy molecules and cause cooling

Q.28 Vapour pressure of a liquid depends upon nature of liquid, temperature and the inter-molecular forces

Q.29 B.pt ↓ V.P ↑ IMF ↓ Volatility ↑

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Q.30 The distillation of a solution under reduced pressure is called vacuum distillation

Q.31 A pressure cooker reduces cooking time because boiling point of water rises

Boiling point ↑ External pressure ↑

Q.32 Molar heat of vapourization of water is 40.6 kJ mol^{-1}

Q.33 Rate of evaporation of a liquid depends on surface area of liquid, inter molecular forces and temperature

Q.34 Steam contains higher potential energy because of extra heat which is absorbed by water molecules during boiling to overcome intermolecular force.

Q.35 The boiling point of a liquid is that temperature at which the vapour pressure of the liquid is equal to the atmospheric pressure

Q.36 The vapour pressure of pure water at 100°C is 1 atm which is equal to 14.7 PSI

Q.37 The strength of hydrogen bonding is 20 times less than a covalent bond.

Q.38 Number of hydrogen bonds per molecule are

NH_3----- 1 H- bond per molecule

HF----- 1 H- bond per molecule

H_2O-----2 H- bond per molecule

Q.39 Number of C-atoms in the compound ↑ hydrogen bounding ↓

Q.40 Hydrogen bonding is maximum in water because its boiling point is 100° C (maximum among the given options).

Q.41 Strength of H – bond ↑ Electronegative difference ↑

Q.42 Ice (water) has strong hydrogen bonding due to which ice cubes unite tc form single larger ice cube.

Q.43 CH_3OH has hydrogen bonding as prominent intermolecular force

Q.44 Solubility, cleansing action of detergents and biological molecules are application of hydrogen bonding.

Q.45 Water has maximum density at 4°C

Q.46 When water freezes at 0°C its density decreases due to empty space present in the structure of ice and volume increases by 9 %.

Q.47 Ice float over water because it is less dense than water.

Q.48 Ice occupy 9 percent more space than liquid water.

Q.49 In proteins, hydrogen bond is produced between oxygen and hydrogen atom.

Q.50 Both H_2O and HCHO are polar molecules and have strong hydrogen bonding.

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Topic 5 SOLIDS

PRACTICE EXERCISE

INTRODUCTION, TYPES OF SOLIDS AND PROPERTIES OF CYRSTALLINE SOLIDS

Q.1 Transition temperature is shown by which of the following pairs

A) Isomorph and polymorph
B) Isomorph and allotrope
C) Allotrope and polymorph
D) All of these

Q.2 Lattice energy decreases with the increase in size of ion because oppositely charged ions

A) Have close packing
B) Becomes less tight
C) Have low empty spaces
D) Have strong electrostatic forces

Q.3 Ionic solids are characterized by

A) Low melting point
B) High vapour pressure
C) Good conductivity in solid state
D) Solubility in polar solvent

Q.4 Which solids are called true solids

A) Metallic
B) Crystalline
C) Amorphous
D) Vitreous

Q.5 Which ionic solid has highest lattice energy

A) LiCl
B) KCl
C) NaCl
D) $MgCl_2$

Q.6 The following is two dimensional covalent solid

A) Diamond
B) Quartz
C) Graphite
D) Silica

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Q.7 Which of the following intermolecular forces are present in solid iodine

A) Dipole – dipole forces
B) Hydrogen bonding
C) London dispersion forces
D) Debye forces

Q.8 Which of the following is not amorphous solid

A) Glass
B) Glue
C) Table salt
D) Rubber

Q.9 Transition temperature of sulphur is

A) 13.2°C
B) 95.5°C
C) 128°C
D) 32.02°C

Q.10 Which of the following is isotropic property

A) Refractive index
B) Cleavage
C) Coefficient of thermal expansion
D) Metallic conduction

Q.11 The theory which explains the malleability and ductility in metals is

A) Electron gas theory
B) Molecular orbital theory
C) Valance bond theory
D) Band theory

Q.12 Which atomic solid is good conductor of electricity

A) Graphite
B) Copper
C) Diamond
D) Iodine

Q.13 When an element exist in more than one crystalline forms, it is known as

A) Anisotropy
B) Allotropy
C) Isomorphism
D) Polymorphism

Q.14 A solid may be made up of

A) Atoms
B) Molecules
C) Ions
D) a, b and c

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Q.15 Which one has the highest melting point and boiling point
A) Ionic crystal
B) Covalent crystal
C) Molecular crystal
D) Metallic crystal

Q.16 In a crystal , the atoms are located at the position of
A) Zero P.E.
B) Minimum P.E.
C) Infinite P.E.
D) Maximum P.E.

Q.17 Which of the following is anisotropic
A) Hydrogen
B) Water
C) Quartz
D) Rubber

Q.18 Crystalline part of otherwise amorphous solids are known as
A) Allotrope
B) Isomorph
C) Crystallites
D) Polymorph

Q.19 The depression in metallic structures are called
A) Interstices
B) Voids
C) Crevices
D) All of these

UNIT CELL, CRYSTAL LATTICE AND THEIR CLASSIFICATION

Q.20 Coinage metals are Cu, Ag & Au and they have _____ crystal system
A) Cubic
B) Tetragonal
C) Hexagonal
D) Trigon

Q.21 The structure of solid iodine is
A) Simple cubic
B) FCC
C) BCC
D) None of these

Q.22 In crystal structure of NaCl, the arrangement of Cl^- ions is
A) Face centered cubic
B) Simple Cubic
C) Body centered cubic
D) Hexagonal

Q.23 In a crystal lattice the correct sequence of bond angles is
A) $bc = \alpha, ca = \beta, ab = \gamma$
B) $bc = \gamma, ca = \beta, ab = \alpha$
C) $bc = \beta, ca = \alpha, ab = \gamma$
D) All are possible

Q.24 In hexagonal close packing the third layer will be similar to all except
A) Fifth
B) Eighth
C) Seventh
D) Ninth

Q.25 The overall structure of diamond looks
A) Face-centered cubic
B) Square planar
C) Tetragonal
D) Hexagonal

Q.26 The arrangement ABC, ABC... is referred as:
A) Cubic close packing
B) Hexagonal close packing
C) Octahedral close packing
D) Tetrahedral close packing

Q.27 Total unit cell dimensions are
A) Seven
B) Six
C) Fourteen
D) Thirty two

Q.28 Cubic crystal system has the following unit cell dimensions
A) $a = b = c$ and $\alpha = \beta = \gamma = 90°$
B) $a \neq b \neq c$ and $\alpha = \beta = \gamma = 90°$
C) $a = b \neq c$ and $\alpha = \beta = \gamma = 90°$
D) $a = b \neq c$ and $\alpha = \beta = 90°, \gamma = 120°$

Q.29 The crystalline form of Tin is
A) Cubic
B) Tetragonal
C) Hexagonal
D) Both a and c

AKASH SOCIETY FOR FUTURE DOCTORS

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CLASSIFICATION OF SOLIDS (IONIC, MOLECULAR, COVALENT AND METALLIC)

Q.30 Which one of the following is a giant molecule

A) SiO_2
B) CH_4
C) CO_2
D) NH_3

Q.31 Molecular crystals are

A) Hard
B) Soft
C) Very hard
D) Always polar

Q.32 The crystals formed due to London forces of interaction are

A) Ionic
B) Covalent
C) Molecular
D) Metallic

Q.33 The number of Cl^- ions per units cell of a simple cubic lattice at the corner is / are

A) 1
B) 4
C) 3
D) 6

Q.34 Which is incorrect about structure of iodine

A) Face-centered cubic
B) $I - I_{(g)} > I - I_{(s)}$
C) Metallic appearance
D) $I - I_{(g)} < I - I_{(s)}$ Bond length

Q.35 Overall ratio of silicon to oxygen atoms in silicon (IV) oxide is

A) 1: 4
B) 1 : 2
C) 4 : 1
D) 2 : 1

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Q.36 C – C bond lengths is diamond crystal are

A) 1.54 pm
B) 154 pm
C) 109.5 pm
D) 1540 pm

Q.37 In interior of silicone (IV) oxide crystal, each silicone atom is directly connected with

A) Two O-atoms
B) Four O-atoms
C) Two O-atoms and two Si-atoms
D) Four Si-atoms

Q.38 Iodine is a molecular solid because the forces between its molecules are

A) Ionic
B) Metallic
C) Covalent
D) Vander wall's forces

Q.39 The coordination number of each ion in NaCl is

A) 4
B) 6
C) 8
D) 10

Q.40 The best conductors of electricity are

A) Ionic solids
B) Molecular solids
C) Metallic solids
D) Covalent solids

Q.41 Which of the following statement is incorrect about silica

A) Every silicon atom is bonded tetrahedrally to four oxygen atoms
B) Every oxygen atom is bonded to two silicon atoms
C) Structure of silica is considered to be essentially one molecule
D) Has very high thermal expansion

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Q.42 During which process, empty spaces between particles become minimum

A) Ionization
B) Fusion
C) Condensation
D) Evaporation

Q.43 A malleable solid is one which can be

A) Converted into wires
B) Melted easily
C) Converted into thin sheets
D) All of above

Q.44 Which type of solids can be drawn into sheets and wires

A) Molecular solids
B) Covalent solids
C) Metallic solids
D) Ionic solids

Q.45 Diamond, Silicon carbide are insoluble in most of the solvents because

A) They have very high lattice energy
B) They do not interact with the solvent
C) They have very big size
D) All of these

Q.46 Independent molecule of NaCl may exist in

A) Solid phase
B) Liquid phase
C) Gaseous phase
D) Vapour phase

Q.47 Which of the following is an example of polar molecular solid

A) Naphthalene
B) Iodine
C) Dry ice
D) Sugar

Q.48 C – C bond length in diamond is same as in

A) Propene
B) Graphite
C) Ethane
D) Acetylene

Q.49 Solid belonging to covalent crystalline type that can conduct electricity is

A) Diamond
B) Graphite
C) Silicon
D) Silver

Q.50 Solid CO_2 (Dry ice) is an example of _____ crystals

A) Covalent
B) Metallic
C) Ionic
D) Molecular

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PAST PAPER QUESTIONS

Q.1 All the collisions between the particles of gases are elastic in nature. What is meant by "Elastic Collisions"?

A) The velocity of the molecules changes

B) No change in mass during the collisions

C) No change in the kinetic energy

D) No change in potential energy during the Collisions

Q.2 Which one of the following expression represent the Avogadro law?

A) V= RnT/P (When T and n are constant)

B) V= RnT/P (When T and P are constant)

C) V= RnT/P (When P and n are constant)

D) V= RP/nT (When T, P and n are constant)

Q.3 The root mean square velocity of gases is inversely proportional to square root of their:

A) Temperature

B) Molar mass

C) Pressure

D) Volume

Q.4 The number of molecules in 22.4 dm^3 of H_2 gas at 0°C and 1 atm are

A) 60.2×10^{23}

B) 6.02×10^{23}

C) 6.02×10^{25}

D) 60.2×10^{22}

Q.5 There are four gases H_2, He, N_2 and CO_2 at 0°C. Which gas shown greater non-ideal behavior?

A) He

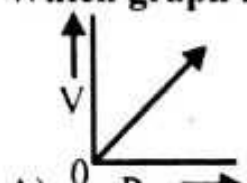
B) CO_2

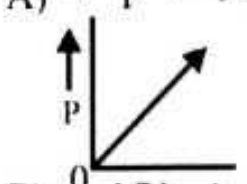
C) H_2

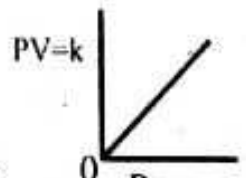
D) N_2

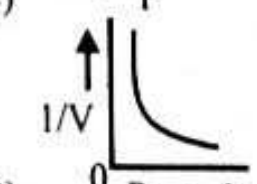
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Q.6 Which graph represents Boyle's law

A) 

B) 

C) 

D) 

Q.7 The coordination number of Na+ in NaCl crystal is

A) 8

B) 2

C) 4

D) 6

Q.8 Identify the value of R at STP

A) 8.314 atm dm^{-3} mol^{-1}

B) 0.0821 cal K^{-1} mol^{-1}

C) 0.0821 atm dm^3 K^{-1} mol^{-1}

D) 8.314 cal K^{-1} mol^{-1}

Q.9 In the equation $\left(P + \frac{n^2 a}{V^2}\right)(V - nb) = RT$, 'b' represents the

A) Excluded volume

B) Excluded pressure

C) Actual volume

D) Excluded volume per mol

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Q.10 Gas is enclosed in a container of 20cm³with the moving piston. According to kinetic theory of gases, what is the effect on freely moving molecules of the gas if temperature is increased from 20°C to 100°C?

A) Colliding capability of molecule will become lower
B) Pressure will become one half
C) Temperature has no effect on freely moving molecules
D) Volume will be increased

Q.11 Which of the following is the correct equation to calculate relative molecular mass of a gas

A) M-mPRT/V
B) M=PV/mRT
C) M = mPR/VT
D) M= mRT/PV

Q.12 Which of the statement is applicable for both ideal and real gases molecules?

A) Have no forces of attraction
B) Collisions between the molecules is elastic
C) Molecules are in random movement
D) The actual volume of gas is negligible as compared to the volume of gas

Q.13 Correct order of boiling points of the given liquids is

A) $H_2O > HF > HCl > NH_3$
B) $HF > H_2O > HCl > NH_3$
C) $H_2O > HF > NH_3 > HCl$
D) $HF > H_2O > NH_3 > HCl$

Q.14 At 1489 mmHg, water will boil at

A) 120C°
D) 100C°
C) 110C°
D) 90C°

Q.15 Ice is less dense than water at

A) 0°C
B) -4°C
C) 4°C
D) 2°C

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Q.16 In crystal lattice of ice, each O-atom of water molecule is attached to

A) Four H-atoms
B) One H-atom
C) Two H-atoms
D) Three H-atoms

Q.17 What is reason that the ice at 0^0C occupies more volume then water:

A) Empty spaces
B) Ionic bond
C) Intermolecular forces
D) Debye forces

Q.18 Water has maximum density at

A) –4°C
B) 0°C
C) 1°C
D) 4°C

Q.19 In the structure of NaCl, each sodium ion is surrounded by chloride ions

A) 4
B) 5
C) 6
D) 8

Q.20 Which one the following have highest lattice energy?

A) NaCl
B) KBr
C) KCl
D) LiCl

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ANSWER KEY

1	B	11	C	21	B	31	B	41	B
2	B	12	C	22	A	32	C	42	C
3	D	13	B	23	A	33	D	43	C
4	B	14	D	24	B	34	B	44	C
5	D	15	B	25	A	35	B	45	C
6	C	16	B	26	A	36	B	46	D
7	C	17	C	27	B	37	B	47	D
8	C	18	C	28	A	38	D	48	C
9	B	19	D	29	B	39	B	49	B
10	D	20	A	30	A	40	C	50	D

PAST PAPER QUESTIONS

1	C	6	B	11	D	16	A
2	B	7	D	12	C	17	A
3	B	8	C	13	C	18	D
4	B	9	D	14	A	19	C
5	B	10	D	15	A	20	D

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EXPLANATORY NOTES

Q.1 Isomorph and allotrope are different crystalline forms of compounds and elements respectively. Therefore, transition temperature is shown by them

Q.2 Lattice energy depends upon size and it is inversely proportional to size.

Q.3 Solubility is based on the principle, "like dissolves like"

Q.4 Only crystalline solids show all the properties of true solids.

Q.5 Lattice energy depends on charge to size ratio. Greater the charge to size ratio, greater is lattice energy.

Q.6 Graphite is layered structure and each carbon is sp^2 hybridized.

Q.7 Solid iodine is non-polar and have LDF.

Q.8 Table salt is NaCl which is a crystalline solid.

Q.9 Rhombic sulphur $\overset{95.5^\circ C}{\rightleftharpoons}$ Monoclinic sulphur

Q.10 Anisotropy is directional property while isotropy is a non-directional. Hence, metallic conduction is isotropic

Q.11 Malleability and ductility in metals is explained by the valance electrons which are involved in metallic bonding.

Q.12 Metals are good conductors of electricity due to delocalized electrons

Q.13 When an element exist in more than one crystalline forms, it is known as allotropy

Q.14 A solid may be made up of atoms (covalent solid), molecules (molecular solid) and ions (ionic solid).

Q.15 Covalent crystals may have network structure therefore, they have high melting and boiling points.

Q.16 Crystal is a stable geometrical shape in which atoms, molecules or ions are located at the position of minimum potential energy.

Q.17 Quartz is a crystalline solid and have anisotropic property

Q.18 Crystalline part of otherwise amorphous solids are known as crystallites

Q.19 The depression in metallic structures are called interstices, crevices and voids.

Q.20 Cu, Ag and Au have cubic crystal system.

Q.21 Solid iodine is a molecular crystalline solid with FCC structure

Q.22 NaCl has FCC crystalline structure.

Q.23 The angle 'α' is between the lengths 'b' and 'c', the angle 'β' is between the sides 'a' and 'c' and angle 'γ' is between sides 'a' and 'b'.

Q.24 Hexagonal close packing is written as ABAB..... or 1212. The balls of third, fifth and seventh layers will be in front of each other.

Q.25 The structure of diamond is FCC.

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Q.26 In cubic close packing the arrangement is called ABC ABC ..... Or 123 123..... It is named as face centered cubic arrangement. The balls of fourth, seventh and tenth layers will be in front of each other.

Q.27 There are three unit cell lengths a, b and c and three unit cell angels (α, β, γ).

Q.28 Cubic $a = b = c$ $\alpha = \beta = \gamma = 90^o$
Examples: Fe, Cu, Ag, Au, NaCl, NaBr, Diamond

Q.29 Tetragonal $a = b \neq c$ $\alpha = \beta = \gamma = 90^o$
Examples: Sn, SnO_2, MnO_2, NH_4Br

Q.30 SiO_2 (Silica) is network crystalline covalent solid

Q.31 Molecular crystal are formed due to intermolecular forces which are not very strong therefore, they are soft.

Q.32 Molecular solids are formed due to LDF or hydrogen bonding.

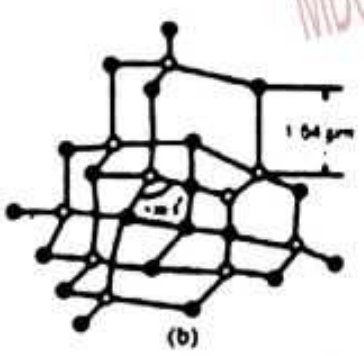
Q.33 A unit cell gets a total share of Cl^- ion at eight corners $= 8 \times \frac{1}{8} = 1$ and number of Cl^- per units cell is 6.

Q.34 I-I bond distance is 271.5 pm and it is appreciably longer than in gaseous iodine (266.6pm).

Q.35 Silicon (IV) oxide is SiO_2. It is a network covalent solid and the ratio of silicon to oxygen atoms is 1 : 2.

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Q.36



Q.37 In silicon (IV) oxide crystal each silicon atom is directly bonded with four oxygen atoms in network structure.

Q.38 Molecular solids are formed due to Vander Waal's forces

Q.39 In NaCl, each Na^+ ion surrounded by six Cl^- ions and each Cl^- ion is surrounded by six Na^+ ions. So, co-ordination number of NaCl is 6.

Q.40 Metallic solids have delocalized electron due to which they can conduct electricity.

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Q.41 Silica has following properties

- Every silicon atom is bonded tetrahedrally to four oxygen atoms
- Every silicon atom is bonded to four oxygen atoms
- Structure of silica is considered to be essentially one molecule
- Has very high thermal expansion

Q.42 In condensation process vapour phase change into liquid and molecules come closer to each other.

Q.43 Metals are malleable and can be converted into thin sheets.

Q.44 Metallic solids are malleable and can be drown into thin sheets and wires.

Q.45 They are network covalent solids and have very large size.

Q.46 Independent molecule of NaCl may exist in only vapour phase

Q.47 Sugar is a polar molecule and have hydrogen bonding.

Q.48 Both diamond and ethane have C – C bond length equal to 154 pm.

Q.49 Graphite has a layer structure and free electron are available along the layers and can conduct electricity.

Q.50 Dry ice is an example of molecular solid.

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Topic 6

CHEMICAL EQUILIBRIUM

PRACTICE EXERCISE

REVERSIBLE AND IRREVERSIBLE REACTIONS AND STATE OF CHEMICAL EQUILIBRIUM

Q.1 At equilibrium, the concentration of reactants and products are
A) Constant
B) Maximum
C) Different
D) Equal

Q.2 Statement, which describe a reversible reaction
A) Both forward and reverse reaction does not occur simultaneously
B) Both forward and reverse reaction occur simultaneously but under different conditions
C) Both forward and reverse reaction occur simultaneously at the same time under same condition
D) Forward and reverse reaction takes place at different time and different conditions

Q.3 For a homogeneous reaction

$$4NH_3 + 5O_2 \rightleftharpoons 4NO + 6H_2O$$

The units of equilibrium constant (Kc) is
A) Conc.$^{+2}$
B) Conc.$^{-1}$
C) Conc.$^{+1}$
D) No units

Q.4 One mole of HI was sealed in a tube heated at 440°C till equilibrium is reached, HI was found to be 50% dissociated, K_c for the reaction is
A) 1
B) 0.5
C) 0.25
D) 0.625

Q.5 For what value of K_c almost forward reaction is complete
A) $K_c = 10^{-30}$
B) $K_c = 1$
C) $K_c = 10^{30}$
D) $K_c = 0$

Q.6 1 mole of ethyl alcohol was treated with one mole of acetic acid at 25°C. $\frac{2}{3}$rd of acid changes into ester at equilibrium. The equilibrium constant of the reaction will be
A) 1
B) 3
C) 2
D) 4

Q.7 At equilibrium concentration of SO_2 is 2M, O_2 is 2M and SO_3 is 4M. $2SO_2 + O_2 \rightleftharpoons 2SO_3$. What will be the Kc value of given reaction
A) 0.2
B) 4
C) 2
D) 8

EQUILIBRIUM CONSTANT EXPRESSION AND ITS APPLICATIONS

Q.8 In a reaction $CO_{(g)} + 2H_{2(g)} \rightleftharpoons CH_3OH_{(g)}$, $\Delta H° = -92kJ/mol$. Concentration of hydrogen, carbon monoxide and methanol become constant at equilibrium, what will happen
A) Reaction become faster
B) Equilibrium state disturbs
C) Reaction become slow
D) Equilibrium state remains undisturbed

Q.9 If kc value is small then equilibrium position will shift
A) Towards left
B) Remains unchanged
C) Towards right
D) It is always constant value

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Q.10 **The equilibrium expression for a reaction is $K_c = \frac{X^2}{V(a-X)}$, what is true for this reaction.**

A) Increase of pressure favoured forward reaction
B) Decrease of pressure favoured forward reaction
C) Decrease of pressure favoured backward reaction
D) Increase in volume favoured backward reaction

Q.11 **For the reaction $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$. The equilibrium constant changes with**

A) Total pressure
B) Concentration of H_2 and I_2
C) Catalyst
D) Temperature

Q.12 **Correct relationship b/w K_c and K_p can be written as**

A) $K_p = K_c (R)^{\Delta n}$
B) $K_c = K_p (RT)^{\Delta n}$
C) $K_p = K_c (RT)^{\Delta n}$
D) $K_p = K_c (R/N)^{\Delta n}$

Q.13 **For the given reaction $PCl_5 \rightleftharpoons PCl_3 + Cl_2$**

A) $K_p > K_c$
B) $K_p < K_c$
C) $K_p = K_c$
D) $K_p = K_c = 0$

Q.14 **For the reaction $H_2 + I_2 \rightleftharpoons 2HI$. Equilibrium concentration of H_2, I_2 and HI are 8,3 and 24mol/dm^3 respectively. K_c of the reaction is**

A) 24
B) 26
C) 1
D) 9

Q.15 **For the following reaction in the gaseous phase**

$CO + \frac{1}{2}O_2 \rightleftharpoons CO_2$, $\frac{Kc}{Kp}$ is

A) $(RT)^{\frac{1}{2}}$
B) RT
C) $(RT)^{-\frac{1}{2}}$
D) RT^{-1}

MEDICAL SOCIETY FOR FUTURE DOCTORS

THE LE-CHATELIER'S PRINCIPLE AND ITS APPLICATIONS IN INDUSTRY

Q.16 **In the reaction $A_{2(g)} + 4B_{2(g)} \rightleftharpoons 2AB_{4(g)}$ such that ΔH is negative, the formation of $AB_{4(g)}$ will be favoured at**

A) Low temperature and high-pressure
B) High temperature and low-pressure
C) Low temperature and low pressure
D) High temperature and high pressure

Q.17 $N_2 + 3H_2 \rightleftharpoons 2NH_3$ $\Delta H = -41.02kJ / mol$

Forward reaction is favoured by

A) Adding NH_3 at equilibrium
B) Decreasing temperature
C) Adding catalyst
D) Decreasing concentration of H_2

Q.18 **In a given system, water and ice are in equilibrium, if the pressure is applied to the system then**

A) More ice is formed
B) Amount of ice and water will remain the same
C) More ice is melted
D) Both A) and B)

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Q.19 If the temperature is increased for following reaction, then it will go in

$$N_2 + 3H_2 \rightleftharpoons 2NH_3 \qquad \Delta H = -Ve$$

A) Forward direction
B) Remain constant
C) Reverse direction
D) Cannot be predicted

Q.20 In Haber process, equilibrium mixture contains _____ NH_3 by volume

A) 20%
B) 55%
C) 70%
D) 35%

Q.21 Catalyst used in Haber's process for manufacturing of NH_3 is

A) Fe(MgO, Al_2O, SiO_2)
B) MgO
C) Al_2O_3
D) SiO_2

pH, pOH AND Kw, Ka, pKa, Kb AND pKb

Q.22 Which of the following is strongest conjugate base

A) CH_3COO^-
B) OH^-
C) Cl^-
D) $C_2H_5O^-$

Q.23 $HA + H_2O \rightleftharpoons A^- + H_3O^+$

Conjugate base in above reaction is

A) HA
B) H_2O
C) A^-
D) H_3O^+

Q.24 The conjugate base of $H_2PO_4^{-1}$ is

A) H_3PO_4
B) HPO_4^{-2}
C) PO_4^{-3}
D) HPO_4^{-1}

Q.25 pKa value of three acid. A, B, C are 4.3, 3.3 and 5.5 respectively, which represent correct order of strength

A) A > B > C
B) C > A > B
C) B > A > C
D) C > B > A

Q.26 Which is correct statement

A) pKa × pKb = 14
B) pKa + pKb = Kw
C) Ka × Kb = pKw
D) Ka ×Kb = Kw

Q.27 At 90°C, pure water has $[H_3O^+]$ is 10^{-6} mol/dm^3. What is the value of K_w at 90°C

A) 10^{-8}
B) 10^{-6}
C) 10^{-12}
D) 10^{-14}

Q.28 With increase in temperature, ionic product of H_2O

A) Decreases
B) Remains same
C) Increases
D) May increase or decrease

Q.29 The pH of neutral water is 6.8 then the temperature of H_2O is

A) 25^{0}C
B) More than 25^{0}C
C) Less than 25^{0}C
D) Not predicted

Q.30 The value of K_w in an acidic aqueous solution at 298 K is

A) $>10^{-14}$
B) 10^{14}
C) $< 10^{-14}$
D) 10^{-14}

Q.31 Which statement is incorrect

A) pH and $[OH^-]$ are inversely related to each other
B) pOH and $[OH^-]$ are inversely related to each other
C) pH and $[OH^-]$ are directly related to each other
D) pOH means potential of hydroxyl ion concentration

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Q.32 Which of the following is not correct

A) $pH = \frac{1}{\log[H^+]}$

B) $pH = \log\frac{1}{[H^+]}$

C) $[H^+] = 10^{-pH}$

D) $pH = -\log[H^+]$

Q.33 What is the pH of 0.1M solution of weak acid having ionization constant (Ka) is 10^{-7}

A) 7
B) 6
C) 4
D) 5

Q.34 The pH of 1M MOH solution which is only 10% dissociated

A) 10
B) 13
C) 3
D) 1

Q.35 pH of monoprotic acid is 3.0 at 25°C. The hydrogen ion concentration in the solution would be

A) 0.001
B) 0.01
C) 0.0001
D) 10^{-5}

Q.36 pH of 10^{-3} mole dm^{-3} of H_2SO_4

A) 3
B) 2.7
C) 4
D) 1.7

COMMON ION EFFECT AND BUFFER SOLUTION

Q.37 Basic buffer solution is

A) HF / NaF
B) $(COOH)_2$ / $(COONa)_2$
C) H_2CO_3 / Na_2CO_3
D) NH_4OH/NH_4Cl

Q.38 Buffer action can be explained by all except

A) Common ion effect
B) Le-Chatelier's principle
C) Law of mass action
D) Solubility product

Q.39 A basic buffer solution can be prepared by mixing

A) Strong acid and its salt with weak base
B) Strong base and its salt with weak acid
C) Weak base and its salt with strong acid
D) Weak acid and its salt with strong base

Q.40 The pH of ideal buffer is

A) 10
B) 7
C) Less than 7
D) 0

Q.41 A certain buffer solution contains equal conc. of $\bar{X}$ and HX. ka for HX is 10^{-8}. The pH of buffer is

A) 3
B) 11
C) 8
D) 14

Q.42 Which Henderson equation is not correct?

A) $pH = pKa + \log\frac{[salt]}{[acid]}$

B) $pH = pKa - \log\frac{[salt]}{[acid]}$

C) $pH = pKa - \log\frac{[acid]}{[salt]}$

D) $Pka = pH - \log\frac{[salt]}{[acid]}$

Q.43 For acidic buffer, pH < pKa if

A) [salt] = [acid]
B) [salt] < [acid]
C) [salt] > [acid]
D) [salt] > [base]

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Q.44 When HCl gas is passed through saturated solution of rock salt, the solubility of NaCl

A) Increases
B) May increase or decrease
C) Decreases
D) None of these

Q.45 An excess of silver nitrate is added to the aqueous barium chloride and the precipitate is removed by filtration. What are the main ions in the filtrate

A) Ag^+ and NO_3^- only
B) NO_3^- and Ba^{+2}only
C) Ag^+ and NO_3^- and Ba^{+2}only
D) Cl^- and NO_3^- and Ba^{+2}only

Q.46 Ionization of $KClO_3$ is suppressed by

A) Increasing temperature
B) Adding KCl
C) Adding $NaNO_3$
D) Decreasing temperature

EQUILIBRIA OF SLIGHTLY SOLUBLE IONIC COMPUNDS (SOLUBILITY PRODUCT)

Q.47 If ionic product is equal to K_{sp} then the solution is

A) Unsaturated
B) Ideal
C) Supersaturated
D) Saturated

Q.48 The solubility product is only applicable for those substance whose molar concentrations is

A) Equal to 0.1M
B) Equal to 1
C) Equal to or Less than 0.01
D) Greater than 0.1

Q.49 In a saturated solution of AgCl, the molar concentration of Ag^+ and Cl^- is $1.0x10^{-5}$ M each. What is the value of Ksp

A) 1.0×10^{-5}
B) 0.1×10^{-5}
C) 1.0×10^{-15}
D) 1.0×10^{-10}

Q.50 The molar solubility of sparingly soluble salt AB_3 is "S" mol/dm^3, the corresponding solubility product K_{sp} is given in term of K_{sp} by the reaction.

A) $S=\left(\frac{K_{sp}}{128}\right)^{1/4}$
B) $S=\left(\frac{K_{sp}}{27}\right)^{\frac{1}{4}}$
C) $S=\left(27K_{sp}\right)^{\frac{1}{3}}$
D) $S=\left(\frac{K_{sp}}{81}\right)^{\frac{1}{4}}$

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PAST PAPERS QUESTIONS

Q.1 **Formation of NH_3 is reversible and exothermic process, what will happen on cooling?**

A) More reactant will form
B) More N_2 will be formed
C) More H_2 will be formed
D) More product (NH_3) will be formed

Q.2 **During the manufacture of nitric acid, nitric oxide is oxidized to nitrogen dioxide. This reaction is given as**

$2NO_{(g)} + O_{2(g)} \rightleftharpoons 2NO_{2(g)} \quad \Delta H = -114kJ/mol$

According to Le Chatelier's Principle

A) Reaction must not be temperature dependent
B) Reaction must be carried out at room temperature
C) Reaction must be carried out at low temperature
D) Reaction must be carried out at high temperature

Q.3 **For an equilibrium reaction;**

$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$ **the forward reaction is exothermic, increase in temperature shifts the equilibrium position towards left because,**

A) the concentrations of SO_3, SO_2 and O_2 increase as the temperature increases
B) the concentrations of SO_2 and O_2 increase and concentration of SO_3 decreases as the temperature increases
C) the concentrations of SO_2 and O_2 decrease and concentration of SO_3 increases as the temperature increases
D) the concentrations of SO_2 and O_2 increase and concentration of SO_3 stays same as the temperature increases

Q.4 **Which of the following factors effect a reversible chemical reaction in accordance with the Le-Chatelier principle?**

A) Pressure
B) Concentration
C) Temperature
D) Pressure, concentration and temperature

Q.5 **Which one of the following factors does not affect the equilibrium position?**

A) Catalyst
B) Temperature
C) Concentration of reactants and product
D) Pressure

Q.6 **Units of Kc for the following reaction is: $H_2 + I_2 \rightarrow 2HI$**

A) mol^2dm^{-6}
B) $moldm^{-3}$
C) no unit
D) $mol^{-2}dm^6$

Q.7 **For which of the following equilibrium reaction, K_c has no units?**

A) $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$
C) $SO_{2(g)} + 2O_{2(g)} \rightleftharpoons 2SO_{3(g)}$
C) $CO_{(g)} + H_2O_{(g)} \rightleftharpoons CO_{2(g)} + H_{2(g)}$
D) $2NO_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$

Q.8 **The Kc Unit for the reaction $N_{2(g)}+3H_{2(g)} \rightarrow 2NH_{3(g)}$ are**

A) $mole^{-1}dm^{+6}$
B) $mole^{-2}dm^{+6}$
C) $mole^{-2}dm^{+3}$
D) $mole^{-1}dm^{+3}$

Q.9 **The value of equilibrium constant (K_c) for the reaction $2HF_{(g)} \rightleftharpoons H_{2(g)} + F_{2(g)}$ is 10^{-13} at 2000°C calculate the value of K_p for this reaction**

A) 2×10^{-13}
B) 10^{-13}
C) 186×10^{-13}
D) 3.48×10^{-9}

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Q.10 The chemical substance, when dissolved in water, gives "H⁺" is called:

A) Neutral
B) Acid
C) Base
D) Amphoteric

Q.11 According to Lowry – Bronsted acid & base concept, H_2O is

A) Base
B) An amphoteric species
C) A salt
D) An acid

Q.12 If Ka for an acid is higher , the stronger is the acid , relate the strength of acid with pKa

A) Higher pKa , weaker the acid
B) Lower pKa , stronger the acid
C) pKa has no relation with the strength of an acid
D) Both A and B

Q.13 The K_a values of HCl, CH_3COOH, HF and H_2SO_4 are 10^{+7}, 1.85×10^{-5}, 6.7×10^{-5} and 10^{+2} respectively. The decreasing order of acidic strength is:

A) $HCl > H_2SO_4 > HF > CH_3COOH$
B) $HCl > HF > H_2SO_4 > CH_3COOH$
C) $CH_3COOH > HF > H_2SO_4 > HCl$
D) $HCl > CH_3COOH > HF > H_2SO_4$

Q.14 What will be the pH of a solution of NaOH with a concentration of 10^{-3} M?

A) 3
B) 14
C) 11
D) 7

Q.15 Human blood maintains its pH between

A) 6.50 – 7.00
B) 7.20 – 7.25
C) 7.50 – 7.55
D) 7.35 – 7.40

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Q.16 Which one of the following bases has highest Kb value?

A) NH_4OH
B) $Ca(OH)_2$
C) NaOH
D) CH_3NH_2

Q.17 What is the pH of 0.1M of HCl?

A) 1
B) 0.01
C) 0.1
D) –1

Q.18 What is the correct relation between pH and pKa?

A) $pH = pKa + \log\left[\frac{Acid}{Base}\right]$
B) $pH = pKa - \log\left[\frac{Acid}{Base}\right]$
C) $pH = pKa - \log\left[\frac{Base}{Acid}\right]$
D) $pKa = pH + \log\left[\frac{Base}{Acid}\right]$

Q.19 The pH of 10^{-2} M aqueous solution of sodium hydroxide is

A) 12
B) 13
C) 14
D) 10

Q.20 The Pka values of CH_3COOH is 4.74, the pH of equimolar solution of acetic acid and sodium acetate is

A) 13.0
B) 4.79
C) 7.2
D) 4.74

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Q.21 The product of the concentrations of each ion in saturated solution of a sparingly soluble salt at 298K raised to the power of their relative concentrations is

A) Ksp
B) Ka
C) Kb
D) Kw

Q.22 Which one of the following is the correct representation for K_{sp}?

$$AgCl \rightleftharpoons Ag^{+} + Cl^{-}$$

A) $K_{sp} = \frac{[AgCl]}{[Ag^{+1}][Cl^{-1}]}$
B) $K_{sp} = [Ag^{+1}][Cl^{-1}]$
C) $K_{sp} = \frac{[Ag^{+1}][Cl^{-1}]}{[AgCl]}$
D) $K_{sp} = [AgCl]$

Q.23 Value of K_{sp} for $PbSO_4$ system at 25°C is equal to

A) 1.6×10^{-5} mol^2dm^{-6}
B) 1.6×10^{-6} $mol^2 dm^{-6}$
C) 1.6×10^{-8} mol^2dm^{-6}
D) 1.6×10^{-7} mol^2dm^{-6}

Q.24 $Ca(OH)_2$ is sparingly soluble having solubility value 6.5×10^{-6}. What will be its solubility

A) 2.75×10^{-2}
B) 2.75×10^{2}
C) 1.17×10^{-2}
D) 3.63×10^{3}

Q.25 Precipitation occurs when the product of ionic concentration is?

A) Greater than Ksp
B) Equal to Ksp
C) Less than Ksp
D) Equal to unity

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ANSWER KEY

1	A	11	D	21	A	31	A	41	C
2	C	12	C	22	D	32	B	42	B
3	C	13	A	23	C	33	C	43	B
4	C	14	A	24	B	34	B	44	C
5	C	15	C	25	C	35	A	45	C
6	D	16	A	26	D	36	B	46	B
7	C	17	B	27	C	37	D	47	D
8	D	18	C	28	C	38	D	48	C
9	C	19	C	29	C	39	C	49	D
10	D	20	D	30	D	40	B	50	B

PAST PAPER QUESTIONS

1	D	6	C	11	B	16	C	21	A
2	C	7	C	12	D	17	A	22	B
3	B	8	B	13	A	18	B	23	C
4	D	9	B	14	C	19	A	24	C
5	A	10	B	15	D	20	D	25	A

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EXPLANATORY NOTES

Q.1 At dynamic equilibrium

(i) Rate of forward reaction (R_f) = Rate of backward reaction (R_b)

(ii) Concentration of reactant and product becomes constants

It means at equilibrium, concentration of reactant and product does not change with time no matter how much long reaction proceed

Q.2 In dynamic equilibrium, both forward and reverse reaction takes place simultaneously and $R_f = R_b$

Q.3

$$\Delta n = n_p - n_R$$
$$= 10 - 9$$
$$\Delta n = +1$$

for unit of k_c

$$k_c = (\text{conc})^{\Delta n}$$

$$kc = (\text{conc})^{+1}$$

Q.4 $2HI \rightleftharpoons H_2 + I_2$

1	0	0
$1-\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$

According to statement HI was found to be 50% dissociated.

0.50– 0.25	0.25	0.25

$$Kc = \frac{[H_2][I_2]}{[HI]^2} = \frac{(0.25)(0.25)}{(0.50)^2}$$

$$\frac{1}{4} = 0.25$$

Q.5 If the Kc value is very high reaction is more favourable in forward direction.

Q.6

$$CH_3COOH + C_2H_5OH \rightleftharpoons CH_3COOC_2H_5 + H_2O$$

1	1	0	0
$1-\frac{2}{3}$	$1-\frac{2}{3}$	$\frac{2}{3}$	$\frac{2}{3}$
$\frac{1}{3}$	$\frac{1}{3}$	$\frac{2}{3}$	$\frac{2}{3}$

$$Kc = \frac{[CH_3COOC_2H_5][H_2O]}{[CH_3COOH][C_2H_5OH]}$$

$$Kc = \frac{\left(\frac{2}{3}\right)\left(\frac{2}{3}\right)}{\left(\frac{1}{3}\right)\left(\frac{1}{3}\right)} = 4$$

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Q.7

$$Kc = \frac{[SO_3]^2}{[SO_2]^2[O_2]} = \frac{(4)^2}{(2)^2(2)}$$

$$= \frac{16}{8} = 2$$

Q.8 Concentration of reactant and product becomes constants
It means at equilibrium, concentration of reactant and product does not change with time no matter how much long reaction proceed

Q.9

$$K_c = \frac{[\text{products}]}{[\text{reactants}]}$$

(i) If [Products]/[Reactants] < K_c then reaction will proceed in forward direction to attain equilibrium.

(ii) If [Products]/[Reactants] > K_c then reaction will move in reverse direction to attain equilibrium.

(iii) If [Products]/[Reactants] = K_c then it means reaction is already at equilibrium.

Q.10 If volume factor is in denominator of K_c expression, it means mole (volume) of product are more than mole (volume) of reactant. So, less pressure favours the forward reaction because according to Le-Chatelier principle increases in pressure move reaction in direction in which volume is less.

Q.11

$$K_c = \frac{K_f}{K_r}$$

Equilibrium constant (Kc) is ratio of K_f and K_r. its value is only changed by change in temperature. Change in temperature (ΔT) changes both equilibrium constant (K_c) as well as equilibrium state / position (Q_c)

Q.12 $K_p = K_c(RT)^{\Delta n}$, $K_p = K_x(RT/V)^{\Delta n}$, $K_p = K_n\left(\frac{P}{N}\right)^{\Delta n}$

Q.13

If $\Delta n = +Ve$ then $K_p > K_c$

If $\Delta n = -Ve$ then $K_p < K_c$

If $\Delta n = 0$ then $K_p = K_c$

and

$$\Delta n = n_p - n_R$$

for $PCl_5 \rightleftharpoons PCl_3 + Cl_2$

$$\Delta n = 2 - 1$$

$$\Delta n = 1$$

Because Δn is +Ve so $K_p > K_c$

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Q.14

$$K_c = \frac{[HI]^2}{[H_2][I_2]} = \frac{(24)^2}{(8)(3)}$$

$$= \frac{24 \times 24}{24} = 24$$

Q.15

$$\Delta n = n_P - n_R$$

$$= 1 - \frac{3}{2}$$

$$= -\frac{1}{2}$$

$$K_p = K_c(RT)^{\Delta n}$$

$$K_p = K_c(RT)^{-\frac{1}{2}}$$

$$K_p = \frac{K_c}{(RT)^{\frac{1}{2}}}$$

$$(RT)^{\frac{1}{2}} = \frac{K_c}{K_p}$$

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Q.16

$$A_{2(g)} + 4B_{2(g)} \rightleftharpoons 2AB_{4(g)} \quad \Delta H = -Ve$$

5mole 2mole

5 volume 2 volume

According to Le-Chatelier principle, for exothermic reaction

$$\text{Yield} \propto \frac{1}{\text{Temperature}}$$

And increase in pressure move reaction in direction in which volume in less. Because reactant have more volume than product so increase in pressure favours forward reaction

Q.17

According to Le-Chatelier principle, for exothermic reaction

$$\text{Yield} \propto \frac{1}{\text{Temperature}}$$

Q.18

Ice $\rightleftharpoons$ liquid water

According to Le-Chatelier principle, increase in pressure move reaction in direction in which volume is less. Ice has 9% more volume than liquid water. So, increase in pressure will convert ice(more volume) into liquid water (less volume). So, by increasing pressure ice starts to melt.

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Q.19 For exothermic reaction

$$\text{Yield} \propto \frac{1}{\text{Temperature}}$$

If temperature is increased then yield of product become less. It means reaction move in reverse direction

Q.20 The equilibrium mixture has 35% by volume of NH_3.

- Nearly 13% of all nitrogen fixation on earth is accomplished through Haber's process.
- About 80% of NH_3 is used for the production of fertilizers.

Q.21 Optimum conditions for the reasonable yield of ammonia:

(i) Temperature around 673K (400°C)

(ii) Pressure about 200-300atm.

(iii) Pieces of iron crystals embedded in fused mixture of MgO, Al_2O_3 and SiO_2.

Q.22 Conjugate base of very weak acid is very strong.
Ethanol is weaker acid and its conjugate base $C_2H_5O^-$ is stronger.
The species which left behind after removal of 1 proton from an acid is called conjugate base. So, A^- is conjugate base of acid HA.

Q.24 According to Lowry Bronsted concept an acid is proton donor.

$$H_2PO_4^{-1} + H_2O \rightleftharpoons HPO_4^{-2} + H_3O^+$$

$H_2PO_4^{-1}$ acts as an acid and H_2O acts as a base in above reaction.

Q.25 Acid strength is $\propto$ 1/pKa, Smaller the pKa value stronger will be the acid.

Q.26 According to Lowry Bronsted concept of acid and base $K_a \times K_b = K_w$.

Q.27 At 90°C, pure water has $[H^+] = 10^{-6}$ and $[OH^-] = 10^{-6}$ so, $K_w = 10^{-12}$

Q.28 By increasing the temperature ionization of water increases. Therefore, ionic product of water increases.

Q.29 pH of water decreases by increasing the temperature because ionization of water increases.

Q.30 $K_w = [H^+][OH^-]$
$= (10^{-7})(10^{-7}) = 10^{-14}$

Q.31 $$pH \propto \frac{1}{[H^+]} \propto [^-OH] \propto \frac{1}{pOH}$$

Q.32 pH = - log $[H^+]$, it can be written as given below

$$pH = \frac{1}{\log[H^+]} \qquad pH = \log\frac{1}{[H^+]}$$

Q.33

$$[H^+] = \sqrt{[HA] \times Ka}$$
$$[H^+] = \sqrt{0.1 \times 10^{-7}}$$
$$[H^+] = \sqrt{10^{-8}} = 10^{-4}$$
$$pH = -\log[H^+]$$
$$pH = -\log 10^{-4}$$
$$= 4\log 10$$
$$= 4(1) = 4$$

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Q.34

$$MOH \rightleftharpoons M^+ + OH^-$$

$$1M \longrightarrow 1M$$

$$10\%\ \text{dissociated} = \frac{10}{100} \times 1 = 10^{-1}$$

$pOH = \log [OH^-]$

$pOH = -\log 10^{-1} = 1 \log 10 = 1$

$pH + pOH = 14$

$pH = 14 - pOH$

$pH = 14 - 1 = 13$

Q.35 For monoprotic acid $[H^+] = 10^{-pH}$

$[H^+] = 10^{-3} = 0.001$

Q.36

$$H_2SO_4 \longrightarrow 2H^+ + SO_4^{2-}$$

$$1M \longrightarrow 2M$$

$$10^{-3}M \longrightarrow 2 \times 10^{-3}M$$

$$pH = -\log[H^+] = -\log 2 \times 10^{-3} = -\log 2 - \log 10^{-3}$$

$$= -0.3 + 3 \log 10 = -0.3 + 3(1) = 2.7$$

Q.37 Basic buffer is the mixture of weak base and salt of it with strong acid. NH_4OH is weak base and NH_4Cl is salt of strong acid (HCl).

Q.38 There is no role of solubility product in buffer action.

Q.39 NH_4OH is weak base and NH_4Cl is salt of strong acid (HCl). It is an example of basic buffer.

Q.40 If the pH of buffer is 7 then it is called neutral buffer which is ideal.

Q.41 $pKa = -\log K_a$

$pKa = -\log 10^{-8}$

$pKa = 8 \log 10$

$= 8(1) = 8$

$$pH = pKa + \log\left[\frac{\text{Salt}}{\text{Acid}}\right]$$

$$pH = 8 + \log \frac{1}{1}$$

$pH = 8 + 0 = 8$

If concentration of salt and acid is equal then buffer solution has pH = pKa.

Q.42 The Henderson equation can be written as given below:

$$pH = pKa + \log \frac{[salt]}{[acid]}$$

$$pH = pKa - \log \frac{[acid]}{[salt]}$$

$$Pka = pH - \log \frac{[salt]}{[acid]}$$

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Q.43 For acidic buffer pH will be less then pKa, if [salt] < [acid]
pH will be greater than pKa if [salt] > [acid]
pH will be equal to pKa if [salt] = [acid]

Q.44

$$NaCl \rightleftharpoons Na^{+} + Cl^{-}$$

$$HCl \rightleftharpoons H^{+} + Cl^{-}$$

Due to common ion effect solubility of NaCl decreases.

Q.45

$$2AgNO_3 + BaCl_2 \longrightarrow 2AgCl + Ba^{+2} + NO_3^{-}$$

If $AgNO_3$ is in excess then filterate contains Ba^{+2}, NO_3^{-} and Ag^{+}.

Q.46

$$KClO_3 \rightleftharpoons K^{+} + ClO_3^{-}$$

$$KCl \rightleftharpoons K^{+} + Cl^{-}$$

The solubility of less soluble salt $KClO_3$ in water is suppressed by addition of more soluble salt KCl by common ion effect.

Q.47 According to solubility product
i) If ionic product = K_{sp}, then solution is saturated
ii) If ionic product < K_{sp}, then solution is unsaturated
iii) If ionic product > K_{sp}, then solution is supersaturated

Q.48 The solubility product is applicable for sparingly soluble salt whose concentration is equal to or less than $0.01 moldm^{-3}$.

Q.49

$$AgCl \rightleftharpoons Ag^{+} + Cl^{-}$$

$$K_{sp} = [Ag^{+}][Cl^{-}]$$

$$(1\times10^{-5})\times(1\times10^{-5})$$

$$= 1\times10^{-10}$$

Q.50 For compound having two ions $K_{sp} = S^2$

$$2\times10^{-10} = S^2$$

$$\sqrt{2\times10^{-10}} = S$$

$$S = 1.41\times10^{-5}$$

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Topic 7 REACTION KINETICS

PRACTICE EXERCISE

RATE OF REACTION AND FACTORS AFFECTING RATE OF REACTION

Q.1 **Which one of the following is correct about following reaction if iron is not 100% pure**

$$2Fe + 3H_2O + O_2 \longrightarrow Fe_2O_3.3H_2O$$

A) Very fast reaction
B) Moderately reaction
C) Very slow reaction
D) Not predicted

Q.2 **Which of the following reactions are usually slow**

A) Neutralization of acids and bases
B) Organic substitution reaction
C) Explosive reaction of O_2 and H_2
D) Photochemical reactions

Q.3 **For a chemical reaction to occur**

A) The vessel shall be open
B) Reacting molecules should have less energy than Ea at time of collision
C) Reacting molecules must be properly oriented and energy more than or equal to Ea
D) The reacting molecules must not collide with each other

Q.4 **The increase in reaction rate as a result of increase in temperature from 10K to 100K is**

A) 512
B) 400
C) 614
D) 112

Q.5 **By increasing the concentration of reactants, the rate of reaction_____**

A) Decreases
B) Remains constant
C) Increases
D) Not predicted

Q.6 **Select the correct rate law from given data**

[A] moles dm^{-3}	[B] moles dm^{-3}	Rate of reaction (moles $dm^{-3} sec^{-1}$)
0.1	0.1	2×10^{-5}
0.2	0.1	4×10^{-5}
0.1	0.2	4×10^{-5}
0.2	0.2	8×10^{-5}

A) Rate = $k[A][B]$
B) Rate = $k[A]^0[B]^2$
C) Rate = $k[A]^2[B]$
D) Rate = $k[A][B]^2$

Q.7 **The rate of reaction involving ions can be studied by**

A) Spectrometric method
B) Optical rotation method
C) Dilatometric method
D) Electrical conductivity method

Q.8 **Which method for rate determination is useful for those reaction, which involve small volume change in solutions**

A) Refractometric method
B) Optical rotation method
C) Dilatometric method
D) Spectrometric method

Q.9 **Which method for rate determination is applicable to reactions in solutions, where there are changes in refractive indexes of the substance taking part in the chemical reaction**

A) Dilatometric method
B) Refractometric method
C) Optical rotation method
D) Spectrometric method

Q.10 **The angle through which plane polarized light is rotated by the reacting mixture is measured by _____**

A) Refractometric method
B) Dilatometric method
C) Spectrometric method
D) Optical rotation method

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SPECIFIC RATE CONSTANT (VELOCITY CONSTANT) AND UNITS OF RATE CONSTANT

Q.11 The specific rate constant of a chemical reaction is the rate of the reaction when the concentration of the reactant is

A) Less than unity
B) Greater than unity
C) Equal to unity
D) Equal to the concentration of 2nd order reaction

Q.12 The unit of rate constant of second order reaction is

A) $mol\ dm^{-3}\ sec^{-1}$
B) $mol^{-2}\ dm^{+6}$
C) sec^{-1}
D) $mole^{-1}\ dm^{+3}\ sec^{-1}$

ORDER OF REACTION AND ITS DETERMINATION

Q.13 The 2nd order reaction becomes 1st order when

A) One of the reactants is limiting
B) One of the reactants is in large excess
C) None of the reactants is in large excess
D) Both reactants in large excess

Q.14 The half-life time for a 1st order decomposition of a substance dissolved in CCl_4 is 2.5 hours at 30°C. The amount of substance left after 10 hours if the initial weight of the substance is 160g

A) 5g
B) 15g
C) 10g
D) 20g

Q.15 Hydrolysis of ethyl acetate into acetic acid and ethanol in the presence of mineral acid is

A) Fractional order reaction
B) 1st order reaction
C) Pseudo 1st order reaction
D) 2nd order reaction

Q.16 For a reaction $A + 2B \longrightarrow C$, rate is given by $Rate = k[A][B]$, hence the order of the reaction is

A) 3
B) 1
C) 2
D) 0

Q.17 For a chemical reaction $A \longrightarrow B$, the rate of reaction doubles when the concentration of A is increased four times. The order of reaction for A is

A) Zero
B) Two
C) One
D) Half

Q.18 In first order reaction, the concentration of the reactant is reduced to 25% in one hour. The half-life period of reaction is

A) 120 min
B) 30 min
C) 60 min
D) 15 min

Q.19 What will be order of reaction if doubling the concentration of reactant increases the rate by factor 4 and tripling the concentration of reactant by a factor of 9

A) 1
B) 3
C) 2
D) 0

Q.20 When the concentration of reactant in the reaction is increased by 8 times, the rate increased only by 2 times. The order of reaction is

A) 1
B) $\frac{1}{2}$
C) $\frac{1}{3}$
D) 2

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Q.21 **In the reaction A + B ⟶ Product**

The doubling of [A], increases the reaction rate four times but the doubling of [B] has no effect on rate. The rate expression is

A) Rate = K $[A]^2[B]^0$
B) Rate = K $[A]^2$ $[B]^2$
C) Rate = K [A]
D) Rate = K [A] [B]

Q.22 **The rate law of a reaction is, rate =k$[A]^2$[B]. On doubling the concentration of both A and B, the rate of reaction increases _____ time**

A) 4
B) 8
C) 9
D) 2

Q.23 **For the reaction A + B ⟶ C + D , doubling the concentration of both the reactants increases the reaction rate by 8 times and doubling the initial concentration of only B simply doubles the reaction rate. The rate law for the reaction is**

A) Rate = $k[A][B]^2$
B) R = $k[A]^{1/2}[B]^2$
C) Rate = $k[A][B]$
D) Rate = $k[A]^2[B]$

Q.24 **The rate of reaction 2X + Y ⟶ Products .**

Rate = $k[X]^2[Y]$ of X in large excess, the order of reaction is

A) 3^{rd}
B) 1^{st}
C) 2^{nd}
D) 0^{th}

Q.25 **For the 1^{st} order decomposition reaction $2N_2O_{5(g)} \rightarrow 2N_2O_{4(g)} + O_{2(g)}$ the half-life is given as**

A) 0.693/k
B) log2/k
C) 0.693/2k
D) ln2/k

Q.26 **The half-life period of zero order reaction is equal to**

A) $\frac{0.693}{K}$
B) $\frac{1}{Ka}$
C) $\frac{a}{2K}$
D) $\frac{1.5}{Ka^2}$

Q.27 **For which of the reaction, half-life is inversely proportional to the initial concentration of the reactants**

A) Zero order
B) 2^{nd} order
C) 1^{st} order
D) 3^{rd} order

Q.28 **If 'a' is the initial concentration of the reactant then half-life period of the reaction of n^{th} order is directly proportional to**

A) a^{n+1}
B) a^n
C) a^{1-n}
D) a^{n-1}

Q.29 **For the first order reaction, half-life is 14 sec. The time requires for the initial concentration to reduce to $\frac{1}{8}^{th}$ of its value is**

A) 28s
B) $(14)^2$ s
C) 42s
D) $(14)^3$ s

Q.30 **For the reaction $N_2O_5 \longrightarrow 2NO_2 + \frac{1}{2}O_2$, $t_{1/2} = 24$ min. Starting with 10g of N_2O_5 how many grams of N_2O_5 will remain after a period of 72 min**

A) 0.063g
B) 1.77g
C) 0.50g
D) 1.25g

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Q.31 The rate constant of reaction is 3×10^{-3} moldm^{-3}sec^{-1}. The order of reaction is
A) 1
B) 3
C) 2
D) 0

ACTIVATION ENERGY AND ITS RELATION WITH RATE OF REACTION

Q.32 Activation energy of a reaction
A) Includes the average kinetic energy of the reactants
B) Is in addition to the average K.E. of the reactants
C) Is in addition to the average K.E. of the products
D) Required for effective collisions

Q.33 E_a appears as a potential energy hill between _____ for carrying out the reaction
A) Among the reactants
B) Reactants and the products
C) Among the products
D) None of the above

Q.34 If E_f and E_r are activation energies of forward and reverse reaction. The reaction is known to be exothermic then
A) $E_f > E_r$
B) $E_f < E_r$
C) $E_f >>> E_r$
D) $E_f = E_r$

Q.35 For an endothermic reaction A $\longrightarrow$ B, an activation energy of forward reaction is 15 kcal mol^{-1} and enthalpy change of reaction is 5 kcal mol^{-1}. The activation energy for reverse reaction B $\longrightarrow$ A is
A) 10 kcal mol^{-1}
B) 15 kcal mol^{-1}
C) 20 kcal mol^{-1}
D) zero

Q.36 Which one is the assumption of collision theory of reaction rate
A) During a chemical reaction the particles must collide
B) Reaction between the colliding particles can only take place if upon collision they possess the activation energy
C) Only those collisions are effective which take place in proper orientation
D) All statements are correct

Q.37 The equation for the rate constant is $k = Ae^{-E_a/RT}$ A chemical reaction will proceed more rapidly if there is a decrease in
A) k
B) E_a
C) A
D) T

CATALYSIS, ENZYME AND THEIR ROLE AS BIOCATALYST

Q.38 Oxidation of $SO_{2(g)}$ in the presence of $NO_{(g)}$ catalyst is an example of
A) Homogeneous catalysis
B) Auto catalysis
C) Heterogeneous catalysis
D) Negative catalysis

Q.39 If the energy of the activated complex lies close to energy of reactants, it means that reaction is
A) Slow
B) Endothermic
C) Exothermic
D) Exothermic and fast

Q.40 The activation energy for a simple chemical reaction A $\longrightarrow$ B is E_a in forward direction. The activation energy for reverse reaction
A) Can be less than or more than E_a
B) Is negative of E_a
C) Is always double of E_a
D) Is always less than E_a

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Q.41 A catalyst can
A) Accelerate the reaction rate
B) Retard the reaction rate
C) Chemically un-consumed at the end of the reaction
D) All of the above

Q.42 Which of the following statements regarding a catalyst is not true
A) A catalyst does not alter the equilibrium in a reversible reaction
B) A catalyst can initiate the reaction which is not thermodynamically feasible
C) Catalytic reactions are very specific in nature
D) A catalyst remains unchanged in composition and quantity

Q.43 When potential energy of the transition state is very high, then which one of the following results is applicable?
A) Low activation energy and fast reaction
B) High activation energy and fast reaction
C) Low activation energy and slow reaction
D) High activation energy and slow reaction

Q.44 Which of the following best explains the effects of a catalyst on the rate of a reversible reaction?
A) It decreases the rate of the reverse reaction
B) It increases the kinetic energy of the reacting mole molecules
C) It moves the equilibrium position to the right
D) It provides a new reaction path with a lower activation energy

Q.45 The rate of catalyzed reaction is independent of the concentration of
A) Reactants
B) Products
C) Catalyst
D) None of these

Q.46 What is the correct relation between rate and activation energy
A) Rate $\propto$ Ea
B) Rate $\propto \frac{1}{Ea}$
C) Rate = Ea
D) All of them

Q.47 Oxidation of $SO_{2\,(g)}$ in the presence of $V_2O_{5(s)}$ is an example of
A) Homogeneous catalysis
B) Auto catalysis
C) Heterogeneous catalysis
D) Negative catalysis

Q.48 The complex protein molecules which catalyze the organic reactions in living cells are known as _____
A) Negative catalysts
B) Co-enzymes
C) Catalyst for catalysts
D) Enzyme catalysts

Q.49 Concentrated sugar solution under goes hydrolysis into glucose and fructose by an enzyme_____
A) Zymase
B) Maltase
C) Invertase
D) None of these

Q.50 Which of the followings is correct about enzyme catalysts
A) These are in pure crystalline state
B) The activity of enzyme catalyst is inhibited by poison
C) Enzyme Catalytic reaction have maximum rate at optimum temperature
D) All of these

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PAST PAPERS QUESTIONS

Q.1 **In some reactions a product formed acts as a catalyst. This phenomenon is called**
A) Negative catalysis
B) Activation of catalyst
C) Heterogeneous catalysis
D) Autocatalysis

Q.2 **The reaction rate in forward direction decreases with the passage of time because**
A) Concentration of reactants decreases
B) Concentration of product decreases
C) The order of reaction changes
D) Temperature of the system changes

Q.3 **For the reaction $2NO + O_2 \rightleftharpoons 2NO_2$, the rate equation for the forward reaction is**
A) Rate = k $[NO][O_2]$
B) Rate = k $[NO_2]^2[O_2]$
C) Rate = k $[NO_2]^2$
D) Rate = k $[NO_2]$

Q.4 **Choose the type of catalysis in the following reaction**

$$2SO_{2(g)} \xrightleftharpoons{NO_{(g)}} 2SO_{3(g)}$$

A) Homogeneous catalysis
B) Heterogeneous catalysis
C) Biological catalysis
D) Gas catalysis

Q.5 **What is the measure of activation energy is an endothermic reaction?**
A) The energy of activation of backward reaction is less than that of forward reaction.
B) The energy of activation of forward-backward reaction is same.
C) The energy of activation of backward reaction is more than that of forward reaction.
D) The energy of activation of forward reaction is less than that of backward reaction.

Q.6 **If energy of activated complex is close to energy of reactants, it means that the reaction is**
A) Fast
B) Slow
C) Moderate
D) Very slow

Q.7 **According to the collision theory of bimolecular reactions in gas phase , minimum amount of energy required for an effective collision is known as**
A) Heat of reaction
B) Has no effect on the reaction
C) Rate of reaction
D) Energy of activation

Q.8 **If the energy of activation of a chemical reaction is very low, the rate of that chemical reaction is observed to be very high because?**
A) Concentration of the reactants becomes irrelevant
B) Number of efficient or fruit collisions increase
C) Reaction proceeds without any transition state
D) Molecules of the reactants move slowly

Q.9 **The influence of temperature on reaction rate is predicted by**
A) Free energy charge
B) Arrhenius equation
C) Wander Waal's equation
D) Kinetic equation

Q.10 **For which change of temperature, the rate of reaction become approximately double**
A) 293K
B) 20°C
C) 283K
D) 10°C

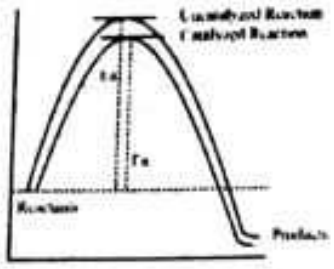
Q.11 **It is experimentally found that catalyst is used to**
A) Lower the activation energy
B) Increase the activation energy
C) Lower the pH
D) Decrease the temperature of other reactants

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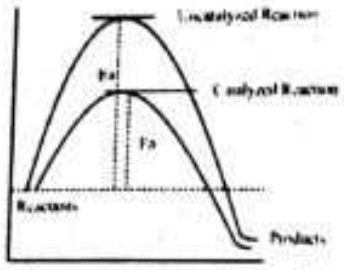
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Q.12 Which one of the following graphs is representation for more rapid catalyzed reaction?

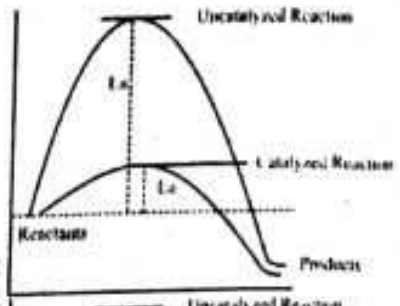
A)



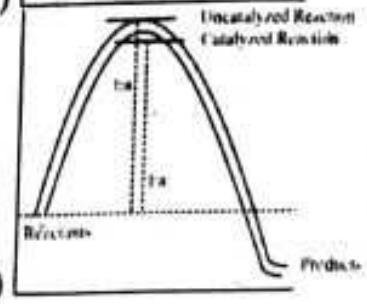
B)



C)



D)



Q.13 Role of a catalyst in a chemical reaction is to

A) Increase rate of a reaction
B) Decrease yield of a reaction
C) Decrease rate of a reaction
D) Increase yield of product

Q.14 Glucose is converted into ethanol by the enzyme present in the yeast

A) Urease
B) Invertase
C) Zymase
D) Sucrase

Q.15 In zero order reaction, the rate is independent of

A) Concentration of the product
B) Temperature of the reaction
C) Concentration of the reactant
D) Surface area of the product

Q.16 $2A + B \rightarrow$ Product

If the reactant 'B' is in excess, the order of reaction with respect to 'A' in given rate law Rate = $k[A]^2[B]$ is

A) 2nd order reaction
B) 1st order reaction
C) Pseudo 1st order reaction
D) 3rd order reaction

Q.17 The rate constant 'k' is 0.693 min^{-1}. The half-life for the 1st order reaction will be

A) 1 min
B) 2 min
C) 0.693 min
D) 4 min

Q.18 Unit of K in first order Reaction is

A) s^{-1}
B) moles dm^{-3} s^{-1}
C) moles dm^{-3}
D) mol^{-1} dm^3

Q.19 Rate of first order reaction depends on

A) Concentration of one reactant
B) Concentration of three reactants
C) Concentration of two reactants
D) Independence of the initial concentration

Q.20 The decomposition of phosphorus pentachloride in the presence of moisture takes place by the following mechanism

$$PCl_{5\,(s)} + H_2O_{(l)} \rightarrow POCl_{3\,(l)} + 2HCl_{(aq)} \quad \text{(Slow Step)}$$

$$POCl_{3\,(l)} + 3H_2O_{(l)} \rightarrow H_3PO_{4\,(l)} + 3HCl_{(aq)} \quad \text{(Fast Step)}$$

$$PCl_{5\,(s)} + 4H_2O_{(l)} \rightarrow H_3PO_{4\,(l)} + 5HCl_{(aq)}$$

The rate equation for this reaction will be:

A) $Rate = k[PCl_5][H_2O]^4$
B) $Rate = k[PCl_5][H_2O]$
C) $Rate = [PCl_5][H_2O]$
D) $Rate = k[POCl_3][H_2O]^3$

Q.21 The unit of rate constant is same as that of rate of reaction in

A) First order reaction
B) Second order reaction
C) Zero order reaction
D) Third order reaction

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Q.22 **Rates of photo-chemical reactions do not change with the change in concentration of reactants. What is the order of such reactions?**

A) Second order reactions
B) First order reactions
C) Pseudo first order reactions
D) Zero order reactions

Q.23 **The half-life of N_2O_5 at 45°C is 24 minutes. How long will it take for sample of N_2O_5 to decay to 25% of its original concentration?**

A) 24 minutes
C) 120 minutes
B) 72 minutes
D) 48 minutes

Q.24 **When the change in concentration is 6×10^{-4} moldm^{-3} and time for that change is 10 seconds, the rate of reaction will be**

A) 6×10^{-3} moldm^{-3} sec^{-1}
C) 6×10^{-2} moldm^{-3}sec^{-1}
B) 6×10^{-4} moldm^{-3} sec^{-1}
D) 6×10^{-5} moldm^{-3}sec^{-1}

Q.25 **For the first order reaction, half-life is related to the expression Kt1/2=0.693 Half-life is the**

A) Time taken for the concentration of the product to the increase to half of its original value.
B) Time taken for the concentration of the reactant, to fall to half of its products value.
C) Time taken for the concentration of the reactant to fall to half of its original value
D) Time taken for the concentration of the reactant to fall to quarter of its original value

Q.26 **The rate of reaction involving ions can be studied by method**

A) Dilatometric
C) Electrical conductivity
B) Refractrometric
D) Optical rotation

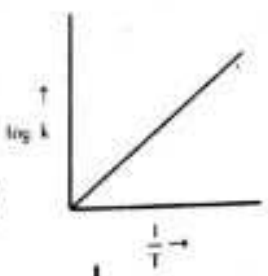
Q.27 **If the reactants or product of a chemical reaction can absorb ultraviolet, visible or infra-red radiation then the rate of a chemical reaction can best be measured by which one of the following methods?**

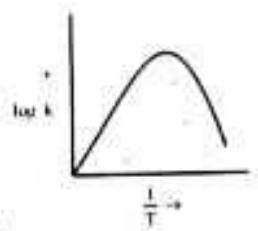
A) Chemical method
C) Graphical method
B) Spectrometry
D) Differential method

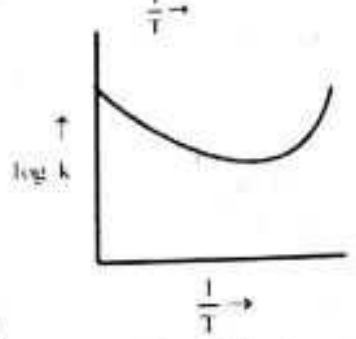
Q.28 **If concentration time graph of a reactant indicates a constant half-life, then the order reaction with respect the reactant is**

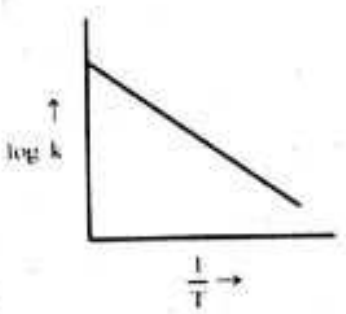
A) First order
C) Zero order
B) Second order
D) Half order

Q.29 **By considering Arrhenius equation, the graph between, '$\frac{1}{T}$' and 'log k' gives a curve of the type**

A)


C)


B)


D)


Q.30 **On increasing the temperature of the rection from 20°C to 30°C, the rate of rection will become**

A) Half
C) Triple
B) Double
D) Ten times

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ANSWER KEY

1	C	11	C	21	A	31	D	41	D
2	B	12	D	22	B	32	D	42	B
3	C	13	B	23	D	33	B	43	D
4	A	14	C	24	C	34	B	44	D
5	C	15	C	25	A	35	A	45	C
6	A	16	C	26	C	36	D	46	B
7	D	17	D	27	B	37	B	47	C
8	C	18	B	28	C	38	A	48	D
9	B	19	C	29	C	39	D	49	C
10	D	20	C	30	D	40	A	50	D

PAST PAPER QUESTIONS

1	D	6	A	11	A	16	A	21	C	26	C
2	A	7	D	12	C	17	A	22	D	27	B
3	B	8	B	13	A	18	A	23	D	28	A
4	A	9	B	14	C	19	A	24	D	29	D
5	A	10	D	15	C	20	B	25	C	30	B

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EXPLANATORY NOTES

Q.1 It is ruesting of iron so it is very slow process

Q.2 Orgnanic subsitution reactions involve covalent bond therefore these are slow reaction for example hydrolysis of ester.

Q.3 The amount of energy required for effective collisions is called activation energy.

Q.4 Temperature increases from 10 k to 100 k is 90 k which is 9 interval of 10 k

$$\text{Rate increases} = (2)^{\text{No of interval of 10k}}$$

$$\text{Rate increases} = (2)^{9} = 512$$

Q.5 By increasing the concentration of reactants, number of effective collisions increases so rate of reaction increases

Q.6 Rate is directly proportional to concentration of A and concentration of B so it is 2nd order reaciton

Q.7 The rate of reactions which involve ions is measured by the electrical conductivity method.

Q.8 This method is applicable for the measurement of rate of those reactions which involve small volume change in the solutions.

Q.9 The method is applicable to reactions in solutions where there are changes in refractive indices of the substances taking part in the chemical reactions.

Q.10 In this method, the angle through which plane polarized light is rotated by the reaction mixture is measured by a polarimeter.

Q.11 The rate of reaction when the concentrations of reactants are unity is called Specific rate constant or velocity constant.

Using equation (1):

$$\text{Rate of reaction} = k[A]^a[B]^b$$

Suppose $[A] = [B] = 1 \text{ moles/dm}^3$

$$\text{Rate of reaction} = k[1]^a[1]^b$$

$$\text{Rate of reaction} = k \qquad (\text{since, } [1]^a[1]^b = 1)$$

Q.12 For **second order** reaction, the units of rate constants k are given by:

Units of $k = (\text{concentration})^{1-n}(\text{time})^{-1}$

For second order $n = 2$

$$\text{Units of } k = (\text{mole/dm}^3)^{1-2}(\text{s})^{-1}$$

$$\text{Units of } k = (\text{mole/dm}^3)^{-1}\,\text{s}^{-1}$$

$$\text{Units of } k = \text{moles}^{-1}\,\text{dm}^3\,\text{s}^{-1}$$

$$\text{Units of } k = \text{dm}^3\,\text{moles}^{-1}\,\text{s}^{-1}$$

Q.13 The substance taken in small amount controls the rate and the order is noted with respect to that substance. The reason is that a small change in concentration of a substance taken in very small amount affects the value of rate more appreciably.

Q.14 $$\text{Number of half-life} = \frac{\text{Total time}}{\text{Half-life}}$$

$$\frac{10}{2.5} = 4$$

$$160g \rightarrow 80g \rightarrow 40g \rightarrow 20g \rightarrow 10g$$

After 4 half-life 10g left behind

Q.15 In hydrolysis of ester water is in large excess therefore it is pseudo 1st order reaciton

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Q.16 Rate = $k[A][B]$ the sum of the exponents of concentration terms in given rate law equation is two

Q.17

$$\text{Rate} = [A]^n$$

$$2 = [4]^n,\ 2 = 2^{2n},\ 1 = 2n,\ n = \frac{1}{2}$$

Q.18 After two half-life concentration of reactant is reduced to 25%.

$$\text{Half-life} = \frac{\text{Total time}}{\text{No. of half-life}}$$

$$t_{\frac{1}{2}} = \frac{60\text{min}}{2} = 30\,\text{min}$$

Q.19 For 2nd order reaction

$$\text{Rate} = k[A]^2$$

$$\text{Rate} = k[2]^2 = 4$$

$$\text{Rate} = k[3]^2 = 9$$

Q.20

$$\text{Rate} = [A]^n$$

$$2 = [8]^n,\ 2 = 2^{3n},\ 1 = 3n,\ n = \frac{1}{3}$$

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Q.21 Rate of reaciton is directly proportional to the square of concentration of A and is independent to concentration of B

Q.22

$$\text{Rate} = k[A]^2[B]$$

$$\text{Rate} = (2)^2(2),\ = 4\times 2 = 8$$

Q.23 It is overall 3rd order reaction. With respect to A, it is 2nd order reaction with respect to B is 1st order

Q.24 X is large excess, so rate of reaction is independent to the concentration of X and is directly proportional to the concentration of Y. It is 1st order reaciton with respect to Y.

Q.25 $\left[t_{\frac{1}{2}}\right]_I = \frac{0.693}{k}$

Q.26 For zero order reaction half-life period is directly proportional to the initial concentration of reactant

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Q.27

$$\left[t_{1/2}\right]_n \propto \frac{1}{a^{n-1}}$$

$$\left[t_{1/2}\right]_2 \propto \frac{1}{a^{2-1}}$$

$$\left[t_{1/2}\right]_2 \propto \frac{1}{a}$$

Q.28

$$\left[t_{1/2}\right]_n \propto \frac{1}{a^{n-1}}$$

$$\left[t_{1/2}\right]_n \propto a^{-(n-1)}$$

$$\left[t_{1/2}\right]_n \propto a^{1-n}$$

Q.29 After three half-life concentraiton of reactant is reduced to $\frac{1}{8}$th

Total time = half-life × Number of half-life

$= 14\text{sec} \times 3 = (14)^3\text{sec}$

Q.30 $\text{Number of Half-life} = \frac{\text{Total time}}{\text{Half-life}} = \frac{72}{24} = 3$

$10 \rightarrow 5 \rightarrow 2.5 \rightarrow 1.25$

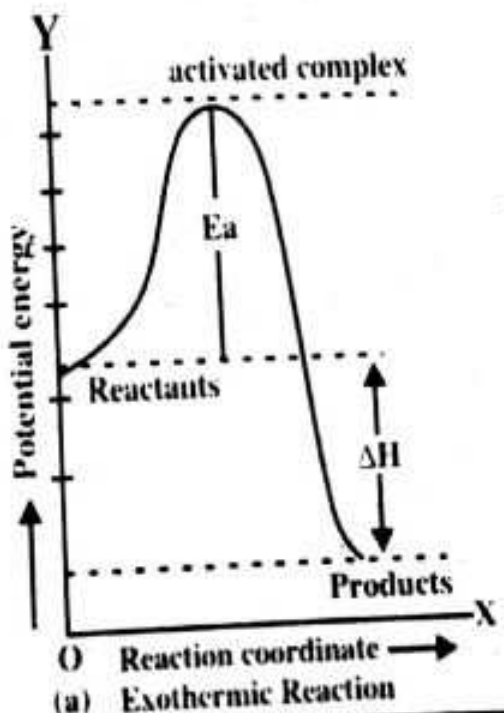
After three half-life 1.25g of N_2O_5 is left behind

Q.31 The unit of rate constant in given statement is $\text{moldm}^{-3}\text{sec}^{-1}$ which shows it is zero order reaction.

Q.32 The minimum amount of energy required by the colliding molecules for effective collision is called activation energy.

Q.33 Potential of activated complex is higher than that of reactant and product

Q.34



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Q.35 $Ea_r = Ea_f - \Delta H$

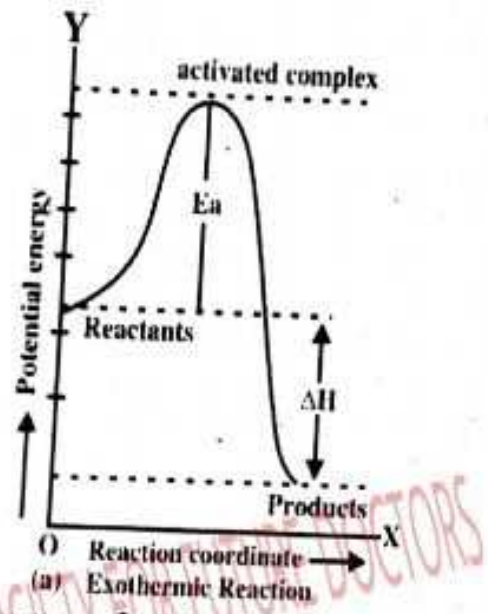
$= 15 - (+5) = 10$

Q.37 Rate of reaction is $\propto \frac{1}{E_a}$

Q.38 The catalysis in which the reactants and the catalyst are in same phase is called homogeneous catalysis.

$$2SO_{2(g)} + O_{2(g)} \overset{NO_{(g)}}{\rightleftharpoons} 2SO_{3(g)}$$

Q.39



(a) Exothermic Reaction

Q.40 (i) For exothermic reaction, energy of activation for forward reaction is less than the energy of activation for backward reaction.

(ii) For endothermic reaction, energy of activation for forward reaction is greater than the energy of activation for backward reaction.

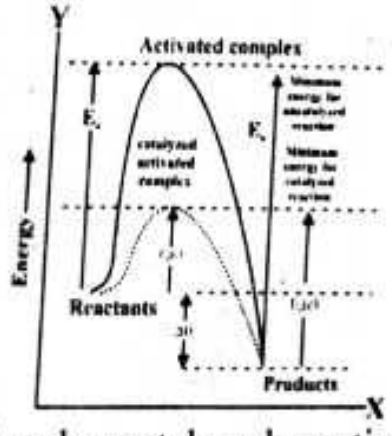
Q.41 A substance which alters the rate of chemical reaction but remains chemically unchanged at the end of the reaction is called a catalyst.

Q.42 A catalyst cannot start a reaction, which is not thermodynamically feasible. It is now considered that a catalyst can initiate a reaction.

Q.43 Ea $\propto$ P.E of activated complex

Rate of reaciton $\propto \frac{1}{E_a}$

Q.44



Catalyzed and uncatalyzed reaction

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Q.46 Rate of reaciton is inversly proportional to the activaiton energy. Lower the activaiton energy reaction will be fast.

Q.47 The catalysis in which reactants and the catalyst are in different phases is called heterogeneous catalysis.

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons^{V_2O_{5(s)}} 2SO_{3(g)}$$

Q.48 **(a) Negative catalyst:**

The substances which retard the rate of reaction are called negative catalysts or inhibitors.

(b) Co-Enzyme

The protein component of the enzyme is called apo-enzyme and the non-protein component is called the co-enzyme. The co-enzyme is also known as co-factor.

(c) Catalyst for catalyst:

A substance which promotes the activity of catalyst is called activator or promotor or catalyst for catalyst.

(d) Enzyme catalyst:

Enzymes are the complex protein molecules and catalyze the organic reactions in the living cells.

Q.49

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{Invertase}} \underset{\text{fructose}}{C_6H_{12}O_6} + \underset{\text{glucose}}{C_6H_{12}O_6}$$

Q.50 All are the correct characteristics of enzym catalysts

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Topic 8 THERMOCHEMISTRY AND ENERGETICS OF CHEMICAL REACTIONS

PRACTICE EXERCISE

SYSTEM, SURROUNDING, STATE FUNCTION AND DIFFERENT TERMS USED IN THERMODYNAMICS

Q.1 Calorie is equivalent to

A) 0.4184 J
B) 40.18 J
C) 4.184 J
D) 418.4 J

Q.2 Thermodynamics does NOT deal with

A) Heat of reaction
B) Rate of reaction
C) Spontaneity of reaction
D) Entropy of reaction

Q.3 Which of the following is not a state function

A) Thermal energy at constant pressure
B) Enthalpy
C) Internal energy
D) Work done

Q.4 If an endothermic reaction is allowed to take place very rapidly in air, the temperature of the surrounding air will

A) Remains constant
B) Decrease
C) Increase
D) Either increase or decrease

Q.5 The exothermic process is

A) Evaporation
B) Respiration
C) Sublimation
D) Boiling

Q.6 All of the following are exothermic process except

A) Freezing of water
B) Evaporation
C) Condensation
D) Combustion

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Q.7 A process, which take place on its own without any outside assistance, is termed as

A) Isothermal process
B) Non-spontaneous
C) Spontaneous
D) Adiabatic process

Q.8 The work done by expansion of gas against constant pressure is

A) $P\Delta V$
B) PV
C) $-P\Delta V$
D) ΔPV

Q.9 A state function which describes together the internal energy and product of pressure and volume is called

A) Enthalpy
B) Internal energy
C) Work
D) Kinetic energy

FIRST LAW OF THERMODYNAMICS AND ENTHALPY CHANGES

Q.10 The enthalpy of formation of a compound is:

A) Positive
B) Either positive or negative
C) Negative
D) None of the above

Q.11 Enthalpy is an expression for the

A) Heat content
B) Internal energy
C) Rate of reaction
D) Activation energy

Q.12 Which one of the following has standard enthalpy of formation is zero?

A) $Fe_{(g)}$
B) $Cu_{(s)}$
C) $C_{(l)}$
D) $Na_{(g)}$

Q.13 What is correct about heat of combustion:

A) It is positive in some cases while negative in other
B) It is applicable to gaseous substances only
C) It is always negative
D) It is always positive

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Q.14 **Which of the following statement is correct**
A) ΔH is positive for exothermic reaction
B) ΔH is negative for endothermic reactions
C) The heat of neutralization of strong acid with strong base is always the same
D) The enthalpy of fusion is negative

Q.15 **What is not correct about ΔH_f**
A) Its value gives an idea about the relative stability of reactants and the products
B) It is always negative
C) Value depends upon nature of bonds
D) Its value can be greater or less than zero

Q.16 **Which of the following has positive value of enthalpy**
A) Neutralization
B) Atomization
C) combustion
D) All of the above

Q.17 **$NaOH + HCl \rightarrow NaCl + H_2O$. Enthalpy change in the above reaction is called**
A) Enthalpy of reaction
B) Enthalpy of neutralization
C) Enthalpy of formation
D) Enthalpy of combustion

Q.18 **The heat of reaction depends upon**
A) Temperature of the reaction
B) Physical states of the reactants and the products
C) Both A) and B)
D) Path of the reaction and the temperature

Q.19 **Enthalpy of neutralization (ΔH_n°) per mole of H_2SO_4 / $Ba(OH)_2$ is**
A) $-57.4\ kJmol^{-1}$
B) $-114.8\ kJmol^{-1}$
C) $+57.4\ kJmol^{-1}$
D) $114.8 kJmol^{-1}$

Q.20 **Which of the following processes has always $\Delta H = -ve$**
A) Formation of compound
B) Dissolution of ionic compound
C) Combustion
D) Dilution of a solution

Q.21 **The enthalpy change for the reaction $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$ is called**
A) Enthalpy of formation
B) Enthalpy of reaction
C) Enthalpy of combustion
D) All of these

Q.22 **Heat absorbed or evolved during the chemical reaction at constant pressure is**
A) ΔH
B) ΔV
C) ΔE
D) $\Delta H + \Delta E$

Q.23 **The change in enthalpy of a system when one mole of the substance is completely burnt in excess of air or oxygen is called**
A) Heat of reaction
B) Heat of formation
C) Heat of atomization
D) Heat of combustion

Q.24 **Which of the following enthalpy change always have a negative value**
A) ΔH_f
B) ΔH_{sol}
C) ΔH_c
D) ΔH_{at}

Q.25 **Neutralization of acid – base is**
A) Spontaneous
B) Non spontaneous
C) Exothermic
D) Both A) and C)

Q.26 **ΔH° represent the enthalpy change at**
A) 0°C and 1 atm pressure
B) 25°C and 1 atm pressure
C) 0K and 1 atm pressure
D) 25°C and 2 atm pressure

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Q.27 The enthalpy changes ΔH of a process is given by the relation

A) $\Delta H = \Delta E + P\Delta V$
B) $\Delta E = \Delta H + \Delta P$
C) $\Delta H = \Delta E - \Delta nRT$
D) $\Delta E = \Delta H + P\Delta V$

Q.28 A system absorbs 100 kJ heat and performs 50 kJ work on the surroundings. The increase in internal energy of the system is

A) 50 kJ
B) 150 kJ
C) 100 kJ
D) 5000 kJ

Q.29 Which equation represents the atomization of iodine

A) $\frac{1}{2}I_{2(s)} \longrightarrow I_{(s)}$
B) $I_{2(l)} \longrightarrow 2I_{(g)}$
C) $I_{2(s)} \longrightarrow 2I_{(g)}$
D) $I_{2(g)} \longrightarrow 2I_{(g)}$

Q.30 The amount of heat which is involved during the completion of chemical reaction at 25°C and 1 atm pressure is called

A) Heat of neutralization
B) Heat of formation
C) Heat of combustion
D) Enthalpy of reaction

Q.31 The $\Delta H°f$ of a reaction is recorded at

A) 273 K
B) 298K
C) 373K
D) 473K

Q.32 Which of the following enthalpies is always negative

A) Enthalpy of solution
B) Enthalpy of combustion
C) Enthalpy of sublimation
D) Enthalpy of formation

Q.33 Which one of the following equation shows standard enthalpy of combustion?

A) $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)}$
B) $CH_{4(s)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)}$
C) $2CH_{4(g)} + 4O_{2(g)} \rightarrow 2CO_{2(g)} + 4H_2O_{(g)}$
D) $CH_{4(l)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)}$

Q.34 Enthalpy of a reaction can be measured by

A) Glass calorimeter
B) Barometer
C) Manometer
D) Thermometer

Q.35 How much heat is absorbed by 100 g of water when its temperature decreases from 25°C to 5°C? (heat capacity is 4.2 J/gK)

A) 84,000 J
B) 2000/4.2 J
C) – 2000/4.2 J
D) – 84,00 J

Q.36 Enthalpy of combustion of food, fuel and other compounds can be measured accurately by

A) Glass calorimeter
B) Thermometer
C) Bomb calorimeter
D) Manometer

Q.37 Which enthalpy of reaction can not be determined by glass calorimeter

A) Enthalpy of formation
B) Enthalpy of solution
C) Enthalpy of neutralization
D) Enthalpy of combustion

Q.38 Total heat energy (q) can be calculated in a bomb calorimeter by using following formula

A) m × s
B) s × ΔT
C) c × ΔT
D) c × s x ΔT

BORN-HABER CYCLE AND HESS'S LAW OF CONSTANT HEAT SUMMATION

).39 Which one of the following is applied to calculate lattice energy indirectly?

A) Born-Haber cycle
B) Le-Chatelier principle
C) Bohr theory
D) All of them

.40 In order to determine ΔH_{latt} of ionic compound which is correct relationship

A) $\Delta H_{latt} = \Delta H_f - \Delta H_x$
B) $\Delta H_{latt} = \Delta H_a + \Delta H_v$
C) $\Delta H_{latt} = \Delta H_f + \Delta H_x$
D) $\Delta H_{latt} = \Delta H_f - \Delta H_{sol}$

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Q.41 **Enthalpy of formation of one mole of ionic compound form gaseous ion under standard condition is called**
A) Dissociation energy
B) Lattice energy
C) Bond energy
D) All of these

Q.42 **Which equation shows lattice energy for ionic compound**
A) $Na_{(s)} + \frac{1}{2}Cl_{2(g)} \rightarrow NaCl_{(s)}$
B) $Na_{(s)} + Cl_{(g)} \rightarrow NaCl_{(s)}$
C) $Na^{+}_{(aq)} + Cl^{-}_{(aq)} \rightarrow NaCl_{(aq)}$
D) $Na^{+}_{(g)} + Cl^{-}_{(g)} \rightarrow NaCl_{(s)}$

Q.43 **With the increase in charge to size ratio of ions, the lattice energy**
A) Remains unaffected
B) Decreases
C) Increases
D) All of these are possible

Q.44 **Hess's law is analogous to**
A) Law of heat summation
B) Law of increasing entropy
C) Law of heat exchange
D) 1st law of thermodynamics

Q.45 **According to Hess's law, the enthalpy changes for a reaction**
A) Depends on path
B) The sum of ΔE and ΔH
C) Independent of the path
D) None of these

Q.46 **One of the best applications of Hess's law to calculate the lattice energy of ionic compound is**
A) Measurement of enthalpy change in a calorimeter
C) Studying of first law of thermodynamics
B) Born-Haber cycle
D) Measurement of a heat of formation of a compound

Q.47 **Which of the following enthalpies of formation cannot be measured directly?**
A) ΔH^{o}_{latt} for ionic compound
B) ΔH^{o}_{f} for B_2O_3
C) ΔH^{o}_{f} for $CO_{(g)}$
D) All of these

Q.48 **Born-Haber cycle is an application of**
A) Hess's law
B) 1st law of thermodynamics
C) Avogadro's law
D) 1st law of thermochemistry

Q.49 **The heat of combustion of ethane (C_2H_6) is –337.0 kcal at 25°C. The heat of the reaction when 3g of ethane is burnt completely is**
A) –3.37 kcal
B) –33.7 kcal
C) +3.37 kcal
D) 33.7 kcal

Q.50 **The standard enthalpy changes of formation of carbon dioxide and water are -394 KJmol^{-1} and -286kJ mol^{-1} respectively, if the standard enthalpy change of combustion of propyne, C_3H_4 is -1938 KJ mol^{-1}. What is its standard enthalpy change of formation?**
A) +1258 kJ mol^{-1}
B) -184 kJ mol^{-1}
C) +180 kJ mol^{-1}
D) -680 kJ mol^{-1}

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PAST PAPERS QUESTIONS

Q.1 **A spontaneous process is**

A) Unidirectional and irreversible
B) Irreversible and real
C) Unidirectional and real
D) All of above

Q.2 **ΔH will be given a negative sign in**

A) Exothermic reactions
B) Decomposition reactions
C) Dissociation reactions
D) Endothermic reactions

Q.3 **Reactants have high energy than products in**

A) Endothermic reactions
B) Photochemical reactions
C) Exothermic reactions
D) Non-spontaneous reactions

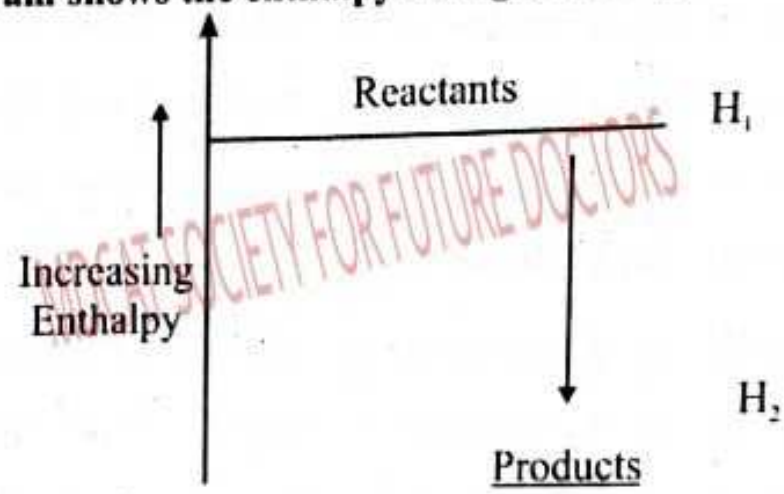
Q.4 **Reaction of water with quick lime result in the rise in the temperature of the system. Using the concentration change, indicate the nature of the reaction?**

A) Third order reaction
B) Non spontaneous reaction
C) Endothermic reaction
D) Exothermic reaction

Q.5 **Which of the following enthalpy change is always exothermic?**

A) Enthalpy of solution
B) Enthalpy of combustion
C) Enthalpy of formation
D) Enthalpy of atomization

Q.6 **The given diagram shows the enthalpy changes during a chemical reaction.**



This diagram represents:

A) An endothermic reaction
B) A non-spontaneous process
C) An exothermic reaction
D) An isothermic process

Q.7 **Heat of formation of MgO is given below. $Mg+1/2O_{2(g)} \rightarrow MgO_{(s)}$ $\Delta H = -692k\ jmol^{-1}$ This equation shows that:**

A) The product is very stable
C) The product is highly unstable
B) The reaction is endothermic
D) The reactants are very stable

Q.8 **When one mole of gaseous hydrogen ions are dissolved in water to form infinitely dilute solution, amount of heat liberated is**

A) -1075kJ/mol
B) -1891kJ/mol
C) -499kJ/mol
D) -1562kJ/mol

Q.9 **In standard enthalpy of atomization heat of surrounding**

A) Remains same
B) Decreases
C) Increases
D) Increases then decreases

Q.10 **Heat of formation ($\Delta H^\circ f$) for CO_2 is**

A) -390 kJ/mole
B) -394 kJ/mole
C) +394 kJ/mole
D) -294 kJ/mole

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Q.11 $2H_2 + O_2 \longrightarrow 2H_2O \quad \Delta H = 205.5\,kJmol^{-1}$ **what will be the enthalpy change in the above reaction**

A) 205.5 kJ mol^{-1}
B) Zero kJ mol^{-1}
C) – 205.5 kJ mol^{-1}
D) 1 kJ mol^{-1}

Q.12 **The equation that represents standard enthalpy of atomization of hydrogen is (2015)**

A) $\frac{1}{2}H_2O_{(l)} \longrightarrow H_{2(g)} + \frac{1}{2}O_{(g)} \quad +218kJmol^{-1}$

B) $\frac{1}{2}H_2O_{(l)} \longrightarrow H_{2(g)} + \frac{1}{2}O_{(g)} \quad -218kJmol^{-1}$

C) $\frac{1}{2}H_{2(g)} \longrightarrow H_{(g)} \quad +218kJmol^{-1}$

D) $\frac{1}{2}H_{2(g)} \longrightarrow H_{(g)} \quad -218kJmol^{-1}$

Q.13 $\frac{1}{2}H_{2(g)} \rightarrow H_{(g)} \; \Delta H = 218KJmol^{-1}$

In this reaction ΔH will be called

A) Enthalpy of atomization
B) Enthalpy of decomposition
C) Enthalpy of formation
D) Enthalpy of the dissociation

Q.14 $Mg + \frac{1}{2}O_2 \longrightarrow MgO_{(s)} + -692KJmol^{-1}$ **at STP.**

Enthalpy of the above reaction will be called:

A) $\Delta H^{\circ}_{...}$
B) $\Delta H^{\circ}_{...}$
C) $\Delta H^{\circ}_{...}$
D) ΔH°_{f}

Q.15 **Determinate the value of Enthalpy of formation of NH_4Cl:**

A) -788 kJmol^{-1}
B) -314.55 kJmol^{-1}
C) -692 kJmol^{-1}
D) None of these

Q.16 **Enthalpy is measured at _____**

A) 300 K and 2 atm
B) 300 K and 1 atm
C) 298 K and 1 atm
D) 295 K and 1 atm

Q.17 **Which enthalpy change is relevant in the following process?**

$Na_{(s)} \rightarrow Na_{(g)} \qquad \Delta H = +$

A) Enthalpy of fusion
B) Enthalpy of atomization
C) Enthalpy of vaporization
D) Enthalpy of formation

Q.18 **When two moles of H_2 and one mole of O_2 react to form H_2O 484KJ heat is evolved what is ΔHf for one mole of H_2O**

A) –484KJmol^{-1}
B) –121KJmol^{-1}
C) –242KJmol^{-1}
D) +242KJmol^{-1}

Q.19 **For a given reaction** $CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$ **the change in enthalpy under standard conditions is called?**

A) Standard enthalpy change of solution
B) Standard enthalpy of neutralization
C) Standard enthalpy change of hydration
D)Standard enthalpy change of formation

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Q.20 **50.0 cm^3 of 1.0 mol dm^{-3} hydrochloric acid reacts with 50.0 cm^3 of 1.0 mol dm^{-3} sodium hydroxide. The temperature rises to 6.5°C. Calculate the enthalpy of neutralization. Specific heat capacity of water is 4.18 Jg^{-1} °C^{-1}**

A) $-54.0 KJmol^{-1}$
C) $+54.0 KJmol^{-1}$
B) $+58.8 KJmol^{-1}$
D) $-58.8 KJmol^{-1}$

Q.21 **Which of the equations shows the same "twice" the enthalpy change of neutralization as the following equatio**

$$HCl + NaOH \rightarrow NaCl + H_2O$$

A) $H_2SO_4 + Mg(OH)_2 \rightarrow MgSO_4 + 2H_2O$
B) $MgCO_3 + 2HCl \rightarrow MgCl_2 + CO_2 + H_2O$
C) $NH_4Cl + NaOH \rightarrow NaCl + H_2O + NH_3$
D) $KOH + HCl \rightarrow KCl + H_2O$

Q.22 **Lattice energy of an ionic crystal is the enthalpy of:**

A) Combustion
C) Dissociation
B) Dissolution
D) Formation

Q.23 **Combustion of graphite to form CO_2, can be done by two ways. Reactions are given as follow**

$C + O_2 \longrightarrow CO_2$ $\quad \Delta H = -393.7 kJmol^{-1}$
$C + \frac{1}{2}O_2 \longrightarrow CO$ $\quad \Delta H_1 = ?$
$CO + \frac{1}{2}O_2 \longrightarrow CO_2$ $\quad \Delta H_2 = -283 kJmol^{-1}$

A) – 676 kJ mol^{-1}
C) + 110 kJ mol^{-1}
B) – 110 kJ mol^{-1}
D) 676 kJ mol^{-1}

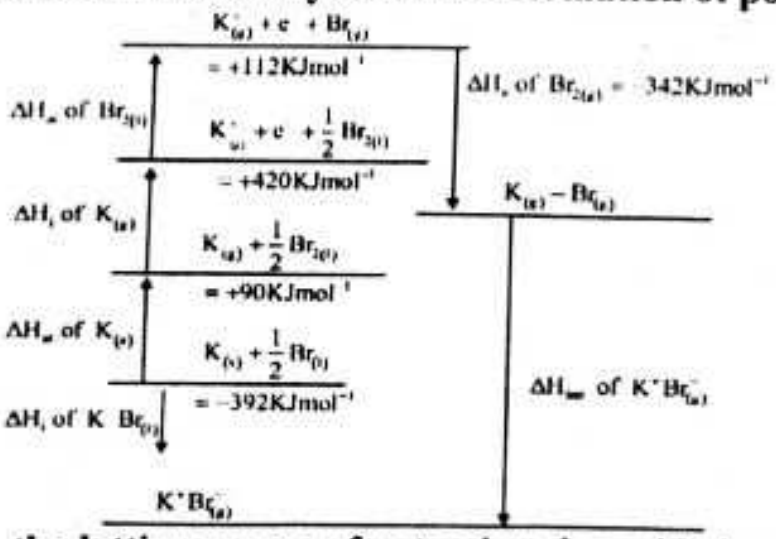
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Q.24 **Calculate the lattice energy of sodium chloride on the basis of Born-Haber cycle when**

$\Delta H_f[NaCl] = -411 KJmol^{-1}$, $\Delta H_{at}[Na] = +107 KJmol^{-1}$, $\Delta H_{at}[Cl] = +122 KJmol^{-1}$,
$\Delta H_{ii}[Na] = +496 KJmol^{-1}$, $\Delta H_{ea}[NaCl] = -349 KJmol^{-1}$

A) 376 kJ/mole
C) -376 kJ/mole
B) +787 kJ/mole
D) -787 kJ/mole

Q.25 **The given diagram is a Born-Haber cycle for the formation of potassium bromide.**



Using the given data, the lattice energy of potassium bromide is calculated to be

A) –672kJ mol^{-1}
C) –672KCal mol^{-1}
B) –787 kJ mol^{-1}
D) +672 J mol^{-1}

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ANSWER KEY

1	C	11	A	21	D	31	B	41	B
2	B	12	B	22	A	32	B	42	D
3	D	13	C	23	D	33	B	43	C
4	B	14	C	24	C	34	A	44	D
5	B	15	B	25	D	35	D	45	C
6	B	16	B	26	B	36	C	46	C
7	C	17	B	27	A	37	D	47	D
8	C	18	C	28	A	38	C	48	A
9	A	19	A	29	C	39	A	49	B
10	B	20	C	30	D	40	A	50	B

PAST PAPER QUESTIONS

1	D	6	C	11	C	16	C	21	A
2	A	7	A	12	C	17	B	22	D
3	C	8	A	13	A	18	C	23	B
4	D	9	B	14	D	19	B	24	D
5	B	10	B	15	C	20	A	25	A

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EXPLANATORY NOTES

Q.1 1 Cal = 4.184J

Q.2 Thermodynamics is study of heat change during a reaction not rate of reaction.

Q.3 As work done is not property of system so not a state function.

Q.4 Endothermic reaction absorb heat. Heat is taken from surrounding. So, temperature of surrounding air decreases.

Q.5 Respiration involve exothermic process.

Q.6 In evaporation molecule absorb energy and leave the surface of liquid.

Q.7 A process which take place on its own without any outside assistance, is known as spontaneous process.

Q.8 Work done by the system is considered negative.

Q.9 $H = E + PV$

Q.10 Enthalpy of formation may be negative or positive.

$$Mg_{(s)} + \frac{1}{2}O_2 \longrightarrow MgO_{(s)} \qquad \Delta H°f = -692kJ/mol$$

$$\frac{1}{2}N_{2(g)} + O_{2(g)} \longrightarrow NO_{2(g)} \qquad \Delta H°f = 33.18kJ/mol$$

Q.11 Heat content of the system is called enthalpy.

Q.12 Standard enthalpy of an element in its standerd state is zero.

Q.13 The standard enthalpy of a combustion is the amount of heat evolved when one mole of substance is completely burnt in excess of oxygen under standard conditions. It is denoted by (ΔH_c°).

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$$C_{(s)} + \frac{1}{2}O_2 \longrightarrow CO_{2(g)} \qquad \Delta H°C = -393.7kJ/mol$$

Q.14 Enthalpy of neutralization is merely the heat of formation of liquid water from its ionic components.

$$H^+_{(aq)} + Cl^-_{(aq)} + Na^+_{(aq)} + OH^-_{(aq)} \rightleftharpoons Na^+_{(aq)} + Cl^-_{(aq)} + H_2O_{(l)}$$

The main reaction that takes place during neutralization is

$$H^+_{(aq)} + OH^-_{(aq)} \rightleftharpoons H_2O_{(l)} \qquad \Delta H_n = -57.4\ kJ.mol^{-1}$$

Enthalpy of neutralization of any strong acid and strong base is approximately the same i.e -57 .4 kJ mol^{-1}.

Q.15 The standard enthalpy of formation of a compound is the amount of heat absorbed or evolved when one mole of compound is formed from its elements under standard conditions.

Q.16 Enthalpy of neutrilization and enthalpy of combustion are always negative, while enthalp of atomization is always positive

Q.17 The standard enthalpy of neutralization is the amount of heat evolved when one mole of H^+ ions from an acid react with one mole of OH^- ions from a base to form one mole of water under standard conditions i.e. 298K and one atmosphere pressure.

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Q.18 Heat of reaciton depends upon
(i) Temperature of reaction
(ii) Physical states of reactants and products

Q.19

$$H_2SO_4 + Ba(OH)_2 \longrightarrow BaSO_4 + 2H_2O$$
$$2H^+ + 2OH^- \longrightarrow 2H_2O \qquad q_n = -114.8kJ$$
$$1H^+ + 1OH^- \longrightarrow 1H_2O \qquad \Delta H°n = -57.4kJ/mol$$

Q.20 Enthalpy of combustion is always negative. While enthalpy of solution may be negative or positive.

Q.21

i) When carbon reacts with oxygen to form CO_2, 393.7 $kJmol^{-1}$ of energy is released. This is called enthalpy of formation of CO_2. It is also called enthalpy of combustion of C as well as enthalpy of reaction.

$$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)} \qquad \Delta H_f^\circ = -393.7\ kJ.mol^{-1}$$

Q.22 Heat absorb or evolved during the chemical reaciton at constant pressure is known as enthalpy of reation. It is represnted by ΔH.

Q.23 The change in enthalpy of a system when one mole of the substance is completely burnt in excess of air or oxygen is called enthalpy of combustion.

$$C_2H_5OH_{(l)} + 3O_{2(g)} \longrightarrow 2CO_{2(g)} + 3H_2O_{(l)} \qquad \Delta H_c^\circ = -1368\ kJ.mol^{-1}$$

Q.24 ΔH_f = may be +ve or -ve
ΔH_{sol} = may be +ve or -ve
ΔH_c = always -ve
ΔH_{at} = always +ve

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Q.25 Enthalpy of neutrilizaiton is a spontaneous process as well as exothermic.

$$H^+_{(aq)} + Cl^-_{(aq)} + Na^{+1}_{(aq)} + OH^-_{(aq)} \rightleftharpoons Na^+_{(aq)} + Cl^-_{(aq)} + H_2O_{(l)}$$

The main reaction that takes place during neutralization is

$$H^+_{(aq)} + OH^-_{(aq)} \rightleftharpoons H_2O_{(l)} \qquad \Delta H_n = -57.4\ kJ.mol^{-1}$$

Q.26 Standard conditions for enthalpy measurement are given below
Temperature = 25°C (298k), Pressure = 1atm

Q.27 The enthalpy changes of a process is given by following relation
$\Delta H = \Delta E + P\Delta V$

Q.28

$\Delta E = q - w$
$= 100 - 50$ Work done on the surrounding by system is negative.
$= 50kJ$

Q.29 The standard enthalpy of atomization of an element is the amount of heat absorbed when one mole of gaseous atoms are formed from the element under standard conditions i.e. 298K and one atmosphere pressure.

Examples:
The standard enthalpy of atomization of hydrogen is given below

(i) $\frac{1}{2} H_{2(g)} \longrightarrow H_{(g)} \qquad \Delta H_{at}^\circ = +218kJmol^{-1}$

(ii) $I_{2(s)} \longrightarrow 2I_{(g)} \qquad \Delta H_{at} = +ve$

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Q.30 The amount of heat which is involved during the completion of chemical reaction at 25°C And 1atm pressure is called enthalpy of reaction.

Q.31 Standard conditions for enthalpy measurement are given below
Temperature = 25°C (298k), Pressure = 1atm

Q.32 (i) Enthalpy of solution and enthalpy of formation may be +ve or -ve.
(ii) Enthalpy of sublimation is always +ve while enthalpy of combustion is always -ve.

Q.33 1 mol of substance burnt in excess of oxygen enthalpy change is called enthalpy of combustion.

Q.34 Enthalpy of reaction can be measured by glass calorimeter or bomb calorimeter.

Q.35

$$q = m \times s \times \Delta T$$
$$= 100 \times 4.2 \times 20$$
$$= 8400$$
$$= -8400J$$

As heat released during reaction is absorbed by H_2O.

Q.36 Enthalpyof combuistion of food, fuel and other compounds can be accurately measured by bomb calorimeter

$$q = c \times \Delta T$$

Q.37 Enthalpy of formation, enthalpy of neutrilization and enthalpy of solution can be determind by glass calorimeter. Enthalpy of combustion can be determind by bomb calorimeter.

Q.38 $q = c \times \Delta T$
where
c = heat capacity
ΔT = change in temperature

Q.39 Born-Haber cycle is applied to calculate lattice energy indirectly.

Q.40 Lattice energy of ionic compound can be calculated by following formula
$\Delta H_{latt} = \Delta H_f - \Delta H_x$

Q.41 The amount of heat which is released when one mole of ionic compound is formed from gaseous ions under standard conditions is called lattice energy.
$Na^+_{(g)} + Cl^-_{(g)} \rightarrow NaCl_{(s)}$ $\Delta H_{latt} = -787kJ/mol$

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Q.43 Smaller the size of ion → High charge density
Greater the charge on the ion
Higher the charge density ⟶ Higher the lattice energy

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Q.44 If a chemical change takes place by several different routes, the overall energy change is the same, regardless of the route by which the chemical change occurs, provided the initial and final conditions are the same.

$$\Delta H = \Delta H_1 + \Delta H_2$$

OR

The sum of enthalpy changes in closed cycle is zero.

$\sum \Delta H(\text{cycle}) = 0$

Q.45 If a chemical change takes place by several different routes, the overall energy change is the same, regardless of the route by which the chemical change occurs, provided the initial and final conditions are the same.

Q.46 Born-Haber cycle is best application of Hess's law to calculate the lattic energy of ionic Compound

$\Delta H_{latt} = \Delta H_f - \Delta H_x$

Q.47 (i) Heat of formation of **Al_2O_3 and B_2O_3** cannot be measured directly. It is difficult to burn these substances completely in oxygen, as protective layer of their oxides is formed on the surface. So, for the determination of heat of formation of Al_2O_3 and B_2O_3 Hess's law is used.

(ii) Heat of formation of CO cannot be measured directly due to the formation of CO_2 with it.

Q.48 Born-Haber cycle is best application of Hess's law to calculate the lattic energy of ionic Compound

$\Delta H_{latt} = \Delta H_f - \Delta H_x$

Q.49 $C_2H_6 + \frac{1}{2}O_2 \longrightarrow 2CO_2 + 3H_2O \Rightarrow \Delta H = -337\text{kcal}$

30g of C_2H_6 produces heat $\Rightarrow$ –337kcal

3g of C_2H_6 produces heat $\Rightarrow$ –33.7kcal

Q.50 $C + O_2 \longrightarrow O_2$ $\Delta H = -394$ _____ (i)

$H_2 + \frac{1}{2}O_2 \longrightarrow H_2O$ $\Delta H = -286$ _____ (ii)

$C_3H_4 + 4O_2 \longrightarrow 3CO_2 + 2H_2O$ $\Delta H = -1938$ _____ (iii)

Required $3C + 2H_2 \longrightarrow C_3H_4$ $\Delta H = ?$

Multiply equation (i) with (iii), equation (ii) with (ii)

Reverse equation (iii) and adding them

$3C + 3O_2 \longrightarrow 3CO_2$ $\Delta H = -1182$

$2H_2 + O_2 \longrightarrow 2H_2O$ $\Delta H = -572$

$3CO_2 + 2H_2O \longrightarrow C_3H_4 + 4O_2$ $\Delta H = +1938$

$3C + 2H_2 \longrightarrow C_3H_4$ $\Delta H = -184$

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Topic 9 ELECTROCHEMISTRY

PRACTICE EXERCISE

OXIDATION NUMBER OR STATE

Q.1 The oxidation state of carbon-atom in glucose is

A) +4
B) +6
C) -4
D) None of these

Q.2 In which of the following substance does sulphur exhibit its highest oxidation state

A) S_8
B) SO_2Cl_2
C) SO_2
D) $Na_2S_2O_3$

Q.3 What is the oxidation state of oxygen is KO_2

A) $-\frac{1}{2}$
B) -1
C) -2
D) -3

Q.4 Apparent charge on an atom of an element in a molecule or ion is called oxidation number. It may be

A) Positive
B) Negative
C) Zero or fraction
D) All of these

Q.5 Apparent charge on atom in molecule is

A) Valency
B) Oxidation number
C) Coordination number
D) Charge number

Q.6 The oxidation number of oxygen atom in OF_2 and H_2O_2

A) $-2, -1$
B) $-1, +2$
C) $+2, -1$
D) $+2, +1$

BALANCING OF EQUATION BY REDOX AND BY ION ELECTRON METHOD

Q.7 The element on the reactant side which has been reduced is

$$HI + H_2SO_4 \rightarrow I_2 + SO_2 + H_2O$$

A) H
B) S
C) I
D) O

Q.8 A redox reaction is

$$MnO_{2(s)} + 4H^+ \longrightarrow Mn^{+2}_{(aq)} + 2H_2O$$

A) $2e^-$ are added on LHS
B) $4e^-$ are added on LHS
C) $2e^-$ are added on RHS
D) $4e^-$ are added on RHS

Q.9 In which of the following changes there is a transfer of the five electrons

A) $MnO_4^{2-} \rightarrow MnO_2$
B) $MnO_4^{1-} \rightarrow Mn^{+2}$
C) $CrO_4^{2-} \rightarrow Cr^{+3}$
D) $Cr_2O_7^{-2} \rightarrow 2Cr^{+2}$

Q.10 In the reaction $H_2S + Cl_2 \rightarrow 2HCl + S$, H_2S acts as

A) Reducing agent
B) Oxidizing agent
C) Nitrating agent
D) Sulphonating agent

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Q.11 $8H^+ + MnO_4^- \longrightarrow Mn^{2+} + 4H_2O$, **which one is correct about given equation**

A) $5e^-$ in R.H.S
B) $3e^-$ in R.H.S
C) $5e^-$ in L.H.S
D) $3e^-$ in L.H.S

Q.12 Which of the following reactions occur at cathode

A) $Cu^{2+} + 2e^- \rightarrow Cu$
B) $Hg + \frac{1}{2}O_2 \rightarrow HgO$
C) $Cu + 2e^- \rightarrow Cu^{2+}$
D) $Mg + \frac{1}{2}O_2 \rightarrow MgO$

Q.13 In which of the following changes there is a transfer of two electrons

A) $MnO_4^{2-} \longrightarrow MnO_2$
B) $CrO_4^{2-} \longrightarrow Cr^{+3}$
C) $MnO_4^- \longrightarrow Mn^{+2}$
D) $Cr_2O_7^{2-} \longrightarrow 2Cr^{+3}$

EXPLANATION OF ELECTROLYSIS (PREDICT THE PRODUCT)

Q.14 The reaction taking place at anode and cathode are respectively

A) Oxidation and reduction
B) Reduction and oxidation
C) Reduction and hydrolys
D) Oxidation and hydrolysis

Q.15 The electrolysis product of molten NaCl at electrodes

A) Na and Cl_2
B) Na and NaOH
C) H_2 and Cl_2
D) H_2, Cl_2 and NaOH

Q.16 During the electrolysis of aqueous KNO_3, H_2 is produced at cathode instead of potassium due to

A) Reduction potential of "K" is greater than hydrogen
B) Hydrogen is more reactive than potassium
C) Reduction potential of potassium is less than hydrogen
D) All of the above are possible reasons

Q.17 The cathodic reaction in the electrolysis of dil H_2SO_4 with Pt electrodes

A) reduction
B) Oxidation
C) Both oxidation and reduction
D) Neither oxidation nor reduction

Q.18 The product produced at the cathode when aqueous sodium chloride is electrolyzed

A) H_2
B) O_2
C) Cl_2
D) Na

Q.19 For the purification of copper, impure copper is made the_____:

A) Cathode
B) Anode
C) Solution
D) Both A & B

STANDARD ELECTORDE POTENTIAL AND SHE

Q.20 Cell potential depends upon

A) Temperature
B) Nature of electrolyte
C) Concentration of ions
D) All of these

Q.21 When an element is in contact with 1M aqueous solution of its own ions, at 298K then potential is called?

A) Standard reduction potential
B) Reduction potential
C) Standard electrode potential
D) Both "A" and "C"

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Q.22 The electric current obtained from galvanic cell is a result of electrons being pushed forced from the negative electrode, through an external wire, to positive electrode. The force with which these electrons move through the wire is called

A) Electromotive force
B) Cell potential
C) Electrode potential
D) Both A) and B)

Q.23 Which is incorrect about standard electrode potential

A) It is the difference of potential of a cell, consisting of particular electrode and the SHE
B) The potential set up, when an electrode is in contact with one molar solution of its ions at standard conditions
C) The electrode potential of a single electrode can be measured directly
D) Both A and B

Q.24 Which is not true about SHE

A) Finely divided platinum black is used as electrode
B) Temperature is kept 25°C
C) One molar solution of H_2SO_4 is used as electrolyte
D) Electrode potential of any element can be calculated by comparison method

Q.25 The oxidation reaction that takes place in the SHE is

A) $H_{2(gas)} \longrightarrow 2H^+_{(aq)} + 2e^-$
B) $2H^+_{(aq)} + 2e^- \longrightarrow H_{2(gas)}$
C) $2H_2O_{(l)} \longrightarrow 2H_{2(g)} + O_{2(g)}$
D) $2H_2O_{(l)} + 2e^- \longrightarrow OH^-_{(aq)} + H_{2(g)}$

Q.26 The working condition/s for SHE

A) 1atm pressure
B) 298K temperature
C) 1M H^+ solution
D) All of these

Q.27 The potential of SHE is taken as zero which is a _____ value

A) Reference
B) Exact
C) Arbitrary
D) Experimental

Q.28 The electrochemical series is based on

A) pH scale
B) Hydrogen scale
C) Redox scale
D) Arrhenius scale

Q.29 SHE acts as anode when connected with Cu electrode but cathode with Zn electrode because

A) Zn has less reduction potential than hydrogen and Cu more
B) Zn has high oxidizing potential than hydrogen and Cu more
C) Zn is above in electrochemical series than hydrogen and Cu below
D) All the above are possible reasons

Q.30 If a salt bridge is removed from two half cells

A) Reaction will stop
B) EMF drop to zero
C) EMF is decreased
D) Electrodes will be reversed

Q.31 The cathode has the reduction potential

A) Less than anode
B) More than anode
C) The same as anode
D) Always zero

Q.32 $Al / Al^{+3} \parallel Zn^{+2} / Zn$ galvanic cell, the anode is

A) Al
B) H_2
C) Zn
D) KCl

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ELECTROCHEMICAL SERIES AND ITS APPLICATIONS

Q.33 Electrochemical series is useful in:

A) Prediction of the feasibility of a chemical reaction
B) Calculation of voltage
C) Comparison of the relative tendencies of the metals and non-metals to get oxidized or reduced
D) All of the above

Q.34 Four metals A, B, C and D are having standard electrode potentials as -3.0< -1.66, -0.4 and 0.8 V respectively. Which one will be the best reducing agent:

A) A
B) C
C) B
D) D

Q.35 The oxidation potential of Mg and Al are +2.37V and 1.66V, respectively. The Mg in chemical reaction:

A) Will be replaced by Al
B) Would not be able to replace Al
C) Will replace Al
D) None of the above

Q.36 The ability of elements to act as reducing agent ____ down to electrochemical series

A) Increases
B) Remains constant
C) Decreases
D) Depends upon the reaction conditions

Q.37 Halogens are placed at lower level of electrochemical series, this indicates that

A) Halogens are good reducing agents
B) Halogens are good oxidizing agents but bad reducing agents
C) Halogens are good oxidizing agents as well as good reducing agents
D) All the above statements are correct

Q.38 Li has least reduction potential in electrochemical series. Which element has highest E°_{red}

A) N
B) O
C) F
D) Cl

Q.39 The value of oxidation potential would be positive if it is

A) Below SHE
B) Equal to SHE
C) Above SHE
D) Both A and B

Q.40 Greater the value of the standard reduction potential of the given specie:

A) Greater is its tendency to accept electrons to undergo reduction
C) Greater is its tendency to accept electron to undergo oxidation
B) Greater is its tendency to lose electrons to undergo reduction
D) Greater is its tendency to lose electrons to undergo oxidation

Q.41 In the following cell representation

$$Zn_{(s)}\left|Zn^{2+}_{(aq)}(1M)\right\|Cu^{2+}_{(aq)}(1M)\left|Cu_{(s)}\right.$$

The line || in the representation shows

A) Salt bridge
B) Phase boundary
C) Molar concentration
D) Both A and B

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Q.42 In a galvanic cell, the electrode occupying a lower position in the electrochemical series:

A) Will act as Cathode
B) Reduction will take place on it
C) Oxidation will take place on it
D) Both "A" and "B"

Q.43 In Zn / Zn^{+2} (1 M) // Cu^{+2} (1 M) / Cu galvanic cell, which one is incorrect statement

A) Zn is negatively charged
B) Zn will be oxidized
C) Cu is negatively charged
D) Cu^{2+} will be reduced

Q.44 In electrochemical series, metal will be easily oxidized if

A) $E^{\circ}_{red} = 0.521$ V
B) $E^{\circ}_{red} = -1.66$ V
C) $E^{\circ}_{red} = 1.08$ V
D) $E^{\circ}_{red} = -0.76$ V

Q.45 $E°_{red}$ values of metals are W= –3.06 V, X = +2.07 V , Y = –1.85 V , Z = +1.14 V indicate the least reactive metal

A) W
B) Y
C) X
D) Z

Q.46 If the sum of E° values of the two half cells is negative, then:

A) The reaction will be feasible
B) The reaction may or may not be feasible
C) The reaction will not be feasible
D) No prediction can be made

Q.47 The cell will function best if its calculated emf is

A) Small +ve
B) Large +ve
C) Small –ve
D) Large –ve

Q.48 Which of the following metal will liberate hydrogen gas when react with steam

A) Cu
B) Ag
C) Au
D) Mg

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Q.49 The overall positive value for the reaction potential predicts that process is energetically

A) Not feasible
B) Feasible
C) Impossible
D) No indication

Q.50 Two half-cell reaction are

$2H^+ / H_2$, $E°_{red} = 0.00$ V
Ag^{+1} / Ag , $E°_{red} = +0.80$ V
$E°_{cell}$ of cell is

A) 0.80 V
B) 0.00 V
C) –0.80 V
D) –1.66 V

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PAST PAPERS

Q.1 The reaction which is responsible for the production of electricity in the voltaic cell is
A) Hydrolysis
B) Reduction
C) Oxidation
D) Redox

Q.2 In all oxidation reactions, atoms of an element in a chemical species lose electrons and increases their
A) Oxidation states
C) Electrode
B) Reduction states
D) Negative charges

Q.3 In $MgCl_2$, the oxidation state of Cl is
A) Zero
B) +2
C) -2
D) -1

Q.4 Which one of the following behave as a redox reaction?
A) $NaCl + AgNO_3 \rightarrow NaNO_3 + AgCl$
B) $2Cl^- \rightarrow Cl_2 + 2e^-$
C) $2Na + Cl_2 \rightarrow 2NaCl$
D) $Na^+ + 1e^- \rightarrow Na$

Q.5 In SO_4^{-2} the oxidation number of sulphur is
A) –8
B) +8
C) –6
D) +6

Q.6 Study the following redox reaction:
$10Cl^- + 16H^+ + 2MnO_4^- \longrightarrow 5Cl_2 + 2Mn^{+2} + 8H_2O$
Which statement is true about this reaction?
A) Manganese is oxidized from +7 to +2.
B) Chloride ions are reduced from -1 to zero
C) Chlorine is reduced from zero to -1
D) Manganese is reduced from +7 to +2

Q.7 In NO_3^- the oxidation number of N is
A) +5
B) +2
C) +3
D) –3

Q.8 The oxidation state of carbon in $C_2O_4^{-2}$ is
A) +4
B) +3
C) –4
D) +2

Q.9 The value of oxidation number of chlorine in $HClO_3$ is
A) +7
B) –1
C) +5
D) +3

Q.10 In votaic cell a salt bridge is used in order to
A) Pass the electric current
B) Prevent the flow of ions
C) Mix solutions of two half cells
D) Allow movement of ions between two cells

Q.11 The potential difference of an electrochemical cell is measured by
A) Galvanometer
B) Voltmeter
C) Calorimeter
D) Ammeter

Q.12 In an electrochemical series, elements are arranged on the basis of:
A) pH scale
B) pOH scale
C) pKa scale
D) Hydrogen scale

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Q.13 The E° value of standard copper half-cell is +0.34V, measured when it is connected with SHE i.e. Standard hydrogen electrode. In this case the half reaction taking place at SHE is

A) $2H^+_{(aq)} + 2e^- \longrightarrow H_{2(g)}$

B) $2H^+_{(aq)} + 2e^- \longrightarrow 2H_{(g)}$

C) $H_{2(g)} \longrightarrow 2H^+_{(aq)} + 2e^-$

D) $H_{2(g)} \longrightarrow 2H_{(g)} + 2e^-$

Q.14 The standard electrode potential of hydrogen is arbitrarily taken at 298k is –

A) 1.00volt

B) 0.00 volt

C) 0.10 volt

D) 10.0 volt

$Mg^{2+} + 2e^- \rightarrow Mg \quad E^\circ = -2.37V$

$Zn^{2+} + 2e^- \rightarrow Zn \quad E^\circ = -0.76V$

$2H^+ + 2e^- \rightarrow H_2 \quad E^\circ = 0.000V$

$Cu^{2+} + 2e^- \rightarrow Cu \quad E^\circ = +0.34V$

$Cl_2 + 2e^- \rightarrow 2Cl^- \quad E^\circ = +1.36V$

$Au^{3+} + 3e^- \rightarrow Au \quad E^\circ = +1.50V$

Keeping in view the values of standard reduction potential given above, which one of the following would you select as a feasible redox chemical reaction?

A) $2Au + 6H^+ \rightarrow 2Au^{3+} + 3H_2$

B) $Mg + 2H^+ \rightarrow Mg^{2+} + H_2$

C) $2Cl^- + I_2 \rightarrow Cl_2 + 2I^-$

D) $Cu + Zn^{2+} \rightarrow Cu^{2+} + Zn$

Q.15 Coinage metals Cu, Ag and Au are the least reactive because they have

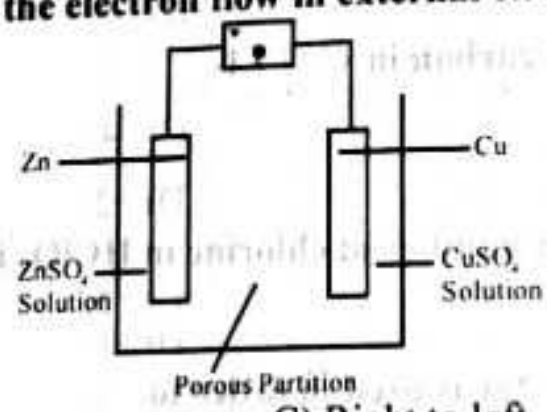
A) Negative reduction potential

B) Positive reduction potential

C) Negative oxidation potential

D) Positive oxidation potential

Q.16 In the figure given below, the electron flow in external circuit is from



A) Zinc to copper electrode

B) Copper to zinc electrode

C) Right to left

D) porous partition to zinc electrode

Q.17 Study the following facts

$Zn \longrightarrow Zn^{+2} + 2e^- \quad E^\circ = +0.76V$

$Cu \longrightarrow Cu^{+2} + 2e^- \quad E^\circ = -0.34V$

A) $Cu + Zn^{+2} \longrightarrow Cu^{+2} + Zn$

B) $Cu^{+2} + Zn^{+2} \longrightarrow Cu + Zn$

C) $Cu^{+2} + Zn \longrightarrow Cu + Zn^{+2}$

D) $Cu^{+2} + Zn^{+2} \longrightarrow Cu + Zn^{+2}$

Q.18 Keeping in mind the electrode potential, which one of the following reactions is feasible?

A) $Zn^{+2} + Cu \longrightarrow Cu^{+2} + Zn$

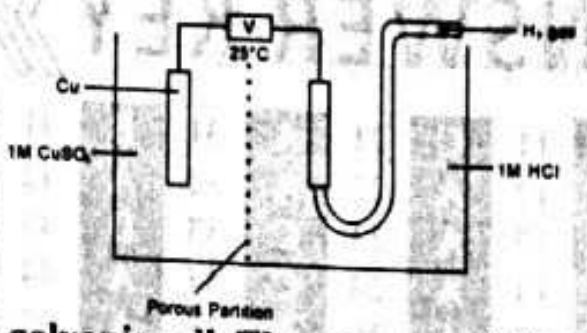
B) $Zn + MgSO_4 \longrightarrow ZnSO_4 + Mg$

C) $Fe + CuSO_4 \longrightarrow FeSO_4 + Cu$

D) $Cd + MgSO_4 \longrightarrow CdSO_4 + Mg$

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Q.19



The diagram shows a galvanic cell. The current will flow from

A) Hydrogen electrode to copper electrode
B) Copper electrode to hydrogen electrode
C) Hydrogen electrode to HCl solution
D) $CuSO_4$ solution to hydrogen electrode

Q.20 Stronger is the oxidizing agent, stronger is the

A) emf of cell
B) Reduction potential
C) Oxidation potential
D) Redox potential

Q.21 Which of the following metal does not liberate hydrogen on reaction with acid?

A) Mg
B) Zn
C) Pt
D) Ca

Q.22 Which one of the following elements is the strongest reducing agent?

A) Chlorine
B) Magnesium
C) Sodium
D) Aluminium

Q.23 Rusting of iron metal Fe occurs when Fe gets converted into Fe_2O_3. What happen with Fe?

A) Fe is neutralized
B) Fe is reduced
C) Fe is sublimed
D) Fe is oxidized

Q.24 During space flights, astronauts obtained water from

A) Nickel cadmium cells
B) Fuel Cell
C) Lead accumulator
D) Alkaline battery

Q.25 The electrolyte used in fuel cell is

A) KOH
B) $NaNO_3$
C) NaCl(aq)
D) Molten NaCl

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ANSWER KEY

1	D	11	C	21	A	31	B	41	A
2	B	12	A	22	A	32	A	42	D
3	A	13	A	23	C	33	D	43	C
4	D	14	A	24	C	34	A	44	B
5	B	15	A	25	A	35	A	45	C
6	C	16	C	26	D	36	C	46	A
7	B	17	A	27	C	37	B	47	B
8	A	18	A	28	B	38	C	48	D
9	B	19	B	29	D	39	C	49	B
10	A	20	D	30	B	40	A	50	A

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1	D	6	D	11	B	16	B	21	C
2	A	7	A	12	D	17	A	22	C
3	D	8	B	13	C	18	C	23	D
4	C	9	C	14	B	19	A	24	B
5	D	10	D	15	B	20	B	25	A

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EXPLANATORY NOTES

Q.1 Net charge on carbon in glucose is zero.

$C_6H_{12}O_6$

$6x+12+(-2)6=0$ Let x be net oxidation state of carbon.

$6x=0$

$x=0$

Q.2

S_8	O
SO_2Cl_2	$x+(-2)_2+(-1)_2=0$
	$x-4-2=0$
	$x=+6$
SO_2	$x+(-2)_2=0$
	$x=4$
$Na_2S_2O_3$	$(+1)_2+2x+(-2)_3=0$
	$+2+2x-6=0$
	$2x-4=0$
	$2x=+4$
	$x=2$

Q.3 Let x be oxidation state of "O" KO_2

$+1+2x=0$

$2x=-1$

$x=-\frac{1}{2}$

Q.4 Oxidation state may be zero, fractional, positive or negative.

Q.5 Apparent charge on atom in molecule is called oxidation number.

Q.6 **OF_2**

$O+2(-1)=0$

$O-2=0$

$O=+2$

H_2O_2

$2(+1)+2O=0$

$2O=-2$

$O=-1$

Q.7 $HI+H_2SO_4 \rightarrow I_2+SO_2+H_2O$. The oxidation number of sulphur is reduced from +6 to +4.

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Q.8 $MnO_2 + 4H^+ \longrightarrow Mn^{+2} + 2H_2O$

+4 +2

In order to balance charge 2 electrons have to be added on L.H.S.

$MnO_2 + 4H^+ + 2e^- \longrightarrow Mn^{+2} + 2H_2O$

Q.9

Reaction	Change in O.S	Transfer of es
$MnO_4^{-2} \longrightarrow MnO_2$	$+6 \longrightarrow +4$	2
$MnO_4^{-1} \longrightarrow Mn^{+2}$	$+7 \longrightarrow +2$	5
$CrO_4^{-2} \longrightarrow Cr^{+3}$	$+6 \longrightarrow +3$	3
$CrO_4^{-2} \longrightarrow Cr^{+3}$	$2(+6 \longrightarrow +3)$	3×2

Q.10 $H_2S \longrightarrow$ S oxidation state of S changes from –2 to 0. Hence t is oxidized by Cl_2 making H_2S reducing agent at Cl_2 is reduced to Cl^- substance oxidation state (x).

Q.11 $8H^+ + MnO_4^- \longrightarrow Mn^{2+} + 4H_2O$. The oxidation number of Mn in MnO_4^- is +7 and in Mn^{2+} is +2. The reduction takes place in given reaction. 5 electrons are added in L.H.S.

Q.12 Reduction takes place at cathode which is addition of electrons in the reaction.

$Cu^{2+} + 2e^- \rightarrow Cu$

Q.13 A) $MnO_4^{2-} \longrightarrow MnO_2$

oxidation number of Mn in MnO_4^{2-} is +6 and in MnO_2 is +4. Hence there are transfer of two electrons.

B) $CrO_4^{2-} \longrightarrow Cr^{+3}$

Oxidation number of Cr in CrO_4^{2-} is +6 and in Cr^{+3} is +3. Hence there are transfer of 3 electrons.

C) $MnO_4^- \longrightarrow Mn^{+2}$

Oxidation number of Mn in MnO_4^- is +7 and in Mn^{2+} is +2. Hence there are transfer of 5 electrons.

D) $Cr_2O_7^{2-} \longrightarrow 2Cr^{+3}$

Oxidation number of chromium in $Cr_2O_7^{2-}$ is +6 and in Cr^{3+} is +3. Hence there are transfer of 3 electrons.

Q.14 Oxidation takes place at anode and reduction takes place at cathode.

Q.15 For molten NaCl

At anode

$2Cl^- \longrightarrow Cl_2 + 2e^-$

At cathode

$2Na^+ + 2e^- \longrightarrow 2Na$

Net reaction

$2NaCl \longrightarrow 2Na + Cl_2$

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Q.16 Reduction potential of potassium is less than hydrogen. H^+ will be reduced instead of K^+ at cathode and hydrogen gas is produced.

Q.17 Electrolysis of dilute H_2SO_4.

At anode: O_2 is produced (Oxidation)

At cathode: H_2 is produced (Reduction)

Q.18 For aqueous solution of NaCl at cathode.

H_2O is reduced to H_2 as its E^*_{red} is higher than Na^+.

$$2H_2O + 2e^- \longrightarrow H_2 + 2OH^-$$

Q.19 Electrolytic cell is used for the purification of copper. Impure copper is made the anode and thin sheet of pure copper is made the cathode and copper sulphate solution is used as an electrolyte.

Q.20 As reduction potential of electrodes changes by change in

i) Temperature
ii) Concentration of ions
iii) Nature of electrolyte

Hence cell potential also changes.

$$E^*_{cell} = E^*_{oxidation} + E^*_{reduction}$$

Q.21 Standard electrode potential is measured at 298K for electrode in 1M aqueous solution of its ions.

Q.22 emf or cell potential is the force to drive electron in a circuit.

Q.23 Electrode potential is measured by comparing it with SHE.

Q.24 Conditions for SHE

i) Pt electrode coated with finely divided Pt black
ii) T = 25°C = 298k
iii) 1M = H^+ ions
iv) P = 1 atm

As one molar H_2SO_4 = 2M H^+ hence it is not correct.

Q.25 In SHE H_2 gas is oxidized to H^+ ions by loss of electron $H_{2(g)} \longrightarrow 2H^+ + 2e^-$

Q.26 Conditions for SHE

i) Pt electrode coated with finely divided Pt black
ii) T = 25°C = 298k
iii) 1M = H^+ ions
iv) P = 1 atm

Q.27 SHE itself is a reference electrode hence its E^*_{red} is take zero Arbitrary i.e. without any other reference.

Q.28 ECS shows E^*_{red} value in ascending order and E^*_{red} is measured by comparing with SHE i.e. H-scale.

Q.29 In ECS Zn has less reduction potential than hydrogen and Cu. Zn is above in ECS and Cu is below.

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Q.30 Salt bridge maintain the electrical neutrality between two half cells preventing net charge accumulation which will occur if salt bridge is removed and hence emf will drop to zero.

Q.31 At cathode reduction takes place hence it has greater E°_{red} than anode.

Q.32 $Al \xrightarrow{\text{oxidation}} Al^{+3} + 3e^{-}$, as Al is oxidized hence it acts as anode and will get negative charge while zinc will act as cathode and is reduced.

Q.33 Reactivity of metal $\propto \frac{1}{E^{\circ}_{red}}$

Q.34 Reducing power is $\propto \frac{1}{E^{\circ}_{red}}$

Q.35 Metal with higher oxidation potential has lower reduction potential hence

E°_{red} of Mg = –2.37V

E°_{red} of Al = –1.66V

Metal with lower E°_{red} can replace the metal with higher E°_{red}. Hence Mg will replace Al.

Q.36 In ECs E°_{red} increases down the series. Reducing strength $\propto \frac{1}{E^{\circ}_{red}}$. Hence ability of element to act as reducing agent decreases.

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Q.37 E°_{red} increases down the ECS and oxidizing strength $\propto E^{\circ}_{red}$. As the halogens are placed towards bottom of the series this indication their higher E°_{red} values and hence these are good oxidizing agent.

Q.38 Fluorine is very strong oxidizing agent and is at the bottom of ECS. Indicating its highest E°_{red}.

Q.39 In ECS elements above SHE have negative E°_{red}, $E^{\circ}_{ox} = - E^{\circ}_{red}$ hence elements with negative E°_{red} have positive E°_{ox}.

Q.40 Reduction potential is the ability to get reduced hence greater E°_{red} means greater tendency to accept electrons to undergo reduction.

Q.41 $Zn_{(s)} \left| Zn^{2+}_{(aq)}(1M) \right\| Cu^{2+}_{(aq)}(1M) \left| Cu_{(s)} \right.$

| Represents the phase boundary and || represents salt bridge.

Q.42 At cathode reduction takes place hence it has greater E^{o}_{red} than anode.

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Q.43 Zn = anode = oxidized = negative electrode

Cu = cathode = reduced = positive electrode

Q.44 Tendency to get oxidized $\propto \frac{1}{E^{\circ}_{red}}$.

Q.45 Reactivity of metal $\propto \frac{1}{E^{\circ}_{red}}$.

Q.46 Reaction is feasible when E°_{cell} is positive otherwise it is not feasible

Q.47 If emf is positive the cell reaction will be feasible and cell will work at its best otherwise not.

Q.48 Metals with negative E°_{red} can easily lose electrons hence reducing $H^{+} \longrightarrow H_{2(g)}$ liberating H_2 from steam and aqueous acids. Here Mg has negative E°_{red}.

Q.49 If emf is positive the cell reaction will be feasible and cell will work at its best otherwise not.

Q.50 $E^{\circ}_{cell} = E^{\circ}_{red\ of\ cathode} + E^{\circ}_{ox.\ of\ anode}$

E°_{red} of anode < E°_{red} of cathode

Here SHE = anode E°_{ox} of SHE = 0.00V

$E^{\circ}_{cell} = +0.80 + 0.00 = 0.80V$

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Topic 10 CHEMICAL BONDING

PRACTICE EXERCISE

ATOMIC, IONIC AND COVALENT RADII

Q.1 Which of the following has largest ionic size

A) F^-
B) N^{3-}
C) O^{2-}
D) Na^+

Q.2 In a period, the atomic radii

A) Increases
B) Remain same
C) Decreases
D) First decreases, then increases

Q.3 Which of the following is correct relation for atomic radius

A) $A^- > A > A^+$
B) $A^+ > A > A^-$
C) $A > A^+ > A^-$
D) $A^- > A^+ > A$

IONIZATION ENERGY, ELECTRON AFFINITY AND ELECTRONEGATIVITY

Q.4 The relative attraction of the nucleus for the electrons in a chemical bond is called

A) Ionization energy
B) Electro negativity
C) Electron affinity
D) None of the above

Q.5 In a period, electronegativity from left to right

A) Increases
B) Remain constant
C) Decreases
D) Variable trend

Q.6 Ionization energy depends upon

A) Atomic/ionic radii
B) Nature of orbital
C) Shielding effect
D) All of the above

Q.7 With the increasing atomic number, ionization energy increases along a period because

A) No change in shielding effect along a period
B) Nuclear pull increases with the increase in number of protons
C) Atomic/ionic size decreases along a period
D) All of the above

Q.8 Which of the following has highest ionization energy value

A) Li
B) Be
C) H
D) He

Q.9 Greater shielding effect corresponds to_____ ionization energy value

A) Greater
B) Lesser
C) Zero
D) Variable

Q.10 Which of following has highest 2nd ionization energy

A) Na
B) Mg
C) Al
D) Si

Q.11 The group show abnormal trends in ionization energy are

A) II A and VI A
B) II A and V A
C) III A and VI A
D) VIII A

Q.12 The group that has maximum 1st ionization energy values

A) ns^1
B) ns^2, np^5
C) ns^2
D) ns^2, np^6

Q.13 Which of following group has maximum 1st electron affinity values in same period

A) V A
B) VII A
C) VI A
D) VIII A

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Q.14 Which of the following element has lowest electron affinity

A) N
B) O
C) Cl
D) He

TYPES OF BONDS (IONIC, COVALENT AND CO-ORDINATE BOND)

Q.15 An ionic compound A^+B^- is most likely to form when:

A) Ionization energy of A is high and electron affinity of B is low
B) Ionization energy of A is low and electron affinity of B is high
C) Both the ionization energy and the electron affinity of A and B are high
D) Both the ionization energy and the electron affinity of A and B are low

Q.16 Formation of ionic bond is favoured by

A) High I. E of metal
B) Low E.A of nonmetal
C) Low lattice energy
D) Low I.E of metal

Q.17 Maximum ionic character is exhibited by

A) NaCl
B) KCl
C) CsF
D) HF

Q.18 All of the following species have dative bond except

A) OH^-
B) NH_4^+
C) BF_4^-
D) H_3O^+

Q.19 Co-ordinate covalent bond is present in

A) Nitride ion
B) Hydronium ion
C) Chloronium ion
D) All of these

Q.20 The percentage of co-ordinate covalent bond present in BF_4^- and NH_4^+ respectively

A) 25% and 33%
B) 33% and 25%
C) 33% each
D) 25% each

Q.21 Which of the following molecule contain six bonding electrons

A) NH_3
B) H_2O
C) CO_2
D) C_2H_4

Q.22 If the sharing of an electron pair is unequal and the atom have an electronegativity difference of 1.4 to 1.6, what is this type of sharing called

A) Ionic
B) Non-polar covalent
C) Polar covalent
D) Metallic

VSEPR THEORY

Q.23 The following molecules has linear structure except?

A) CS_2
B) SO_2
C) CO_2
D) $BeCl_2$

Q.24 Which of the following species has lone pair of electrons on central atom?

A) CH_4
B) NH_4^+
C) PCl_5
D) PCl_3

Q.25 Which pair has trigonal planar geometry

A) NH_3, PH_3
B) H_2O, C_2H_2
C) BF_3, AlH_3
D) CO_2, SO_2

Q.26 The shape of NH_2^- is

A) Linear
B) Pyramidal
C) Angular
D) Tetrahedral

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Q.27 NH_4^+ and H_3O^+ are examples of ____ and ___ system respectively

A) AB_3E, AB_2E
B) AB_2, AB_4
C) AB_4, AB_3E
D) AB_4, AB_4

Q.28 Which molecular geometry is not possible for AB_4 type molecules

A) Trigonal planar
B) Trigonal pyramidal
C) Tetrahedral
D) Angular

Q.29 The correct order of bond angles is represented in

A) $CH_4 > H_2O > NF_3 > H_2S$
B) $CH_4 > NF_3 > H_2O > H_2S$
C) $H_2S > H_2O > CH_4 > NF_3$
D) $CH_4 > H_2S > H_2O > NF_3$

Q.30 Which of the following has perfect triangular structure

A) CO_2
B) NO
C) PH_3
D) SO_3

Q.31 The shape of which of following molecules can be explained with concept of VSEPR theory

A) F_2
B) N_2
C) HCl
D) NH_3

VBT AND HYBRIDIZATION (SP^1, SP^2, SP^3)

Q.32 Limitation to valence bond theory (VBT) is that:

A) It doesn't address the shapes of the molecules
B) It doesn't involve the criteria of bond formation
C) It doesn't explain paramagnetic behavior of O_2
D) None of the above

Q.33 End to end overlapping of orbitals give rise to the formation of:

A) Sigma bond
B) Metallic bond
C) Pi bond
D) Co-ordinate covalent bond

Q.34 Pi bonds are produced by overlapping of

A) Un-hybrid orbitals
B) Hybrid and un-hybrid orbitals
C) Hybrid orbitals
D) Atomic orbital and hybrid orbital

Q.35 The concept of hybridization was given to remove which of following drawback (s) of V.B.T

A) It does not explain paramagnetism of O_2
B) It does not explain odd electron system
C) It could not explain tetravalency of carbon
D) All of above

Q.36 Cl_2 molecule is formed by the overlap of

A) s-s orbital
B) s-p orbital
C) p-p head on overlapping of orbitals
D) p-p parallel overlapping of orbitals

Q.37 The process in which the orbitals of different energies and shape mix with each other to give equivalent hybrid orbitals is called:

A) Dissolution
B) Hybridization
C) Resonance
D) Ionization

Q.38 In which of following molecules central atom is not sp^3 hybridized

A) NH_4^+
B) NH_3
C) $\bar{N}H_2$
D) NO_3^-

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Q.39 In ground state the unpaired electrons in carbon are
A) 1
B) 2
C) 3
D) 4

Q.40 The number of true π bonds in benzene molecule are
A) 3
B) 6
C) 12
D) None of these

BOND ENERGY, BOND LENGTH, ENERGETIC OF BOND FORMATION AND DIPOLE MOMENT

Q.41 Formation of chemical bond takes place when
A) Forces of repulsion > Forces of attraction
B) Forces of repulsion = Forces of attraction
C) Forces of attraction > Forces of repulsion
D) Energy is absorbed

Q.42 The central atom which may not follow the octet rule while forming covalent bond
A) C
B) P
C) O
D) F

Q.43 Which one shows high %age of the ionic character
A) HI
B) HCl
C) HF
D) HBr

Q.44 Dipole moment gives the information about:
A) % ionic character
B) Geometry of the molecules
C) Bond angles
D) All of the above

Q.45 Bond length depends upon
A) Hybridization on central atom
B) Size of central atom
C) Nature of molecule
D) All of these

Q.46 Choose the incorrect relationship of bond energies
A) Br – Br > I – I
B) C ≡ C > N ≡ N
C) Cl – Cl > F – F
D) All are correct

Q.47 The S.I unit of dipole moment is
A) Debye
B) mC
C) pm
D) Both A and B

Q.48 Which of the following molecules has non-zero dipole moment.
A) CH_3Cl
B) CO_2
C) BF_3
D) CCl_4

Q.49 Maximum dipole moment is possessed by
A) H_2O
B) CO
C) H_2S
D) CH_4

Q.50 The experimentally determined bond length of C—Cl is 176.7pm and C—C is 154pm what would be the radius of Cl atom
A) 22.7pm
B) 176.7pm
C) 99.7pm
D) 330.7pm

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PAST PAPERS QUESTIONS

Q.1 Which one of the following is the correct dot and cross diagram of bonding between two chlorine atoms

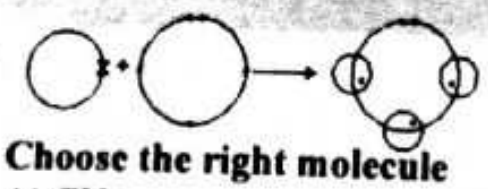
A) $\dot{\underset{\cdot\cdot}{Cl}} + \dot{\underset{\cdot\cdot}{Cl}} \longrightarrow \underset{\cdot\cdot}{\overset{\cdot\cdot}{Cl}}:$

B) $\dot{\underset{\cdot\cdot}{Cl}} + \dot{\underset{\cdot\cdot}{Cl}}: \longrightarrow \underset{\cdot\cdot}{\overset{\cdot\cdot}{Cl}}: + \underset{\cdot\cdot}{\overset{\cdot\cdot}{Cl}}:$

C) $\dot{\underset{\cdot\cdot}{Cl}} + \dot{\underset{\cdot\cdot}{Cl}}: \longrightarrow \underset{\cdot\cdot}{\overset{\cdot\cdot}{Cl}}\cdot\,\underset{\cdot\cdot}{\overset{\cdot\cdot}{Cl}}$

D) $\dot{\underset{\cdot\cdot}{Cl}} + \dot{\underset{\cdot\cdot}{Cl}} \longrightarrow \underset{\cdot\cdot}{\overset{\cdot\cdot}{Cl}}: + \underset{\cdot\cdot}{\overset{\cdot\cdot}{Cl}}$

Q.2



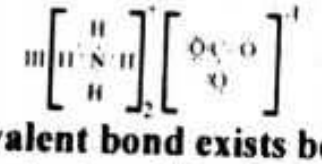
Choose the right molecule

A) CH_3
B) CO
C) H_2O
D) NH_3

Q.3 Observe the given dot and cross structures for the following molecules or ionic species.

I 

II 

III 

IV 

The co-ordinate covalent bond exists between:

A) N and C atoms in structure III and IV
B) N and one H ion in all four structure
C) N and Cl atoms of structure II
D) N and N atoms of structure I

Q.4 According to Valence shell electron pair repulsion theory, the repulsive forces between the electron pairs of central atom of a molecule are in the order

A) Lone pair bond pair> Lone pair-Lone pair
B) Bond pair> Bond pair> Lone pair-Lone pair> Lone pair-Bond pair
C) Lone pair-Bond pair> Bond pair-Bond pair> Lone pair-Lone pair.
D) Lone pair-Lone pair>Lone pair-Bond pair>Bond pair-Bond pair

Q.5 What is the exact value of angle in BF_3

A) 90°
B) 119.5°
C) 104.5°
D) 120°

Q.6 Which option show all the molecules with bond angle 109.5°.

A) $SiCl_4$, NH_4^+, CH_4
B) CH_4, CCl_4, NH_3
C) $SiCl_4$, H_2O, $BeCl_2$
D) CH_4, NH_4^+, PH_3

Q.7 The structure of Xenon trioxide is shown below,



With reference to the Valence shell electron pair repulsion theory, (VSEPR), the shape of XeO_3 is:

A) Tetrahedral
B) Bent (or angular)
C) Trigonal pyramidal
D) Trigonal planar

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Q.8 **Which of the following sets constitutes of all the molecules and ions of non-planar geometry?**

A) $SO_2, C_2H_4, BF_3, NO_3^-$
B) $CH \equiv CH, H_2O, BeCl_2, H_2S$
C) $CH_4, NH_4^+, MnO_4^-, NF_3$
D) PH_4^+, NH_3, SO_3, Benzene

Q.9 **The shape of CO_2 molecule is similar to**

A) H_2S
B) $SnCl_2$
C) SO_2
D) BeF_2

Q.10 **What is the shape of ammonia NH_3 molecule?**

A) Pyramidal
B) Tetrahedral
C) Linear
D) Trigonal planar

Q.11 **The number of bonds in nitrogen molecule is**

A) One σ and one π
B) One σ and two π
C) Three σ only
D) Two σ and one π

Q.12 **When the two partially filled atomic orbital overlap in such a way that the probability of finding the electron is maximum around the line joining the two nuclei, the result is the formation of**

A) Sigma bond
B) Pi-bond
C) Hydrogen bond
D) Metallic bond

Q.13 **pi- bond is formed by sideways overlap of**

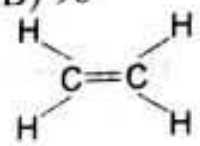
A) s-orbital
B) p-orbital
C) d-orbital
D) None of these

Q.14 **The angle between un-hybridized p-orbital and three sp^2 hybrid orbitals of each carbon atom is**

A) 120°
B) 90°
C) 109.5°
D) 180°

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Q.15



Count the number of σ bonds and π bonds in the molecule

A) 1π and 5σ bonds
B) 2π and 4σ bonds
C) 3π and 3σ bonds
D) 6π and 6σ bonds

Q.16 **Which if the following molecule has largest number of shared pair electrons?**

A) NH_3
B) C_2H_4
C) CO_2
D) N_2

Q.17 **Which one of the following molecules has sp^3 hybridization?**

A) CH_4
B) C_2H_4
C) C_2H_2
D) CO_2

Q.18 **According to the Lewis Concept, ammonia is a lone pair donor, therefore easily accepts a proton to form an ammonium ion as given by an equation**

$$NH_{3(g)} + H^+_{(aq)} \rightarrow NH^+_{4(aq)}$$

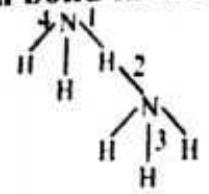
A) H–N–H bond angle decrease from 180°-109.5°
B) H–N–H bond angle decrease from 107°-104.5°
C) H–N–H bond angle increase from 107°-109.5°
D) H–N–H bond angle decrease from 109.5°-120°

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Q.19 DNA molecule is double stranded , in which two chains of DNA are twisted around each other by:

A) Hydrogen bonds
B) Covalent bonds
C) Van der Waal's forces
D) Dative bonds

Q.20 Which bond in the following structure represents hydrogen bonding?



A) 1
B) 3
C) 2
D) 4

Q.21 Which of the following substances exhibits hydrogen bonding?

A) H_2S
B) NH_3
C) HI
D) SiH_4

Q.22 In 'H-F' bond Electronegativity difference is 2.0. What is the type of this bond?

A) Polar covalent bond
B) Non-polar covalent bond
C) pi (π) bond
D) Co-ordinate covalent bond

Q.23 Which of the following molecule has zero dipole moment?

A) PCl_3
B) NH_3
C) BF_3
D) H_2O

Q.24 Boiling point of water is higher than petrol , because intermolecular forces in water are :

A) Weaker than petrol
B) Same as in petrol
C) Stronger than petrol
D) Negligible

Q.25 Metallic conduction involves the relatively free movement of their---------- throughout the metallic lattice:

A) Atoms
B) Ions
C) Electrons
D) Molecules

Q.26 Which type of force is present in gasoline?

A) Dipole-dipole forces
B) Dipole-induced dipole forces
C) Hydrogen bonding
D) London dispersion forces

Q.27 Which one of the following hydrogen bond is stronger than others?

A) $N^{\delta-} - H^{\delta+} \cdots\cdots N^{\delta-} - H^{\delta+}$
B) $F^{\delta-} - H^{\delta+} \cdots\cdots F^{\delta-} - H^{\delta+}$
C) $O^{\delta-} - H^{\delta+} \cdots\cdots O^{\delta-} - H^{\delta+}$
D) $N^{\delta-} - H^{\delta+} \cdots\cdots O^{\delta-} - H^{\delta+}$

Q.28 Which one of the following has zero dipole moment:

A) NH_3
B) $CHCl_3$
C) H_2O
D) BF_3

Q.29 An inter molecular force of attraction X is relatively stronger than the other inter molecular forces, it stabilizes ∝helix and β-pleated sheets of proteins. The double helical structure of DNA is also stabilized by this force of attraction. Identify X.

A) Dipole dipole attraction
B) Ionic interactions
C) Hydrogen bonding
D) van der Waal's Forces

Q.30 Among the following molecules, which one has coordinate covalent (dative) bond?

A) CCl_4
B) CO_2
C) CO
D) CH_4

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ANSWER KEY

1	B	11	C	21	A	31	D	41	C
2	C	12	D	22	C	32	C	42	B
3	A	13	B	23	B	33	A	43	C
4	B	14	D	24	D	34	A	44	D
5	A	15	B	25	C	35	C	45	D
6	D	16	D	26	C	36	C	46	B
7	D	17	C	27	C	37	B	47	B
8	D	18	A	28	A	38	D	48	A
9	B	19	B	29	A	39	B	49	A
10	B	20	D	30	D	40	D	50	C

PAST PAPER QUESTIONS

1	C	6	A	11	B	16	B	21	B	26	D
2	D	7	C	12	A	17	A	22	A	27	B
3	B	8	C	13	B	18	C	23	C	28	D
4	D	9	D	14	B	19	A	24	C	29	C
5	D	10	A	15	A	20	C	25	C	30	C

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EXPLANATORY NOTES

Q.1 Ionic size increases along the period form left to right. More over anions are of larger size as compare to cations. So, order of ionic radius is $N^{-3} > O^{-2} > F^{-1} > Na^{+1}$

Q.2 Atomic radius decreases along the period due to Increase effective nuclear charge.

Q.3 $A^{2-} > A^{-} > A > A^{+} > A^{2+}$

Q.4 The relative attraction of the nucleus for the shared pair of electrons in a chemical bond is called electronegativity.

Q.5 Electronegativity increases from left to right along the period due to increase in effective nuclear charge.

Q.6

$$Ionization\ energy \propto \frac{1}{atomic\ size}$$

$$\propto \frac{1}{shielding\ effect}$$

$$\propto \frac{1}{electron\ to\ proton\ ratio}$$

It also depends on nature of orbital in this order

$s > p > d > f$

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Q.7

$$Ionization\ energy \propto \frac{1}{atomic\ size}$$

$$\propto \frac{1}{shielding\ effect}$$

$$\propto \frac{1}{electron\ to\ proton\ ratio}$$

Q.8 Ionization energy is directly related to the stability of electronic configuration.

Q.9 Down the group ionization energy decreases due to increase in number of shell, shielding effect and atomic size.

Q.10 From sodium after removal of one electron, it has eight electrons in the remaining last shell and octet is complete therefore, second ionization energy value in very high for it.

Q.11 IA < IIA > **IIIA** < IVA < VA > **VIA** < VIIA < VIIIA

Q.12 Ionization energy is directly related to the stability of electronic configuration. ns^2, nsp^6 has already complete octet.

Q.13 Electron affinity increases from left to right along the period and the groups VIIA elements have highest values of 1st electron affinities.

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Q.14 Electron affinity is inversely to the stability of electronic configuration.

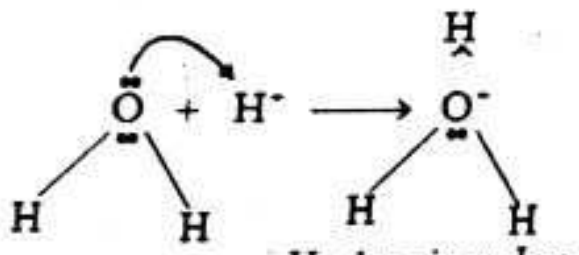
Q.15 Ionic compound is formed between the two atoms when one of them has low ionization energy and other have high electron affinity.

Q.16 Metals of group IA and IIA have low ionization energy means highly electropositive character and great tendency to form ionic bond.

Q.17 Strength of ionic character depends upon electronegativity difference. CsF as greatest electronegativity difference of 3.3 and maximum ionic character of 92 %

Q.18 Dative bond is formed when shared pair of electrons is provided by only one atom. In case of OH^- there is no donor– accepter relationship.

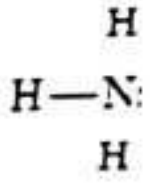
Q.19 Hydronium ion has two covalent bonds and one dative bond.



Hydronium Ion

Q.20 BF_4^- and NH_4^+ both have 3 covalent bonds and 1 co-ordinate covalent bond in their structure. Hence out of total 4 bonds 1 is co-ordinate covalent and each bond have 25% co-ordinate covalent character.

Q.21 Ammonia molecule has 3 sigma bonds and 6 bonding electrons.

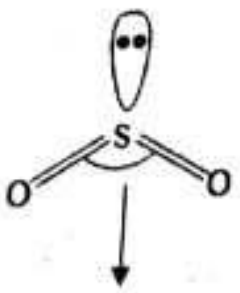


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Q.22 Electronegativity difference as an index to bond nature:

- The bond between two atoms is non-polar covalent if electronegativity difference between them is zero or less than 0.5.
- The bond between two atoms is polar covalent if electronegativity difference between them is 0.5 to 1.6.
- The bond between two atoms is equally covalent and ionic if electronegativity difference is 1.7.

Q.23



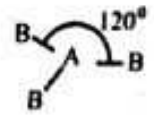
Less than 120°

Bent / angular. SO_2

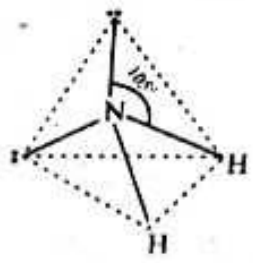
.24 PCl_3 resembles NH_3 molecule. Both P and N belong to group VA and have one lone pairs of electrons in these molecules.

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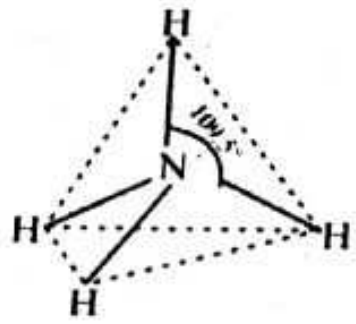
Q.25 BF_3 and AlH_3 are trigonal planar

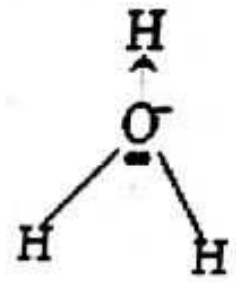


Q.26

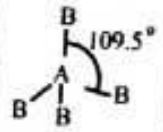
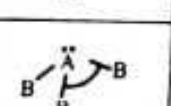
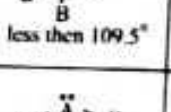


Q.27





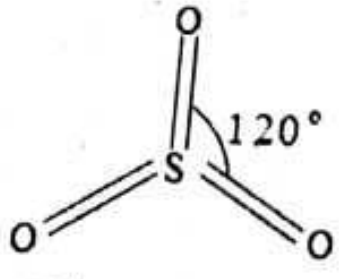
Q.28

AB_4	4	4	0	Tetrahedral	Tetrahedral		$CH_4, SiCl_4$ CCl_4, BF_4^- NH_4^+, SO_4^{-2}
		3	1		Trigonal pyramidal		NH_3, NF_3 PH_3
		2	2		Bent (or angular)		H_2O, H_2S

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Q.29 $CH_4\,(109) > H_2O(104) > NF_3\,(102) > H_2S(92)$

Q.30



Triangular planar

Q.31 VSEPR theory explain structures of polyatomic molecules (more than 2 atoms)

Q.32 Paramagnetic behaviour of oxygen is explained by MOT.

Q.33 End to end overlapping of orbitals is axial overlapping and is linear which results in sigma bond.

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Q.34 π-bonds are produced by overlapping of un-hybrid orbitals

Q.35 VBT does not explain valencies other than ground state.

Q.36 E.C of $_{17}Cl$ $1s^2, 2s^2, 2p^6, 3s^2, 3p^1{}_x, 2p_y{}^2, 2p_z{}^2$

Q.37 The process in which the orbitals of different energies and shape mix with each other to give equivalent hybrid orbitals is called hybridization

Q.38 In NO_3^- the central atom N is sp^2 hybridized.

Q.39 Ground state configuration of $_6C = 1s^2, 2s^2, 2p^2$.

Q.40 Benzene has delocalized electronic cloud.

Q.41 Attractive forces should dominate to keep the atoms together in a chemical bond.

Q.42 Phosphorous can make up to five covalent bonds as in PCl_5.

Q.43 %ionic character is directly related to electronegativity difference.

Q.44 **Dipole moment gives the information about:**

- % ionic character
- Bond angles
- Geometry of the molecules
- All of the above

Q.45 B.L ∝ p character

B.L ∝ atomic radius

$$B.L \propto \frac{1}{\text{Ionic character}}$$

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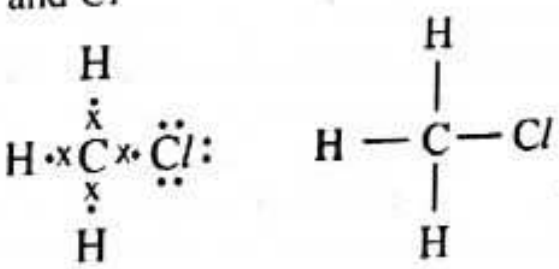
Q.46 Atomic size of N < C.

$$\text{Bond energy} \propto \frac{1}{\text{atomic size}}$$

Q.47 $\mu = q \times r$, q = coulumb, r = meter

The S.I unit of dipole moment is mC

Q.48 CH_3Cl is a polar molecule and has non-zero dipole moment due to polarity between C and Cl



Q.49 H_2O is most polar in given options Δ electronegativity between H and O is higher among given cases.

Q.50 Bond length = $r_C + r_{Cl}$.

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Topic 11 s AND p BLOCK ELEMENTS

PRACTICE EXERCISE

INTRODUCTION, ATOMIC SIZE, ATOMIC RADIUS AND IONIC RADIUS

Q.1 Which of the following represent elements in order of decreasing atomic size?

A) F, Cl, Br
B) S, P, Si
C) Li, Be, B
D) Be, Mg, Ca

Q.2 Which of the following will remain constant along the period

A) Atomic size
B) Shell number
C) Atomic number
D) Ionization energy

Q.3 The correct order of atomic radii is

A) F < K < Na < Li
B) Li < Na < K < F
C) F < Li < Na < K
D) Na < K < Li < F

Q.4 Increase in atomic size down the group is due to

A) Addition of shells
B) Inert pair effect
C) Shielding effect
D) Both A) and C)

Q.5 Atomic radius of fluorine is only larger than _____ in its period

A) Li
B) N
C) O
D) Ne

Q.6 Which one of the following is smallest in size?

A) Na^+
B) F^-
C) O^{2-}
D) N^{3-}

Q.7 Consider the iso-electronic species, K^+, S^{2-}, Cl^- and Ca^{2+}, the radii of the ion decrease as

A) $Ca^{+2} > Cl^- > K^+ > S^{2-}$
B) $Cl^- > K^+ > S^{2-} > Ca^{2+}$
C) $K^+ > Cl^- > Ca^{2+} > S^{2-}$
D) $S^{2-} > Cl^- > K^+ > Ca^{2+}$

Q.8 The radius of fluorine atom is 72pm and that of the fluoride ion (F^-) is _____

A) 72pm
B) 133pm
C) 44pm
D) 36pm

Q.9 One of the following species is iso-electronic with Ca^{2+}. Which is that

A) Sr^{2+}
B) Ar
C) Na
D) Mg^{2+}

Q.10 The radii of H, H^+ and H^- are in the order of

A) $H^+ > H > H^-$
B) $H^- > H > H^+$
C) $H > H^- > H^+$
D) $H > H^+ > H$

Q.11 After losing an electron radius of Na is reduced to

A) 95pm
B) 157pm
C) 181pm
D) 62pm

Q.12 Which statement is correct

A) Loss of valence electron may lead to loss of valence shell
B) Radius of isoelectronic ions decreases left to right in 3rd period
C) Anionic radius increase with magnitude of negative charge
D) All of these

Q.13 Which ion is largest in size in 2nd period

A) Cl^-
B) F^-
C) N^{-3}
D) Be^{+2}

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IONIZATION ENERGY, ELECTRON AFFINITY AND ELECTRONEGATIVITY

Q.14 Ionization energy depends upon

A) Atomic/ionic radii
B) Electron to proton ratio
C) Shielding effect
D) All of these

Q.15 With the increasing atomic number, ionization energy increases along a period because

A) No change in shielding effect along a period
B) Nuclear pull increases with the increase in number of protons
C) Atomic/ionic size decreases along a period
D) All of the above

Q.16 The ionization energy of an element is

A) The energy released when an electron is added to an atom of the element
B) The same as the electron affinity of element
C) Equal in magnitude but of opposite sign to the electron affinity of the element
D) The energy required to remove the outermost electron of an atom of the element

Q.17 The 1st ionization energy of metal is lower and 2nd ionization energy is very high, it indicate that group number is

A) IA
B) IIIA
C) IIA
D) IVA

Q.18 The greater 1st ionization energy would be associated with which of the following configuration

A) $1s^2\ 2s^2\ 2p^6\ 3s^1$
B) $1s^2\ 2s^2\ 2p^5$
C) $1s^2\ 2s^2\ 2p^3$
D) $1s^2\ 2s^2\ 2p^6$

Q.19 Which one of the following series is arranged in order of increasing value

A) The first ionization energies of: Oxygen, Fluorine, Neon
B) The radii of: H^- ion, H atom, H^+ ion
C) The electro negativities of: Chlorine, Bromine, Iodine
D) The boiling points of: Iodine, Bromine, Chlorine

Q.20 In the periodic table, the ionization energy of elements decreases from top to bottom because of

A) Increase in atomic size
B) Decrease in shielding effect
C) Decrease in electronegativity
D) Increase in density

Q.21 In the following, the element with the highest ionization energy is

A) [Ne] $3s^2\ 3p^1$
B) [Ne] $3s^2\ 3p^3$
C) [Ne] $3s^2\ 3p^2$
D) [Ne] $3s^2\ 3p^4$

Q.22 The unit of ionization energy is

A) Joule
B) KJ/mol
C) Calorie
D) KJ

Q.23 Which of the following is NOT true about electronegativity

A) Metal has EN value less than 2
B) With increase in O.S, EN decreases
C) It has no unit
D) It determines the polarity of molecule

Q.24 The power of an atom to attract shared pair of electrons towards itself in a molecule is called

A) Electron Affinity
B) Ionization Potential
C) Electronegativity
D) Hydration Energy

Q.25 Which one of the following elements has greater electronegativity value

A) N
B) O
C) Br
D) C

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Q.26 Which of the following periodic properties has no unit
A) Electron Affinity
B) Ionization Potential
C) Electronegativity
D) Hydration Energy

Q.27 Which of the following elements has greater electronegativity
A) As
B) S
C) Si
D) P

Q.28 Which of the following element has greater negative first electron affinity (EA_1)
A) C
B) B
C) Li
D)Be

Q.29 Which of the following group of elements have positive 1st electron affinity
A) IA
B) IIA
C) VIA
D) VIIA

Q.30 Which of the following halogens has comparatively smaller first electron affinity
A) F
B) Br
C) I
D) Cl

ELECTROPOSITIVITY, M.P, B.P AND ELECTRICAL CONDUCTIVITY

Q.31 Melting points of group IIA elements are considerably higher than those of group IA elements because
A) Size of IIA is greater than IA
B) I.E of IIA is less than IA
C) I.E of IIA is higher than IA
D) IIA provide more binding electron

Q.32 The lowest melting point among these four elements is of
A) Be
B) Mg
C) Ca
D) Sr

Q.33 The highest melting point among these elements is of
A) Nitrogen
B) Oxygen
C) Fluorine
D) Neon

Q.34 Generally the melting point decreases from VA to VIII A along the period but with exception of
A) Phosphorous
B) Sulphur
C) Chlorine
D) Argon

Q.35 Among the given elements of period 3, the greatest value of melting point is observed in case of
A) Mg
B) Al
C) Si
D) P

Q.36 Correct order of melting point of group II A elements
A) Be > Mg > Ca
B) Mg > Be > Ca
C) Ca >Be > Mg
D) Be > Ca > Mg

Q.37 In which group melting and boiling point decreases down the group
A) IA
B) VIIIA
C) VIIA
D) VA

Q.38 The element which has boiling point less than 0°C is
A) Beryllium
B) Boron
C) Carbon
D) Nitrogen

Q.39 Which of the following is incorrect information
A) Metals have free electrons in the valence shell
B) Electrical conductivity of metals increases with the increase of temperature
C) Metalloids are poor conductors of electricity
D) Non-metals have atomic conductance usually less than 10^{-10} ohm^{-1}

Q.40 Which of the following group of elements have extra ordinary high value of electrical conductivity
A) IA
B) IIA
C) IB
D) VIIA

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REACTIVITY AND REACTIONS OF IA, IIA, IIIA AND PERIOD 3 ELEMENTS

Q.41 Which one of the following alkali metals forms only normal oxide when it reacts with O_2

A) Lithium
B) Potassium
C) Sodium
D) Rubidium

Q.42 The elements of group I-A react violently with water and make the solution

A) Neutral
B) Acidic
C) Amphoteric
D) Alkaline

Q.43 What is the nature of reaction $Li_2O + H_2O \longrightarrow 2LiOH_{(aq)}$

A) Decomposition
B) Redox
C) Acid-base
D) All of these

Q.44 Beryllium and barium do not form oxide with oxygen

A) Normal oxide
B) Acidic oxide
C) Basic oxide
D) Amphoteric oxide

Q.45 Which one of the following doesn't react with water even at red hot temperature

A) Be
B) Ca
C) Mg
D) Ba

Q.46 The amphoteric oxide is

A) CaO
B) Na_2O
C) BeO
D) BaO

Q.47 Which of the following is less soluble in water

A) $Be(OH)_2$
B) $Mg(OH)_2$
C) $Ca(OH)_2$
D) $Sr(OH)_2$

Q.48 Which of the following element of 3rd period and group III does not react with water

A) B
B) Mg
C) Al
D) In

Q.49 When aluminum react with chlorine then it produce _____ colored aluminum chloride

A) Pale Yellow
B) Greyish Black
C) Greenish Yellow
D) Reddish Brown

Q.50 Which of the following pair does not react directly with oxygen?

A) P and S
B) Al and Ar
C) Cl and Ar
D) P and Ar

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PAST PAPERS QUESTIONS

Q.1 Which one remains same along a period?

A) Atomic radius
B) Melting point
C) Number of shells (orbits)
D) Electrical conductivity

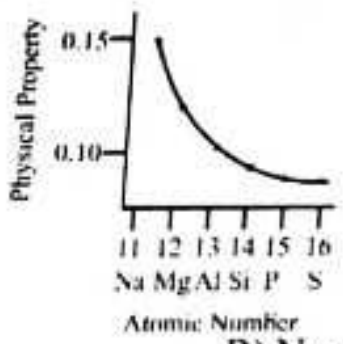
Q.2 Along a period, atomic radius decreases. This gradual decrease in radius is due to

A) Increase in number of shells
B) Increase in number of protons in the nucleus
C) Melting and boiling points first decrease then increase
D) Melting and boiling points first increase then decrease

Q.3 Keeping in view the size of atoms, which order is correct?

A) N > C
B) P > Si
C) Ar > Cl
D) Li > Be

Q.4 Following graph shows a physical property along the period 3 elements. Which physical property is



A) Electron affinity
B) Non-metallic character
C) Atomic radius
D) Melting point up to group IVA

Q.5 Down the group acid-base behavior of metallic oxides of group2 elements changes to

A) More basic
B) Less basic
C) No change
D) More acidic

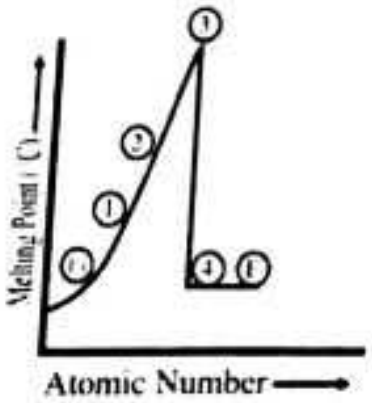
Q.6 Which one of the following will have the smallest radius?

A) Al^{+3}
B) Si^{+4}
C) Mg^{+2}
D) Na^{+1}

Q.7 In the 3rd period of the periodic table which of following property is decreasing consistently?

A) Electrical conductivity
B) Melting point
C) Ionization energy
D) Atomic radius

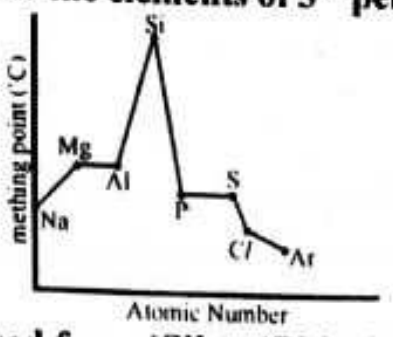
Q.8 The diagram below is a plot of melting points of elements of second period against their atomic numbers. Lithium and fluorine are placed at the extreme ends of the plot. On the basis of melting points where would you place carbon among the empty slots on the plot?



A) 1
B) 2
C) 4
D) 3

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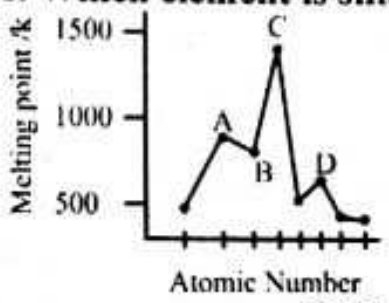
Q.9 The trends in melting points of the elements of 3rd period are depicted in figure below



The sharp decreases observed from 'Si' to 'P' is due to

A) Decrease in atomic radius from 'Si' to 'P'
B) Change in bonding and structure of two elements
C) Different densities of two elements
D) Increase in electron density from 'Si' to 'P'

Q.10 The following sketch shows the melting point of eight elements with consecutive atomic numbers. Which element is silicon?



A) A
B) B
C) C
D) D

Q.11 In period 2 and period 3 maximum melting point shown by elements

A) Lithium and sodium
B) Neon and argon
C) Carbon and silicon
D) Nitrogen and phosphorous

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Q.12 The following sketch show the variation in a physical property of third period elements against their number:



What physical property is plotted in this sketch?

A) Ionic radius
B) Ionization energy
C) Melting point
D) Atomic radius

Q.13 What is the trend of melting and boiling points of the elements of short periods as we move from left to right in a periodic table?

A) Melting and boiling points decrease gradually
B) Melting and boiling points first decrease then increase
C) Melting and boiling points increase gradually
D) Melting and boiling points first increase then decrease

Q.14 Energy required to remove an electron from gaseous neutral atom is

A) Electron affinity
B) Ionization energy
C) Lattice energy
D) Crystal energy

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Q.15 The elements for which the value of ionization energy is low can

A) Gain electrons readily
B) Lose electron less readily
C) Gain electrons with difficulty
D) Lose electron readily

Q.16 More the ionization energy of an element

A) More the electro positivity
C) Less the metallic character
B) More the reducing power
D) Bigger the atomic radius

Q.17 Arrange the following elements according to the trends of ionization energies C, N, Ne, B

A) Ne < N < C < B
C) B < C < N < Ne
B) B < N < C < Ne
D) Ne < B < C < N

Q.18 In the second period of elements, although oxygen lies next to nitrogen yet its ionization first energy is lower than that of nitrogen because?

A) In oxygen, there exists repulsion between pair of electrons present in the same orbital of valence shell
B) Oxygen is paramagnetic in character.
C) Nuclear charge of oxygen is greater than nitrogen.
D) Oxygen has higher electron affinity.

Q.19 Ionization energy decrease down the group from top to bottom due to:

A) Decrease in atomic size
B) Increase in atomic mass
C) Increase in shielding effect of the intervening electrons
D) Increase in proton number

Q.20 The ionization energy of potassium is less than sodium due to

A) Decrease in shielding effect
C) Decrease in electron affinity
B) Increase in nuclear charge
D) Increase in atomic radius

Q.21 Which element has the highest electron affinity among halogens?

A) F
C) I
B) Cl
D) Br

Q.22 Which one of the following properties decreases across the third period of elements in the periodic table?

A) Electronegatively
C) Ability to act as reducing agent
B) Ionization energy
D) Melting and boiling points

Q.23 The hydration energy of Mg^{2+} is less than

A) Na^{+1}
C) Ca^{2+}
B) Li^{+1}
D) Al^{3+}

Q.24 Which of the following oxide is most acidic oxides?

A) Al_2O_3
C) Cl_2O_7
B) Na_2O_3
D) CaO

Q.25 Which of the following compound have Ionic Bond?

A) MgO
C) SiO_2
B) CO_2
D) Al_2Cl_6

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ANSWER KEY

1	C	11	A	21	B	31	D	41	A
2	B	12	D	22	B	32	B	42	D
3	C	13	C	23	B	33	A	43	D
4	D	14	D	24	C	34	B	44	A
5	D	15	C	25	B	35	C	45	A
6	A	16	C	26	C	36	C	46	C
7	D	17	A	27	D	37	A	47	A
8	B	18	D	28	A	38	D	48	C
9	B	19	A	29	B	39	B	49	A
10	B	20	A	30	C	40	C	50	B

PAST PAPER QUESTIONS

1	C	6	B	11	C	16	C	21	B
2	B	7	D	12	C	17	C	22	C
3	D	8	D	13	D	18	A	23	D
4	C	9	B	14	B	19	C	24	C
5	A	10	C	15	D	20	D	25	A

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EXPLANATORY NOTES

Q.1 Atomic size decreases from left to right in period due to increase in effective nuclear charge so from Li to B atomic size decreases

Q.2 Shell no and shielding effect remain constant along period because.
Period No. = Shell No.
Shielding effect $\propto$ No. of shell

Q.3 F is on the extreme right side of periodic table so has smallest size while Li, Na and K are alkali metals having large size. Their size increases down the group so correct order of atomic size is F < Li < Na < K

Q.4 Atomic size increases down the group due to
(i) Increase in no. of shell
(ii) Increase in shielding effect
(iii) Decrease in effective nuclear charge

Q.5 Atomic size decreases from left to right in period due to increase in effective nuclear charge (Zeff) so correct order of atomic size is Li > N > O > F > Ne

Q.6 $\text{Ionic radius} \propto \frac{1}{\text{Magnitude of + ve charge on cation}}$
Ionic radius $\propto$ Magnitude of –ve charge on anion
So, order of ionic radius is $N^{-3} > O^{-2} > F^{-1} > Na^{+1}$

Q.7 $\text{Ionic radius} \propto \frac{1}{\text{Magnitude of + ve charge on cation}}$ If number of shells are constant.
Ionic radius $\propto$ magnitude of –ve charge on anion
So, order of ionic radius is $S^{-2} > Cl^{-1} > K^{+1} > Ca^{+2}$

Q.8 Negative ions have larger radius than the parent neutral atom

Q.9 Atomic No = No. of electrons
$_{20}Ca$ = 20 electrons,
Ca^{+2} = 20 – 2 = 18 electrons
$_{18}Ar$ = 18 electrons

Q.10 $A^{2-} > A^{-} > A > A^{+} > A^{2+} >$

Q.11

Atomic/ Positive ion	Ionic radius (pm)
Na	187
Na^{+1}	95

Q.12 All give statement about atomic radii are correct

Q.13 Along the period from left to right ionic radii increase. More over anion are larger in size than cations.

Q.14 $\text{Ionization energy} \propto \frac{1}{\text{atomic size}}$
$\propto \frac{1}{\text{shielding effect}}$
$\propto \frac{1}{\text{Electron to proton ratio}}$

Q.15 Ionization energy increases along the period due to
- Increase in effective nuclear charge
- Decrease in atomic size
- Almost same shielding effect

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Q.16 The ionization energy of an element is the energy required to remove the outermost electron of an isolated gaseous atom of the element.

Q.17 If there is large gap between 1st and 2nd ionization energy (I.E). It contains one valence electron and it belong to IA group.

Q.18 $1s^2, 2s^2, 2p^6$
It is configuration of noble gas (stable configuration) so it has very high 1st I.E.

Q.19 Ionization energy increases from left to right in period due to increase in effective nuclear charge (Z_{eff}) so order of ionization energy is ${}_8O < {}_9F < {}_{10}Ne$

Q.20 Ionization energy decreases from top to bottom in group due to
(i) Increase in atomic size
(ii) Increase in shielding effect
(iii) Decrease in effective nuclear charge (Z_{eff})

Q.21 ${}_{10}[Ne]\ 3s^2, 3p^3$
This element has half filled (stable) p-orbital. So,
stability of orbital $\propto$ ionization energy

Q.22 Unit of Ionization energy is kJ/mol or ev/mol.

Q.23 With the increase of OS of elements, EN increases as it is observed along the period.

Q.24 The power of an atom to attract shared pair of electrons towards itself in a molecule is called electronegativity.

Q.25 The decreasing order of electronegativity of some important elements is
F > O > N > Cl > Br > I > S > C > H = P

Q.26 Electronegativity is comparative value and has no unit.

Q.27 Electronegativity increases along the period and decreases down the group.

Q.28 Electron affinity generally increase along the period from left to right.
Be < Li < B < C

Q.29 Group-IIA elements have lower values of E.A due to their stable electronic configuration.

Q.30 Electron affinity decreases down the group. The correct for the halogens is
Cl > Br > F > I

Q.31 Melting / boiling point of metals (IA & IIA) depends on
(i) No. of binding electrons
(ii) Metallic structure

Binding energy $\propto$ no. of binding electrons

Binding energy $\propto$ melting and boiling point

Group (IIA) provide two electrons per atom for binding so have highest melting and boiling point than IA.

Q.32 Generally, in group (IIA), melting point decreases down the group so order of melting point Be > Ca > Sr > Ba > Mg
Abnormally, Mg has lowest melting point because of its hexagonal structure. It contains empty spaces so, less binding energy and less melting point

Q.33 London dispersion forces $\propto$ Size $\propto$ polarizability
LDF $\propto$ melting point
Among given options, nitrogen has large size, large polarizability and large LDF and high melting point.

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Q.34 London dispersion forces ∝ Size ∝ polarizability
LDF ∝ melting point
Among given options, nitrogen has large size, large polarizability and large LDF and high melting point.

Q.35 In 3rd period, Si has highest melting point because in its crystal it provides four electron per atom for binding, so high binding energy and highest melting point

Q.36 In IA and IIA group, melting point decreases due to increases in size, less binding energy. IIA group has exceptional order Be > Ca > Sr > Ba > Mg

Q.37 In IA and II A group, melting point decreases down the group due to
(i) Increase in size
(ii) Decreases in binding energy

Q.38 N_2 exist as independent individual non-polar small molecule so has least inter – molecular forces (IMF) and lowest boiling point (boiling point of $N_2 = -196°C$).
Size ∝ Polarizability ∝ London Dispersion Forces
London Dispersion Forces ∝ boiling point
While others have giant structure, high binding energy and high boiling point

Q.39 Electrical conductivity decreases due to increase in temperature because bumping of electron increases which results in hindrance in flow of electrons.

Q.40 I-B elements are coinage metals (Cu, Au, Ag) and have high conductivity.

Q.41 Only Lithium burns in air to form normal oxide, Li_2O(white solid).
$Li + O_2 \longrightarrow Li_2O$ (Lithium oxide)

Q.42 Group 1-A elements react violently with water and make the solution alkaline
$2Na + 2H_2O \longrightarrow 2NaOH + H_2$

Q.43 $\mathbf{Li_2O + H_2O \longrightarrow 2LiOH_{(aq)}}$
It is decomposition reaction, acid-base reaction and also redox reactions.

Q.44 $2Be + O_2 \xrightarrow{800°C} 2BeO$ (Beryllium oxide)
$Ba + O_2 \xrightarrow{500-600°C} BaO_2$ (Barium peroxide)

Q.45 Beryllium does not react with water even at red hot temperature due to the formation of protective oxide layer on the surface.

Q.46 BeO oxides is the only oxide in II-A group that is amphoteric in nature.
$BeO + H_2SO_4 \longrightarrow BeSO_4 + H_2O$
$BeO + 2NaOH \longrightarrow Na_2BeO_2 + H_2O$

Q.47 The solubility of alkaline earth metal hydroxides increases down the group due to decreasing lattice energy of hydroxides and decreasing charge to size ratio of cations.
$Be(OH)_2$ is quite insoluble, $Mg(OH)_2$ is sparingly soluble and $Ca(OH)_2$ is more soluble

Q.48 Al does not react with water because of the formation of protective oxide layer of Al_2O_3

Q.49 Aluminium chloride is pale yellow solid $2Al_{(s)} + 3Cl_{2(g)} \longrightarrow 2AlCl_{3(s)}$

Q.50 Al and Ar do not react directly with oxygen.

MOGHSOCIETY FOR FUTURE DOCTORS

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Topic 12 TRANSITION ELEMENTS

PRACTICE EXERCISE

GENERAL CHARACTERISTICS AND ELECTRONIC CONFIGURATION

Q.1 **Which one possesses maximum number of unpaired electrons**

A) Mn^{2+}
B) Cu^{2+}
C) Fe^{3+}
D) Both A) and C)

Q.2 **The location of transition elements is in between**

A) Lanthanides and actinides
B) Chalcogens and halogens
C) s and p block elements
D) d and f block elements

Q.3 **The correct electronic configuration of 'Cr' is**

A) [Ar] $3d^4 4s^2$
B) [Ar] $3d^5 4s^0$
C) [Ar] $3d^4 4s^2$
D) [Ar] $3d^5 4s^1$

Q.4 **Which pair of elements has abnormal electronic configuration**

A) Ti, V
B) Cr, Mn
C) Cr, Cu
D) Ni, Co

Q.5 **The general electronic configuration of 3d series of transition elements is**

A) [Ar](n–1)$d^{1-10}ns^{1-2}$
B) [Ar] (n–1)$d^{1-2}ns^{1-2}$
C) [Ar] (n–1)$d^{1-10}ns^2$
D) [Ar] (n–2)$d^{1-2}ns^{12}$

Q.6 **Which of the following is a typical transition metal?**

A) Sc
B) Cd
C) Y
D) Co

Q.7 **Correct electronic configuration of Mn**

A) [Ar] $3d^3 4s^2$
B) [Ar] $3d4s^2$
C) [Ar] $3d^4 4s^2$
D) [Ar] $3d^5 4s^2$

Q.8 **Which of the followings has a complete d-subshell in atomic as well as cationic state**

A) Sc
B) Ti
C) Mn
D) Zn

Q.9 **The element which gains electronic configuration of a noble gas at +3 oxidation state**

A) V
B) Sc
C) Ti
D) Cr

Q.10 **At which oxidation state Cu achieves electronic configuration of Zn^{+2}**

A) 0
B) +1
C) +2
D) +3

VARIABLE OXIDATION STATE, COLOR PROPERTY AND USE AS CATALYST

Q.11 **Zinc does not show variable oxidation state, because**

A) Its d-subshell is incomplete
B) It is relatively soft metal
C) Its d-subshell is complete
D) It has two electrons in outermost shell

Q.12 **Which complex shows zero oxidation state of the transition metal**

A) $[Fe(CO)_5]$
B) $K_3[Fe(CN)_6]$
C) $K_2[Fe(CN)_6]$
D) $[Cu(NH_3)_4]SO_4$

Q.13 **The oxidation state of transition elements is usually**

A) Variable
B) Constant
C) Single
D) Infinite

Q.14 **The oxidation number of central metal atom in $[Ni(CO)_4]$ is**

A) 0
B) 2
C) 4
D) 6

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Q.15 In complex compounds, the oxidation number is written in
A) English
B) Roman number
C) Greek
D) Latin

Q.16 The oxidation number of Mn in $[MnO_4]^{-2}$ is
A) +7
B) +6
C) -7
D) -6

Q.17 The higher oxidation state of manganese is
A) +7
B) +6
C) –7
D) +4

Q.18 Which two pairs show same oxidation state of iron
A) Fe_2O_3, FeO
B) $K_3[Fe(CN)_6], K_4[Fe(CN)_6]$
C) $FeCl_3$, $FeSO_4$
D) $Fe_2(SO_4)_3, Fe_2O_3$

Q.19 Which of the following shows only +2 oxidation state
A) Sc
B) Cu
C) Zn
D) Co

Q.20 Which electronic configuration can have possibility of +7 oxidation state
A) $[Ar]3d^5, 4s^2$
B) $[Ar]3d^5, 4s^1$
C) $[Ar]3d^6, 4s^2$
D) $[Ar]3d^{10}, 4s^2$

Q.21 The catalytic ability of transition metals come from
A) Vacant d-orbitals
B) Variable valance
C) Vacant p-subshell
D) High charge density of cations

Q.22 Which transition metals serves as catalyst for oxidation of alkanes
A) Zn
B) Hg
C) Cu
D) As

Q.23 Catalyst used for ammonia synthesis is
A) Cu
B) Zn
C) Co
D) Fe

Q.24 $TiCl_4$ is used as catalyst for manufacture of
A) Sulphuric acid
B) Ethanol
C) Plastics
D) Tetraethyl lead

Q.25 Which of the following compound is expected to be colored
A) Ag_2SO_4
B) MgF_2
C) $ZnCl_2$
D) CuF_2

Q.26 The colour of transition metal complexes is due to:
A) d-d transitions of electrons
B) Ionization
C) Paramagnetic nature of transition elements
D) Loss of s-electrons

Q.27 Which of the following transition metal forms colourless compounds
A) Ti
B) Cu
C) Cr
D) Zn

Q.28 Sc^{3+} has $3d^0$ configuration, its colour will be
A) Colourless
B) Blue
C) Purple
D) Green

Q.29 Number of electrons involved in d-d transition of $[Ti(H_2O)]^{+3}$
A) 1
B) 2
C) 3
D) 4

Q.30 Ti^{+3} shows minimum absorption (maximum transmittance) at ____ P ____ wavelength
A) Yellow, Green
B) Blue, Green
C) Red, Yellow
D) Red, Blue

Q.31 d-d transition cannot be shows by
A) Cu^{+1}
B) Zn^{+2}
C) Sc^{+3}
D) All of the above

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TRANSITION COMPLEXES AND THEIR NOMENCLATURE

Q.32 The algebraic sum of the charges present on the central atom ion and the total charge on the ligands is called

A) Coordination number
B) Oxidation number
C) Coordination sphere
D) Charge on coordination sphere

Q.33 While assigning the name of a complex compounds, the correct order is

A) Cation, Coordination Sphere, Anion
B) Cation, Anion, Coordination Sphere
C) Coordination Sphere, Cation, Anion
D) Anion, Coordination Sphere, Cation

Q.34 The ability of transition elements to form complexes is due to:

A) Small size of metal ion
B) Availability of empty d orbitals
C) Highly charged metal ion
D) All of these

Q.35 When $K_4[Fe(CN)_6]$ is dissolved in a solution of salt, then it produces

A) Simple ions only
B) Complex ions and simple ions
C) Complex ions only
D) Weak acid HCN

Q.36 During the formation of complex compound the Ligands bind with central metal ion / atom by

A) Covalent bonds
B) Ionic bonds
C) Co-ordinate covalent bond
D) All of these

Q.37 Which one complex is more stable

A) $[Cu(H_2O)_6]^{2+}$
B) $[CuCl_4]^{2-}$
C) $[Pt(C_2O_4)_2]^{2-}$
D) All have same stability

Q.38 What is the nature of co-ordination sphere

A) Aninoic in nature
B) Cationic in nature
C) Neutral in nature
D) All are possible

Q.39 The geometry of $[Fe(CO)_5]$ is

A) Pyramidal
B) Octahedral
C) Square planar
D) Bi pyramidal

Q.40 When light is exposed to transition element, then electrons jump from lower orbitals to higher orbitals in

A) Orbitals of s-subshell
B) Orbitals of p-subshell
C) Orbitals of d-subshell
D) Both A) and B)

Q.41 $K_2[Cu(CN)_4]$ which one is correct

A) Potassium tetra cyano cupperate
B) Ligand is positively charged
C) Co-ordination number is 2
D) Central atom is present in anionic sphere

Q.42 The specie which donates electrons to central metal atom in co-ordination sphere is called

A) Anion
B) Ligand
C) Cation
D) Acid

Q.43 The species which donate two electron pairs in a coordination compound is called

A) Ligand
B) Poly-dentate ligand
C) Mono-dentate ligand
D) Bi-dentate ligand

Q.44 The compound or complex ion which has a ring in its structure

A) Polydentate ligand
B) Monodentate ligand
C) Chelate
D) Hydrate

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Q.45 The IUPAC name of $Na_3[Co(NO_2)_6]$ is

A) Sodium hexanitroso cobaltate (III)
B) Sodium hexanitro cobalt (III)
C) Sodium cobaltinitrite (III)
D) Sodium hexanitro cobaltate (III)

Q.46 Which one of the following is correct geometry of complex $[MnCl_4]^{-2}$

A) Square planner
B) Tetrahedral
C) Trigonal bipyramidal
D) Octahedral

Q.47 The number of d electrons of Cr in $[Cr(H_2O)_6]^{3+}$ ion is

A) 2
B) 4
C) 3
D) 5

Q.48 Which is not true about $[Pt(C_2O_4)_2]^{-2}$

A) It is a chelate
B) Ligands are bidentate
C) It is less stable than normal complex
D) It has dicyclic structure

Q.49 Correct formula of triamminotrinitrocobalt (III)

A) $[Co(NH_3)_3(NO_2)_3]$
B) $[Co(NO)_3(NH_3)_3]$
C) $Co[(NH_3)_3(NO_2)_3]$
D) $[Co(NO_2)_3(NH_3)_3]$

Q.50 Which has same charge on central metal atom as the co-ordination sphere

A) $K_4[Fe(CN)_6]$
B) $[Cu(NH_3)_4]SO_4$
C) $[Co(NO_2)_3(NH_3)_3]$
D) $[MnCl_4]^{-2}$

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PAST PAPERS QUESTIONS

Q.1 **The paramagnetic character of substances is due to the presence of**
A) Bond pairs of electrons
B) Lone pairs of electron
C) Unpaired electrons in the atom or molecule
D) Paired electrons in the valence shell of atoms

Q.2 **Which pair of transition elements shows abnormal electronic configuration?**
A) Sc and Zn
B) Cu and Sc
C) Zn and Cu
D) Cu and Cr

Q.3 **Electronic configuration of manganese (Mn) is**
A) Mn(Ar) 3d: ↑ ↑ ↑ ↑ ↑ 4s: ↑↓
B) Mn(Ar) 3d: ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ 4s: ↑
C) Mn(Ar) 3d: ↑↓ ↑↓ ↑ ↑ ↑ 4s: ↑↓
D) Mn(Ar) 3d: ↑↓ ↑↓ ↑↓ ↑ ↑ 4s: ↑

Q.4 **Electronic configuration of Gold $[Au_{79}]$ is**
A) $[Xe]4f^{14},5d^{10},6s^{1}$
B) $[Xe]4f^{10},5d^{10},6s^{2}$
C) $[Xe]4f^{14},5d^{9},6s^{2}$
D) $[Xe]4f^{14},5d^{10},6s^{2}$

Q.5 **The anomalous electronic configuration shown by chromium and copper among 3-d series of elements is due to:**
A) Colour of ions of these metals
B) Variable oxidation states of metals
C) Stability associated with this configuration
D) Complex formation tendency of metals

Q.6 **Which element of 3-d series of periodic table shows the electronic configuration of $3d^8, 4s^2$?**
A) Copper
B) Cobalt
C) Zinc
D) Nickel

Q.7 **Scandium has atomic number 21; which one will be its electronic configuration?**
A) $1s^2, 2s^2, 2p^6, 3s^2, 3s^6, 3d^3$
B) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 4p^1$
C) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^1$
D) $1s^2, 2s^2, 2p^6, 3s^1, 4p^2$

Q.8 **Which of the following is the electronic configuration of Cr?**
A) $[Ar]3d^5 4s^2$
B) $[Ar]3d^6 4s^0$
C) $[Ar]3d^4 4s^2$
D) $[Ar]3d^5 4s^1$

Q.9 **Copper is a typical transition metal. Its atomic number is 29. In which oxidation state does it have partially filled orbital in d-subshell?**
A) Cu
B) Cu^-
C) Cu^{2+}
D) Cu^+

Q.10 **Valence electronic configuration Cu^{2+} is** ^{29}Cu
A) $5d^6$
B) $3d^8$
C) $3d^9$
D) $3d^7$

Q.11 **The total number of transition element is**
A) 58
B) 30
C) 48
D) 25

Q.12 **Oxidation state of 'Mn' in $KMnO_4$, K_2MnO_4, MnO_2 and $MnSO_4$ is in the order**
A) +7, +6, +2, +4
B) +6, +7, +2, +4
C) +7, +6, +4, +2
D) +4, +6, +7, +2

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Q.13 Which one pair has the same oxidation state of 'Fe'?

A) $FeSO_4$ and $FeCl_3$
B) $FeSO_4$ and $FeCl_2$
C) $FeCl_2$ and $FeCl_3$
D) $Fe_2(SO_4)_3$ and $FeSO_4$

Q.14 Identify the element that has maximum oxidation states:

A) Zinc
B) Chromium
C) Vanadium
D) Manganese

Q.15 The geometry of complexes depends upon type of ----------taking place in the valence shell of central metal atom:

A) Protonation
B) Hybridization
C) Deprotonation
D) Dissociation

Q.16 Tick the correct statement

A) Chelates are more stable than ordinary complexes
B) Ordinary complexes are more stable than chelates
C) Monodentate ligand form chelate
D) Chelates have no ring structure

Q.17 Oxidation state of 'Fe' in $K_3[Fe(CN)_6]$ is

A) +2
B) -3
C) -6
D) +3

Q.18 Ligands having two lone pair of electrons for donations to the central transition metal ions are known as

A) monodentate ligand
B) bidentate ligand
C) hexadentate ligand
D) polydentate ligand

Q.19 The shape of $[Co(NH_3)_6]^{3+}$ complex is

A) Square planar
B) Linear
C) Tetrahedral
D) Octahedral

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Q.20 What are the coordination number of Fe and Cu in the following compounds $K_4[Fe(CN)_6]$,$[Cu(NH_3)]SO_4$ respectively

A) –6,–4
B) +6,–4
C) –6, +4(–6,–4)
D) +6, +4

Q.21 $\left[Ti(H_2O)_6\right]^{+3}$ transmits

A) Yellow and red light
B) Yellow and blue light
C) Red and white light
D) Red and blue light

Q.22 Violet color of $\left[Ti(H_2O)_6\right]^{+}$ ion is due to the

A) Central metal ion
B) Complex ion
C) Water molecule
D) Outer anion

Q.23 The color of transition metal complexes is due to transition of electron between

A) p to d orbitals
B) p to p orbitals
C) d to d orbitals
D) d to p orbitals

Q.24 Potassium dichromate is used as an oxidizing agent in redox titrations. During reaction Cr(VI) is reduced to Cr(III). The color change during this transition is

A) Green to colorless
B) Pink to colorless
C) Colorless to pink
D) Orange to green

Q.25 The octahedral geometry of complexes $\left[Co(NH_3)_6\right]^{3+}$ has hybridization

A) sp^3d
B) sp^3d^2
C) spd^4
D) sp^2d^3

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ANSWER KEY

1	A	11	C	21	C	31	D	41	A
2	C	12	A	22	C	32	D	42	B
3	D	13	A	23	D	33	A	43	D
4	C	14	A	24	C	34	B	44	C
5	A	15	B	25	D	35	B	45	D
6	D	16	B	26	A	36	C	46	B
7	D	17	A	27	D	37	C	47	C
8	D	18	D	28	A	38	D	48	C
9	B	19	C	29	A	39	D	49	D
10	B	20	A	30	D	40	C	50	B

PAST PAPER QUESTIONS

1	C	6	D	11	A	16	A	21	D
2	D	7	C	12	C	17	D	22	A
3	A	8	D	13	B	18	B	23	C
4	A	9	C	14	D	19	D	24	D
5	C	10	C	15	B	20	D	25	B

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EXPLANATORY NOTES

Q.1 A) $_{25}Mn^{+2}$ $_{18}[Ar]$ 4s | 3d: ☐ | 1 1 1 1 1

B) $_{29}Cu^{+2}$ $_{18}[Ar]$ 4s | 3d: ☐ | 1↿⇂ 1↿⇂ 1↿⇂ 1↿⇂ 1↿⇂

C) $_{26}Fe^{+3}$ $_{18}[Ar]$ 4s | 3d: ☐ | 1 1 1 1 1

Q.2 Transition element are those elements which lie between s and p – block elements and their properties are also between s and p – block elements.

Q.3 In 3d series (1st series of transition elements), two elements "Cr" and "Cu" have different electronic configuration.

$_{24}Cr$ $[Ar]\ 3d^{5}\ 4s^{1}$

$_{29}Cu$ $[Ar]\ 3d^{10}\ 4s^{1}$

Q.4 Two elements "Cr" and "Cu" have different electronic configuration.

$_{24}Cr$ $[Ar]\ 3d^{5}\ 4s^{1}$

$_{29}Cu$ $[Ar]\ 3d^{10}\ 4s^{1}$

Q.5 d – block (outer) transition elements are those in which d – subshell of penultimate shell (inner to valence shell) is in process of completion. So general electronic configuration of 3d series is $(n-1)\ d^{1-10}\ ns^{1-2}$.

Q.6 Typical transition elements show general properties (colour, paramagnetism, alloy formation etc.) of transition elements while non-typical transition element don't show general properties of transition elements. Group No. IIIB (Sc, Y, La) and IIB (Zn, Cd, Hg) are non-typical transition elements while group No. (IVB, VB, VIB, VIIB, VIIIB and IB) are typical transition elements.

Q.7 Electronic configuration of Mn is $_{25}Mn$ $_{18}[Ar]\ 4s^{2}\ 3d^{5}$.

Q.8

(A) $_{21}Sc$ $_{18}[Ar]\ 4s^{2}\ 3d^{1}$

Sc^{+3} $_{18}[Ar]\ 4s^{0}\ 3d^{0}$

(B) $_{21}Ti$ $_{18}[Ar]\ 4s^{2}\ 3d^{2}$

Ti^{+3} $_{18}[Ar]\ 4s^{0}\ 3d^{1}$

(C) $_{25}Mn$ $_{18}[Ar]\ 4s^{2}\ 3d^{5}$

Mn^{+2} $_{18}[Ar]\ 4s^{0}\ 3d^{5}$

(D) $_{30}Zn$ $_{18}[Ar]\ 4s^{2}\ 3d^{10}$

Zn^{+2} $_{18}[Ar]\ 4s^{0}\ 3d^{10}$

INDIA'S SOCIETY FOR FUTURE DOCTORS

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Q.9

$_{21}Sc$ $_{18}[Ar]$ $4s^2\ 3d^1$

$_{21}Sc^{+3}$ $_{18}[Ar]$ $4s^0\ 3d^0$

Scandium in +3 state has same electronic configuration as $_{18}Ar$.

$_{18}Ar$ $1s^2 2s^2 2p^6 3s^2 3p^6$

Q.10

Cu^{+1} $_{18}[Ar]$ $4s^0\ 3d^{10}$

Zn^{+2} $_{18}[Ar]$ $4s^0\ 3d^{10}$

Q.11

$_{30}Zn$ $_{18}[Ar]$ $4s^2\ 3d^{10}$

Zn^{+2} $_{18}[Ar]$ $4s^0\ 3d^{10}$

Q.12

$\left[\overset{0}{Fe}(CO)_5\right]$, $K_2\left[\overset{+4}{Fe}(CN)_6\right]$

B) $K_3\left[\overset{+3}{Fe}(CN)_6\right]$, $\left[\overset{+2}{Cu}(NH_3)_4\right]SO_4$

Q.13 Transition elements show variable state because in addition to 4s – electrons, 3d –electrons also take part in bonding.

Q.14 $\left[\overset{0}{Ni}(\overset{0}{CO})_4\right]^0$

Oxidation state on CO = 0

Overall coordination sphere has zero charge. So Ni has zero oxidation state.

Q.15 Oxidation number of central metal in the complex is written in roman number i.e.

$K_3\left[\overset{+3}{Fe}(CN)_6\right]$ Potassium Hexacyanoferrate (III)

Q.16 Oxidation no of Mn = ?

Oxidation no of O = –2

Overall charge on coordination sphere = –2

$Mn + 4(-2) = -2$

$Mn - 8 = -2$

$Mn = 8 - 2$

$Mn = +6$

Q.17 Mn belongs to group (VIIB) of periodic table. So, its maximum oxidation state should be +7. Because maximum oxidation state may be equal to group no of element.

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Q.18

Oxidation state of Fe in $Fe_2(SO_4)_3$	Oxidation state of Fe in Fe_2O_3
Charge on sulphate ion = –2 2Fe +3(–2) = 0 2Fe – 6 = 0 2Fe = + 6 Fe = +3	Charge on oxygen = –2 2Fe +3(–2) = 0 2Fe – 6 = 0 2Fe = +6 Fe = +3

Q.19 "Zn" is non-typical transition element it does not show variable oxidation state. So it shows only +2 oxidation state.
i.e $Zn^{2+} = [Ar]4s^0\ 3d^{10}$

Q.20 [Ar] $2d^5\ 4s^2$ is electronic configuration of Mn. It shows maximum +7 oxidation state because it belongs to group VIIB of periodic table.

Q.21 Catalytic property of transition elements is due to
(i) Vacant d–orbitals
(ii) Formation of interstitial compounds which absorb and activate the reacting substance.
(iii) Variable oxidation state due to which these form intermediate compounds which help in formation of desired product.

Q.22 "Cu" is used as catalyst in oxidation of lower alkanes.

$$CH_4 + [O] \xrightarrow[200\ atom]{Cu/400^\circ C} CH_3 - OH.$$

Q.23 Finely divided "Fe" is used as a catalyst in Haber process. $Cr_2O_3 + MgO + SiO_2$ is used as promoter.

$$N_2 + 3H_2 \underset{450^\circ C/200\ atom}{\overset{Fe/MgO/Cr_2O_3/SiO_2}{\rightleftharpoons}} 2NH_3$$

Q.24 For high quality polyethylene (plastic). $(C_2H_5)_3Al + TiCl_4$ is used as catalyst.

$$n(CH_2 = CH_2) \xrightarrow[traces\ of\ O_2(0.1\%)400^\circ C/100\ atom]{(C_2H_5)_3Al + TiCl_4} [CH_2 - CH_2]_n$$

Q.25

Copper in +2 state contain one unpaired electron so it shows d-d transition and certain colour.

Cu^{+2} $_{18}[Ar]$ 4s ↑↓ 3d ↑↓ ↑↓ ↑↓ ↑

Q.26 Following ions of 3d-series contain no unpaired electrons. So, these don't show d-d transition and certain colour
Sc^{+3}, Ti^{+4}, V^{+5}, Cu^{+1} and Zn^{+2}

Q.27 Zinc has complete d-subshell. There is no d-d transition, therefore zinc form a colorless complex

Q.28 $_{21}Sc$ $_{18}[Ar]\ 4s^2\ 3d^1$

Sc^{+3} $_{18}[Ar]\ 4s^0\ 3d^0$

Q.29

$$\left[\overset{+3}{Ti}(H_2O)_6^0\right]^{+3}$$

$_{22}Ti$ $[Ar]\ 4s^2\ 3d^2$

$_{22}Ti^{+3}$ $_{18}[Ar]4s^0\ 3d^1$

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Q.30 In $[Ti(H_2O)_6]^{+3}$, yellow light is absorbed while most of the red and blue lights are transmitted, therefore the solution of $[Ti(H_2O)_6]^{+3}$ ions looks violet in colour.

Q.31 Following ions of 3d-series contain no unpaired electrons. So, these don't show d-d transition and certain colour

Sc^{+3}, Ti^{+4}, Cu^{+1} and Zn^{+2}

Q.32 $\left[Fe(CN)_6\right]^{-4}$ The algebraic sum of central metal and ligand is -4. It is charge on sphere

Q.34 Transition metals can form complexes because these have vacant d–orbital in which ligands can donate electron pairs.

Q.35 $K_4\left[Fe(CN)_6\right] \xrightarrow{\text{Ionization}} 4K^+ + \left[Fe(CN)_6\right]^{-4}$

Q.36 In coordination compounds, ligands are Lewis bases and central metal atom are Lewis acid so these form coordinate covalent bond.

Q.37 Complexes formed by poly-dentate ligands are called chelates. Oxalate ion $\left(C_2O_4^{-2}\right)$ is poly-dentate ligand so it will form chelates. These are stable compounds due to ring structure.

Q.38 A) Anionic coordination sphere $K_4[Fe(CN)_6]$

B) Cationic coordination sphere $[Cu(NH_3)_4]SO_4$

C) Neutral coordination sphere $[Fe(CO)_5]$

Q.39 There are five carbonyl (CO) ligands attached with central atom (Fe), so coordination no is 5. If coordination no. is 5 then geometry is Trigonal bipyramidal.

Q.40 When d-orbitals are involved in bonding, they split into two energy levels (lower and higher). Electrons present in low energy level absorb a part of visible light and jump to higher energy level. This is called d-d transition. Due to this transition, metal ion show colour.

Q.41 In $K_2[Cu(CN)_4]$, potassium is cation while $[Cu(CN)_4]^{-4}$ is anion, so central metal atom "Cu" is present in anionic coordination sphere.

Q.43 Ligands which donate two electron pairs to central metal atom is called bidentate ligand e.g. $C_2O_4^{-2}$, N_2H_4, SO_4^{-2} etc.

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Q.45 In writing IUPAC nomenclature of coordination sphere, following way is used

$$\left[\begin{pmatrix}\text{Neutral ligand}\\ \text{alphabetically}\end{pmatrix}\rightarrow\begin{pmatrix}\text{-ve ligand}\\ \text{alphabetically}\end{pmatrix}\rightarrow\begin{pmatrix}\text{Cationic ligand}\\ \text{alphabetically}\end{pmatrix}\rightarrow\begin{matrix}\text{Central}\\ \text{metal atom}\end{matrix}(\text{oxi.state})\right]$$

and if central metal atom is in anionic coordination sphere then suffix "ate" is used at end of name of metal.

Q.46 In $[MnCl_4]^{-2}$, four chloro group are attached with central metal atom. So, coordination no Is 4. If coordination no is 4 then sp^3 hybridization (except NO_2^{-1}, Cl^{-1}, CO, NH_3) is present

on central atom. So tetrahedral geometry.

Q.47 $\left[\overset{+3}{Cr}(H_2O)_6^0\right]^{+3}$

$_{24}Cr$ $_{18}[Ar]$ $\underset{4s}{\square}$ $\underset{3d}{|1|1|1|1|1|}$

$_{24}Cr^{+3}$ $_{18}[Ar]$ $\underset{4s}{\square}$ $\underset{3d}{|1|1|1|\ |\ |}$

Q.48 In $[Pt(C_2O_4)_2]^{-2}$, $C_2O_4^{-2}$ is polydentate (bi–dentate) ligand, so it is chelate and stable due to ring structure.

Q.49 In writing formula of complex, following way is used.

$$\left[\begin{pmatrix}\text{Central metal}\\ \text{atom}\end{pmatrix}\rightarrow\begin{pmatrix}\text{-ve ligand}\\ \text{alphabetically}\end{pmatrix}\rightarrow\begin{pmatrix}\text{Neutral ligand}\\ \text{alphabetically}\end{pmatrix}\rightarrow\begin{pmatrix}\text{Cationic ligand}\\ \text{alphabetically}\end{pmatrix}\right]$$

Q.50

A) $\overset{+4}{K}_4\left[\overset{+2}{Fe}(CN)_6^{-6}\right]^{-4}$

B) $\left[\overset{+2}{Cu}(NH_3)_4^0\right]^{+2}SO_4^{-2}$

C) $\left[\overset{+3}{Co}(NO_2)_3^{-3}(NH)_3^0\right]^0$

D) $\left[\overset{+2}{Mn}\overset{-4}{Cl_4}\right]^{-2}$

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Topic 13 FUNDAMENTAL CONCEPTS OF ORGANIC CHEMISTRY

PRACTICE EXERCISE

INTRODUCTION AND CLASSIFICATION OF ORGANIC COMPOUNDS

Q.1 _____ **organic compound/s can be classified as acyclic**

A) Isobutane
B) Isopentyne
C) Isobutylene
D) All of these

Q.2 **Compounds containing ring of three or more than three carbon atom and resembling _____ compounds are called alicyclic**

A) Aliphatic
B) Benzene
C) Aromatic
D) Heterocyclic

Q.3 **Alicyclic hydrocarbons will not follow _____ general formula**

A) C_nH_{2n}
B) C_nH_{2n+2}
C) C_nH_{2n-2}
D) C_nH_{2n-4}

Q.4 **Cyclohexane can be classified as**

A) Carbocyclic
B) Alicyclic
C) Aromatic
D) Both A and B

Q.5 **How many secondary carbon atoms are present in Methylcylopropane**

A) 1
B) 2
C) 3
D) 0

Q.6 **Which of the following is not heterocyclic compound**

A) Naphthalene
B) Pyridine
C) Furan
D) Pyrrole

Q.7 **The aliphatic compounds are of two types**

A) Straight chain and cyclic
B) Straight chain and branched
C) Branched chain and alicyclic
D) Homocyclic and alicyclic

Q.8 **Which is not present as heteroatom in heterocyclic compounds**

A) Sulphur
B) Oxygen
C) Nitrogen
D) Chlorine

Q.9 **Which compounds is alicyclic in nature**

A) Cyclobutane
B) n-Butane
C) Iso-butane
D) Toluene

Q.10 **1st synthetic organic compound is**

A) Ammonium cyanate
B) Methane
C) Urea
D) Benzene

Q.11 **Pyridine is an example of**

A) Homocyclic compound
B) Carbocyclic compound
C) Heterocyclic compound
D) Aliphatic compound

Q.12 **Anthracene contains _____ number of fused benzene rings**

A) 1
B) 3
C) 2
D) 4

FUNCTIONAL GROUP AND ISOMERISM

Q.13 **The isomerism in which the compounds differ with respect to functional group but have same molecular formula is called:**

A) Metamerism
B) Position isomerism
C) Functional group isomerism
D) Chain isomerism

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Q.14 Ether shows the phenomenon of:
A) Position isomerism
B) Metamerism
C) Functional group isomerism
D) Cis trans isomerism

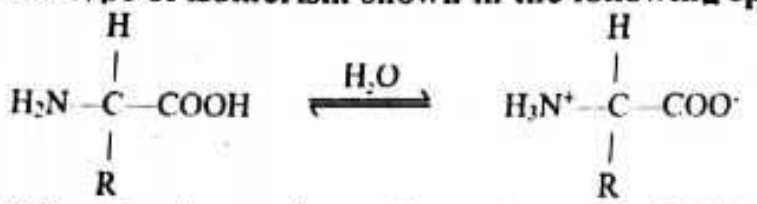
Q.15 Which of the following compounds does not exhibit positional isomerism
A) Alkynes
B) Carboxylic acid
C) Nitroalkanes
D) Alcohol

Q.16 Total number of possible chain isomers of butylalcohol among alcohols are
A) Four
B) Three
C) Five
D) Six

Q.17 Alkanes do not show geometrical isomerism due to
A) Asymmetry
B) Rotation around single bond
C) Resonance
D) Restricted rotation around doubled bond

Q.18 How many esters are possible for $C_4H_8O_2$
A) 2
B) 4
C) 3
D) 5

Q.19 The type of isomerism shown in the following species is



A) Functional group isomerism
B) Metamerism
C) Tautomerism
D) Cis-trans isomerism

Q.20 Which class of compound cannot show positional isomerism
A) Alkanes
B) Alkynes
C) Alkene
D) Alcohol

Q.21 Which one is thioether
A) R – O – R
B) R – S – R
C) R – Se – R
D) R – Te – R

Q.22 Glycols and glycerols can be differentiated on the basis of
A) Number of carbon atom
B) Position of hydroxyl group
C) Number of hydroxyl group
D) All of these

Q.23 Which of the following is functional group of amino functional group
A) $-NH_2$
B) $-C \equiv N$
C) $\diagdown C = NH \diagup$
D) $-\overset{\overset{O}{\|}}{C}-NH_2$

Q.24 Select from the following the one which is alcohol
A) $CH_3–CH_2–OH$
B) $CH_3–O–CH_3$
C) CH_3COOH
D) $CH_3–CH_2–Br$

Q.25 Which one of the following class of compounds has been incorrectly matched with their general formulae
A) Phenol ..... Ar –OH
B) Carboxylic acid ..... RCOOH
C) Ketone ..... R – COR
D) Aldehyde ..... ROR

Q.26 Which of the following is an amide
A) $(NH_2)_2CO$
B) $C_6H_5NH_2$
C) NH_2CH_3
D) $N(CH_3)_3$

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Q.27 **sp-hybridization takes place by the mixing of orbitals**
A) One 1s, one 2p
B) One 2s, two 2p
C) One 2s, three 2p
D) One 2s, one 2p

Q.28 **The percentage of s character in sp^2 hybrid orbital is**
A) 25%
B) 50%
C) 33.3%
D) 75%

Q.29 **The percentage of p character in sp^3 hybrid orbital is**
A) 25%
B) 50%
C) 75%
D) 33%

Q.30 **In sp^2-hybridization, the angle between two hybrid orbitals is**
A) 120°
B) 109.5°
C) 180°
D) 90°

Q.31 **The ethene molecule is**
A) Tetrahedral
B) Octahedral
C) Triangular planar
D) Linear

Q.32 **The shape of ethyne molecule is**
A) Tetrahedral
B) Octahedral
C) Triangular planar
D) Linear

Q.33 **1,2-Dibromoethene shows**
A) Geometrical isomerism
B) Both A) and (b)
C) Position isomerism
D) None of these

Q.34 **Indicate the number of chain isomers that can be obtained from the C_6H_{14}?**
A) 7
B) 5
C) 6
D) 4

Q.35 **C_3H_7OH is the functional group isomer of**
A) CH_3COCH_3
B) CH_3-CH_2-CHO
C) $CH_3OC_2H_5$
D) $(C_2H_5)_2C = O$

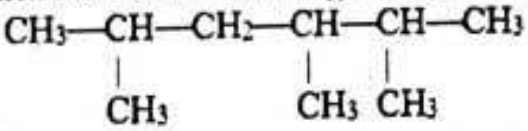
Q.36 **Which of the following compounds will exhibit cis-trans (geometrical) isomerism?**
A) 1-Butene
B) Propene
C) 2-Butyne
D) 2-Butene

Q.37 **Geometrical isomerism in alkenes is due to**
A) Oscillation of H-atom between two polyvalent carbon atoms
B) Optical rotation due to multiple bonds
C) Free rotation about C = C bond
D) Restricted rotation about C = C bond

Q.38 **Di-n–propyl ether and ethyl n-butyl ether are examples of**
A) Metamerism
B) Functional group isomerism
C) Chain isomerism
D) Position isomerism

NOMENCLATURE OF ORGANIC COMPOUNDS

Q.39 **The IUPAC name of the following compound is**



A) 2,4,5-Trimethylhexane
B) 2,3,5-Trimethylhexane
C) 2,3-Dimethyl-4-isopropylbutane
D) All of these

Q.40 **Select from the following which one is alkanone.**
A) CH_3-CH_2-OH
B) CH_3COOH
C) CH_3-O-CH_3
D) CH_3-CH_2-Br

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Q.41 In t-butyl alcohol, tertiary carbon is bonded to:

A) Two hydrogen atoms
B) One hydrogen atom
C) Three hydrogen atoms
D) No hydrogen atom

Q.42 IUPAC name of neopentane

A) 2,2- Dimethyl pentane
B) 2,2- Dimethyl propane
C) 2,3- Dimethyl pentane
D) 2,2- Dimethyl butane

Q.43 Propene and propyne have general formula

A) C_nH_{2n} and C_nH_{2n-2}
B) C_nH_{2n+2}
C) C_nH_{2n-2} and C_nH_{2n+2}
D) C_nH_{2n} and C_nH_{2n+2}

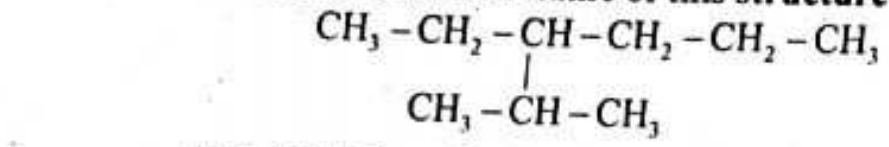
Q.44 Choose the correct name according to IUPAC nomenclature

A) 2–Ethyl–3–methyl pentane
B) 3-Methyl cyclohexane
C) 3–Ethyl–2–methyl pentane
D) 3–Ethyl–4–methyl pentane

Q.45 The name of the compound $HC \equiv C - CH_2 - CH = CH_2$

A) 1-Penten-4-yne
B) 2-Penten-3-yne
C) 4-Penten-1-yne
D) None of these

Q.46 What is the IUPAC name of this structure



A) 3–Ethyl 2–methyl hexane
B) 4–Ethyl 5–methyl hexane
C) Iso propyl hexane
D) 3–Iso propyl hexane

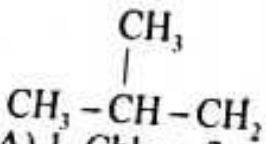
Q.47 The correct name of 3,5,5-Trimethylhexane is

A) 3–Ethyl 2–methyl pentane
B) 2,2,4-Trimethylhexane
C) 2,3–Dimethylpentane
D) 2,3,4-Trimethylhexane

Q.48 Which suffix is used for carboxylic acid

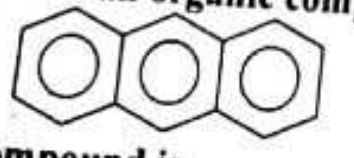
A) – al
B) – ol
C) – oic
D) – ene

Q.49 The IUPAC name of given compound is



A) 1–Chloro-2–methylbutane
B) 1–Chloro-2-methylpropane
C) Iso-butyl chloride
D) 2-Chloro-2-methyl propane

Q.50 Skeletal formula of an organic compound is given below



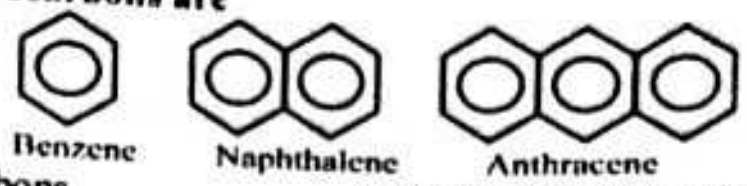
Name of this compound is

A) Naphthalene
B) Anthracene
C) Pyrene
D) Biphenyl methane

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PAST PAPERS QUESTIONS

Q.1 **The given three hydrocarbons are**



A) Alicyclic hydrocarbons
B) Aromatic hydrocarbons
C) Acyclic Hydrocarbons
D) Heterocyclic hydrocarbons

Q.2 **Cyclobutane structure is categorized under**
A) Aromatic compounds
B) Alicyclic compounds
C) Aliphatic compounds
D) Heterocyclic compounds

Q.3 **In the following organic compound carbon atoms in all of them undergo both sp^3 and sp^2 hybridization except X, which has all sp^3 hybrid orbitals, identify X**
A) 1-butanol
B) 2-chloro - 2- butane
C) Trans to butene
D) Butanoic acid

Q.4 **A gasoline of higher octane number can be obtained by**
A) Oxidative cleavage
B) Steam cracking
C) Thermal cracking
D) Catalytic cracking

Q.5 **Which one of the followings is used as typical catalyst for catalytic cracking?**
A) Mixture of SiO_2 and Ni
B) Mixture of Pt and Cu
C) Mixture of Fe and MgO
D) Mixture of SiO_2 and Al_2O_3

Q.6 **What should be the temperature and pressure respectively for catalytic cracking:**
A) 500^0C, 2 atm
B) 900^0C, 2 atm
C) 500^0C, 4 atm
D) 900^0C, 4 atm

Q.7 **Alkenes can be prepared on industrial scale by the following reaction using high temperature and a suitable catalyst. What type of reaction is this?**

$$C_{16}H_{34} \rightarrow C_7H_{16} + 3CH_2 = CH_2 + CH_3 - CH = CH_2$$

A) Cracking
B) Reforming
C) Displacement
D) Double Displacement

Q.8 **The compound with an atom which has an unshared pair of electron is called**
A) Nucleophile
B) Protophile
C) Electrophile
D) None of these

Q.9 **In the following, which one is free radical**
A) Cl^-
B) Cl^+
C) Cl_2
D) $Cl^{\cdot}$

Q.10 **Select a nucleophile from the following examples**
A) NH_4^+
B) NO_2
C) NH_3
D) NO^+_2

Q.11 **Which one of these is NOT a nucleophile?**
A) NH_3^-
B) H_2O
C) BF_3
D) CH^-

Q.12 **Among the following, which one is nucleophile**
A) H^+
B) OH^-
C) Ca^{2+}
D) None of these

Q.13 **Which one is not nucleophile?**
A) BH_3
B) $-NH_2$
C) NH_3
D) $-OR$

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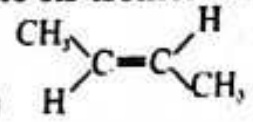
Q.14 Homolysis of a covalent bond yields a very reactive species with incomplete octet in its valence shell. What is this species?

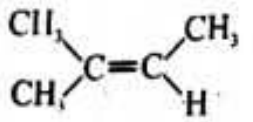
A) A complex ion
B) A free radical
C) An electrophile
D) A nucleophile

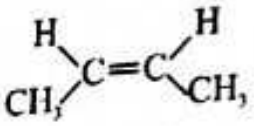
Q.15 1-chloroproane and 2-chloropropane are isomers of each other. The type of isomerism

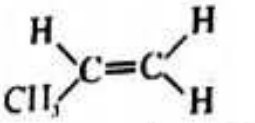
A) Cis-trans isomerism
B) Positional isomerism
C) Chain isomerism
D) Functional group isomerism

Q.16 The cis-isomerism is shown by

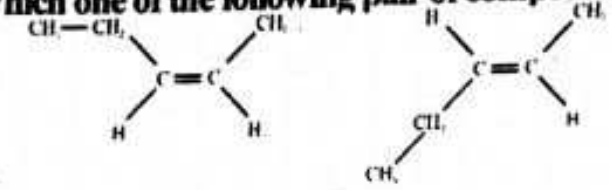
A) 

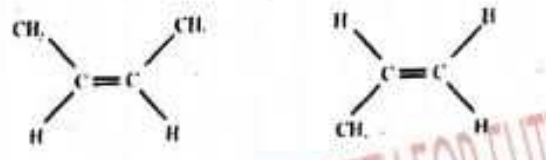
B) 

C) 

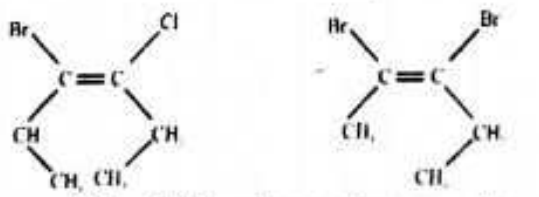
D) 

Q.17 Which one of the following pair of compound is cis and trans isomersm of each other?

A) 

B) 

C) 

D) 

Q.18 Which one of the following pairs can be a cis-trans isomer to each other?

A) $CHCl = CCl_2$ and $CH_2 = CH_2$
B) $CHCl = CH_2$ and $CH_2 = CHCl$
C) CH_3-CH=CH-CH_3 and H_3C-CH=CH-CH_3
D) CH_3-CH_3 and $CH_2 = CH_2$

Q.19 The type of structural isomerism which arises due to the difference in the nature of carbon chain or carbon skeleton is

A) Chain isomerism
B) Position isomerism
C) Cis-Trans isomerism
D) Optical isomerism

Q.20 Name the compound, which shows geometric isomerism:

A) 1-bromo-2-chloropropene
B) 2-pentene
C) 2,3-dimethylpropen
D) Both A & B

Q.21 Butane molecule can have maximum no of isomers

A) 2
B) 4
C) 5
D) 3

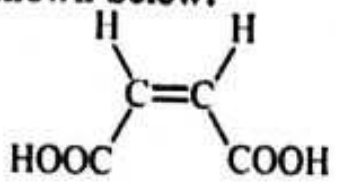
Q.22 Which of the following molecule shows cis – trans isomers?

A) C_2HCl_3
B) C_2H_4
C) $C_2H_2Cl_4$
D) $C_2H_2Br_2$

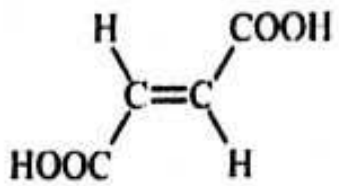
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Q.23 Maleic acid and Fumaric acid, both have chemical formula $C_4H_4O_4$. The structure of these acids is shown below:



Maleic acid



Fumaric acid

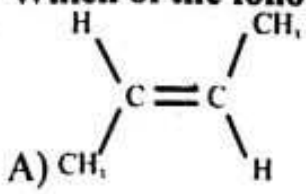
Maleic acid and Fumaric acid are:

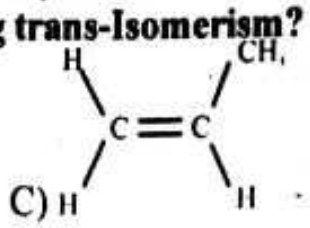
A) Position isomers
B) Cis-trans isomers
C) Metamers
D) Structural isomers

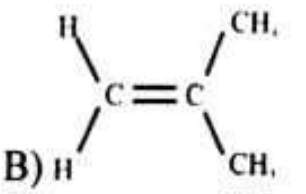
Q.24 Diethyl ether and n-butanol are

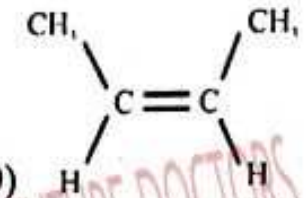
A) Position isomerism
C) Chain isomerism
C) Functional isomerism
D) Tautomerism

Q.25 Which of the following structure is showing trans-Isomerism?

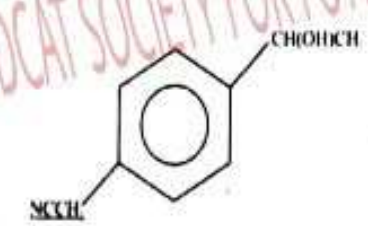
A)


C)


B)


D)


Q.26 The names of functional groups in the following compound X are;

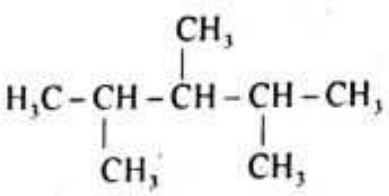


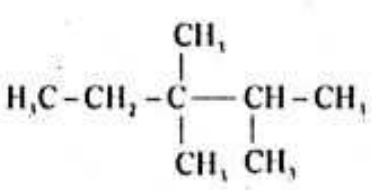
A) Primary alcohol, nitrile and benzene ring
B) Secondary alcohol, nitrile and aryl ring
C) Secondary alcohol, nitrile and phenol ring
D) Secondary alcohol, amine and benzene ring

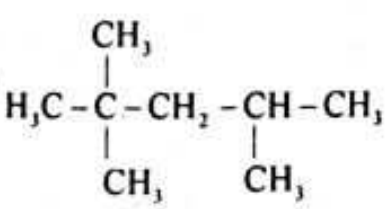
Q.27 Which one of the following is a ketone?

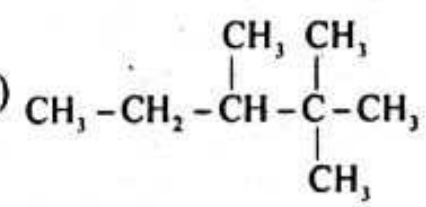
A) $CH_3—O—CH_2—CH_3$
B) $CH_3—CO—CH_2—CH_3$
C) $CH_3COCOOH$
D) $CH_3—CH_2CHO$

Q.28 The structural formula of 2,3,4 trimethylpentane is

A)


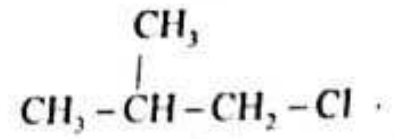
C)


B)


D)


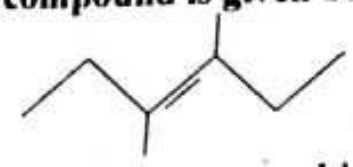
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Q.29 The IUPAC name of the given compound is



A) 1–Chloro-2-methylpropane
B) 1-Chloro-2-methylbutane
C) Isobutyl chloride
D) 2-Methyl-3-chloropropane

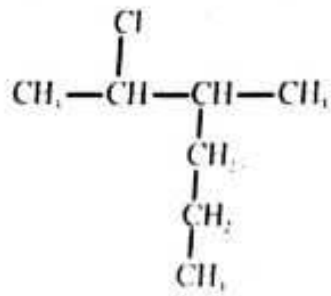
Q.30 Skeletal formula of an organic compound is given below:



It is a hydrocarbon. IUPAC name of the compound is:

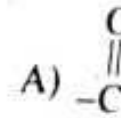
A) 3,3 dimethyl 3-hexene
B) 3,4 dimethyl 3-hexene
C) 3-hexene
D) 2,3 dimethyl 1-hexene

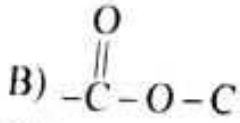
Q.31 Which one of the followings is the best name according to IUPAC system for the formula given below?

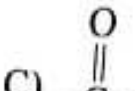


A) 4-methyl-6-chloro heptane
B) 2-chloro-4n propyl hexane
C) 2-chloro-3-methyl hexane
D) 2-chloro-4-n propyl pentane

Q.32 Which one is a functional group of carboxylic acid

A) 

B) 

C) 

D) None of these

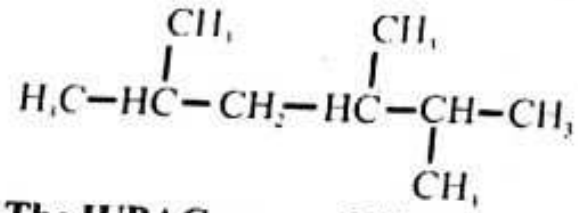
Q.33 Select one which is alcohol

A) $CH_3–O–CH_3$
B) CH_3COOH
C) $CH_3–CH_2–OH$
D) $CH_3–CH_2$-Br

Q.34 IUPAC name of Divinyl acetylene is

A) 1,5- hexadiene-3-ene
B) 3-Hexane-1,5-diyne
C) 1,5- hexadiene-3-yne
D) 3-Hexyne-1,5-diene

Q.35 Have a critical look at the given structure



The IUPAC name of this compound is

A)2-Methyl-4-isopropylpentane
B) 2,3,5-Trimethylhexane
C) 2,4,5-Trimethylhexane
D) 2-Isobuty1-3-methylbutane

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ANSWER KEY

1	D	11	C	21	B	31	C	41	D
2	A	12	B	22	D	32	D	42	B
3	B	13	C	23	A	33	B	43	A
4	D	14	B	24	A	34	B	44	C
5	B	15	B	25	D	35	C	45	A
6	A	16	A	26	A	36	D	46	D
7	B	17	B	27	D	37	D	47	B
8	D	18	B	28	C	38	A	48	C
9	A	19	C	29	C	39	B	49	B
10	C	20	A	30	A	40	C	50	B

PAST PAPER QUESTIONS

1	B	6	A	11	C	16	C	21	A	26	B	31	C
2	B	7	A	12	B	17	A	22	D	27	B	32	A
3	A	8	A	13	A	18	C	23	B	28	A	33	C
4	D	9	D	14	B	19	A	24	C	29	A	34	C
5	D	10	C	15	B	20	D	25	A	30	B	35	A

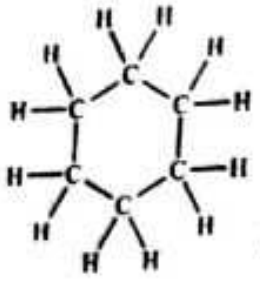
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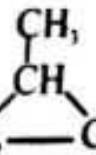
EXPLANATORY NOTES

Q.1 Isobutane, isopentane and isobutylene are open chain acyclic compounds

Q.3 C_nH_{2n+2} is valid only in case of saturated open chain hydrocarbons

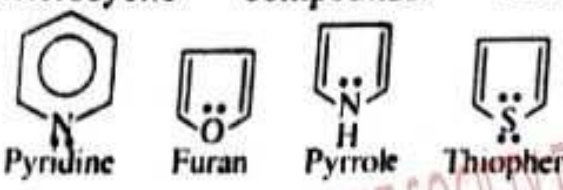
Q.4 The formula of cyclohexane is following





Q.5 In methyl cyclopropane $CH_2—CH_2$ there are one primary carbon, one tertiary carbon and two secondary carbon atoms are present

Q.6 The compounds which contain at least one atom other than carbon in the ring are heterocyclic compounds. The following are heterocyclic compound



Pyridine Furan Pyrrole Thiophene

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Q.7 Aliphatic or open chain compounds are further classified as straight chain and branched compounds

Q.8 In heterocyclic compounds only that heteroatom is possible which as valancy of two or more. Therefore chlorine cannot be a heteroatom because it forms only one bond in order to complete its octet.

Q.9 A) Alicyclic, B) Branched hydrocarbon, C) Straight chain hydrocarbon and D) Aromatic compound

Q.10 Urea is first synthetic organic compound

$NH_4CNO \rightleftharpoons NH_2CONH_2$

Q.11



Pyridine

Pyridine is and example of heterocyclic compound.

Q.12



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Q.13

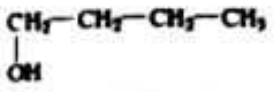
Functional group isomerism	Same molecular formula, but different functional groups	Different	propanal and propanone

Q.14

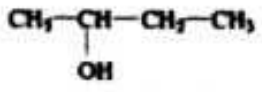
Metamerism	Unequal distribution of carbon atoms (R) on either side of functional group	Same	diethyl ether and methyl n-propyl ether

Q.15 In carboxylic acids position of functional group does not change therefore they do not show positional isomerism

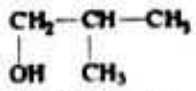
Q.16



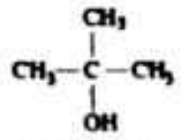
n-butyl alcohol
1-butanol
b.p. 118 °C



sec-butyl alcohol
2-butanol
b.p. 99 °C



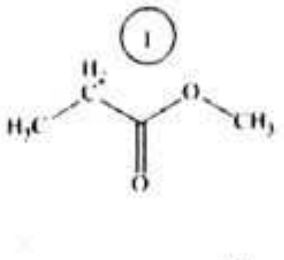
Isobutyl alcohol
2-methyl-1-propanol
b.p. 108 °C

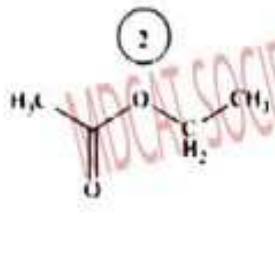


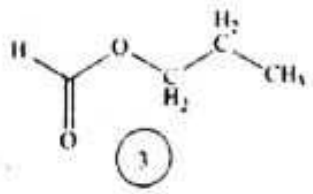
t-butyl alcohol
2-methyl-2-propanol
b.p. 82 °C

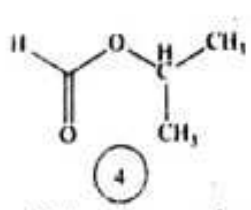
Q.17 Alkanes do not show geometrical isomerism due to rotation around single bond

Q.18





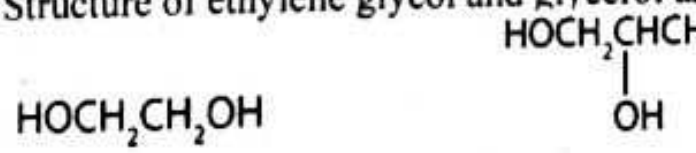




Q.19 The shifting of proton within the molecule is called tautomerism

Q.20 In alkanes there is no functional group, therefore it can not show positional isomerism

Q.22 Structure of ethylene glycol and glycerol are given below



Ethylene glycol

Glycerol

Q.23

$-NH_2$ (Amino)

$\backslash C = NH$ (Imino)

$-C \equiv N$ (Cyano)

$-\overset{\overset{O}{\|}}{C}-NH_2$ (Amide)

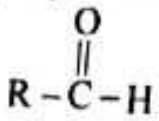
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Q.24 Alcohols have OH-group as a functional group

Q.25

In aldehyde group, carbonyl carbon is linked with one H and one R group



Q.26 Urea is organic compound which belongs to amide class

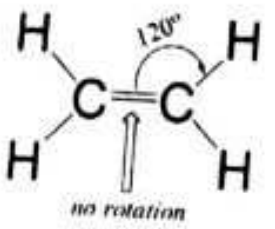
Q.27 Intermixing of one 2s and one 2p give two sp hybridized orbitals

Q.28 In sp^2 hybrid orbital

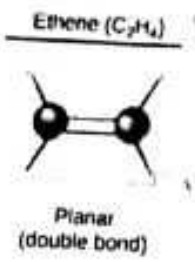
% of s character =1/3 x 100= 33.3%

Q.29 In sp^3 % of p character = 3/4 x 100= 75%

Q.30

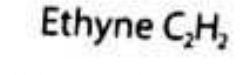


Q.31



Q.32

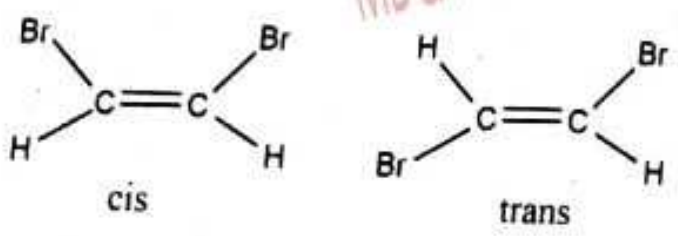
Ethyne C_2H_2



$H-C\equiv C-H$

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Q.33



Q.34

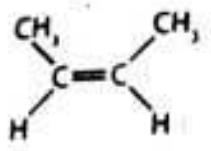
No. of carbon atoms in alkane	No. of isomers
4	2
5	3
6	5

Q.35

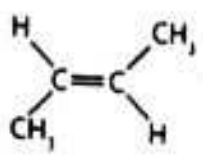
Functional group isomerism	Same molecular formula, but different functional groups	Different	C_3H_7OH and $CH_3OC_2H_5$

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Q.36



cis-2-butene

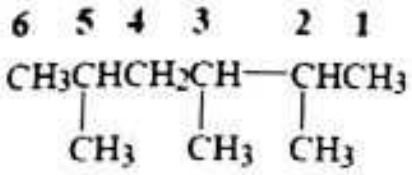


trans-2-butene

Q.38

Metamerism	Unequal distribution of carbon atoms (R) on either side of functional group	Same	di-n-propyl ether and ethyl n-butyl ether

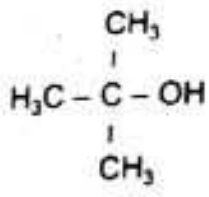
Q.39



2,3,5-Trimethylhexane

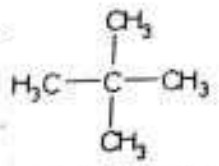
Q.40 Propanone is also known as alkanone

Q.41



t-Butyl Alcohol

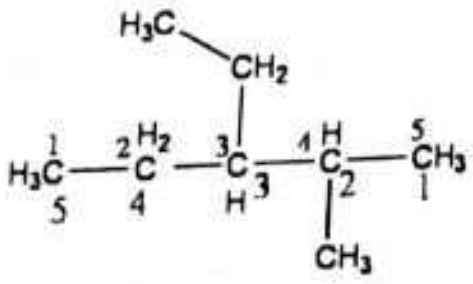
Q.42

Neopentane 

2,2-Dimethylpropane

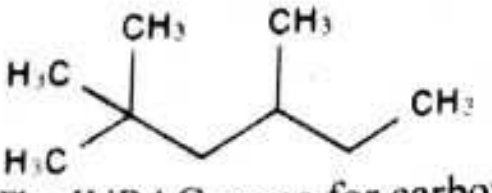
Q.43 Propene is alkene which has general formula C_nH_{2n} and Propyne is alkyne with general formula C_nH_{2n-2}

Q.44



3-ethyl-2-methylpentane

Q.47



Q.48 The IUPAC name for carboxylic acid is used as alkanoic acid. The suffix is -oic

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Topic 14 CHEMISTRY OF HYDROCARBONS

PRACTICE EXERCISE

CHEMISTRY OF ALKANES

THE MECHANISM OF FREE RADICAL SUBSTITUTION REACTION

Q.1 The extent of halogenation of alkanes depends upon the factors:

A) Intensity of UV light
B) Temperature
C) Concentration of X_2 used
D) Both A) and B)

Q.2 Propagation of free radical mechanism takes place by the

A) Reaction of free radical with free radical
B) Formation of two free radicals
C) Consumption as well as production of another free radical
D) Reaction between two molecules

Q.3 The termination step in chlorination of methane in presence of diffused sun light is

A) $Cl_2 \longrightarrow 2C\dot{l}$
B) $Cl_2\dot{C}H + C\dot{l} \longrightarrow HCCl_3$
C) $CH_4 + C\dot{l} \longrightarrow \dot{C}H_3 + HCl$
D) $H_3\dot{C} + Cl_2 \longrightarrow H_3CCl + C\dot{l}$

Q.4 Select the correct option when methane and chlorine gas are made to react with each other in equal proportion volume in presence of sun light:

A) $CH_3Cl + HCl$
B) $CH_2Cl_2 + 2CH_3Cl$
C) $CHCl_3 + Cl_2$
D) $CCl_4 + Cl_2$

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Q.5 If excess of methane is treated with chlorine gas then the major possible hydrocarbons derivative would be:

A) Dichloromethane
B) Tetrachloromethane
C) Chloromethane
D) Trichloromethane

Q.6 The most probable products are _____ when Cl_2 is supplied in very high excess to react with CH_4:

A) $CH_3Cl+HCl$
B) CH_2Cl_2+2HCl
C) $CHCl_3+3HCl$
D) CCl_4+4HCl

Q.7 Halogenation of alkane is believed to proceed through

A) Free radical substitution mechanism
B) Electrophilic substitution mechanism
C) Nucleophilic addition mechanism
D) Nucleophilic substitution mechanism

CHEMISTRY OF ALKENES

PREPARATION OF ALKENES

Q.8 The ease of dehydration of alcohols to produce alkenes is of the order:

A) Tertiary > Secondary > Primary
B) Secondary < Primary < Tertiary
C) Primary > Secondary > Tertiary
D) Tertiary < Secondary < Primary

Q.9 Dehydration of alcohols with conc. H_2SO_4 at 180°C gives:

A) Ethers
B) Alkenes
C) Esters
D) Alkyl halides

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Q.10 Elimination of a halogen atom together with a hydrogen atom from an alkyl halide produces:

A) Alkanes
B) Alkynes
C) Alkenes
D) Alcohols

Q.11 Dehydrohalogenation of RX occurs in the presence of

A) An alcoholic base
B) An alcoholic salt
C) An alcoholic acid
D) An alcoholic Grignard reagent

Q.12 Ethanol with conc. H_2SO_4 at 140°C forms _____.

A) Ethene
B) Ester
C) Ether
D) Ethane

Q.13 Which of the following is not used for the dehydration of alcohols?

A) P_4O_{10}
B) H_2SO_4
C) HNO_3
D) H_3PO_4

REACTIONS OF ALKENES

Q.14 What type of reaction that occurs between ethene and hydrogen?

A) Addition
B) Dehydration
C) Neutralization
D) Oxidation

Q.15 Which of the following will decolorize bromine water?

A) 1-Pentene
B) 2-Methyl-1-butene
C) Pentane
D) Both "A" and "B"

Q.16 Which of the following test can be used for distinguishing an alkane and an alkene

A) Bromine water test
B) Ozonolysis
C) Hydroxylation
D) Both "A" and "C"

Q.17 Hydroxylation of alkenes produce

A) Diols
B) Geminal diols
C) Vicinal diols
D) Mono-ols

Q.18 The preparation of vegetable ghee involves

A) Halogenation
B) Hydroxylation
C) Hydrogenation
D) Dehydrogen

Q.19 The test for unsaturation of organic compounds is carried out by treating alkenes with 1% dilute alkaline $KMnO_4$ solution. The colour of $KMnO_4$ is discharged with the formation of

A) Ethylene glycol
B) Glyoxal
C) Vicinal glycol
D) Oxalic acid

Q.20 In which addition reaction Markownikov's rule is not obeyed:

A) $CH_3CH = CH_2 + HCl \rightarrow$
B) $CH_3CH = CH_2 + HBr \rightarrow$
C) $CH_3CH_2CH = CH_2 + HI \rightarrow$
D) $CH_3CH = CHCH_3 + HBr \rightarrow$

Q.21 In addition of HCl to $CH_3CH = CH_2$, which one will be added first:

A) Cl^+
B) H^+
C) Cl^{-1}
D) $H^\bullet$

Q.22 Which of the following is monoene

A) 1,3-Butadiene
B) 1-Butene
C) 1-Butyne
D) 1,2-Butadiene

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Q.23 Baeyer's reagent is used in the laboratory for

A) Reduction
B) Detection of double bond
C) Oxidation
D) Detection of glucose

PREPARATIONS AND REACTIONS OF ALKYNES

Q.24 The only alkyne which gives an aldehyde upon addition of water

A) Ethyne
B) 1-butyne
C) Propyne
D) 2-butyne

Q.25 Which of the following is not acidic in nature

A) Ethyne
B) 1-butyne
C) Propyne
D) 2-butyne

Q.26 Which of the following is most reactive to give electrophilic addition reactions

A) Alkane
B) Benzene
C) Alkene
D) Alkyne

Q.27 General formula of alkyne is

A) C_nH_{2n+2}
B) C_nH_{2n}
C) C_nH_{2n-2}
D) C_nH_{2n+1}

Q.28 Which of the following will be acidic?

A) Propyne
B) Ethyne
C) 1-butyne
D) All of the above

Q.29 Acetone is prepared by the hydration of

A) Ethyne
B) Ethane
C) Propyne
D) Propane

Q.30 Acetylene gives _____ precipitates with $AgNO_3$ in ammonium hydroxide solution

A) White
B) Orange
C) Red
D) Yellow

Q.31 Which of the following compound reacts with sodium to yield hydrogen gas

A) $CH_3–CH_3$
B) $CH \equiv CH$
C) $CH_3 – CH = CH_2$
D) $CH_3 – C \equiv C–CH_3$

Q.32 Trans 2-butene can be obtained from 2-butyne by using

A) Na / NH_3 (liquid)
B) $LiAlH_4$
C) $Pd(BaSO_4)$ / quinoline
D) H_2 / Pd

CHEMISTRY OF BENZENE

STRUCTURE OF BENZENE

Q.33 Total number of hybrid orbitals of all the carbon atoms in benzene are:

A) 3
B) 12
C) 6
D) 18

Q.34 The resonance energy of benzene is

A) –119.5kJ/mole
B) +150.5kJ/mole
C) –358.5kJ/mole
D) –208kJ/mole

Q.35 The C–C bond length in benzene molecule is

A) 1.54 A^o
B) 1.397 A^o
C) 1.34 A^o
D) 1.09 A^o

Q.36 How many π electrons are there in benzene to form delocalized electronic cloud?

A) 3
B) 8
C) 4
D) 6

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ELECTROPHILIC SUBSTITUTION REACTIONS AND THE MECHANISM

Q.37 What is required other than anhydrous $AlCl_3$, when toluene is prepared by Friedal craft reaction?

A) C_6H_6
B) $C_6H_5C_2H_5$
C) $C_6H_6 + CH_3Cl$
D) C_6H_5Cl and CH_3Cl

Q.38 Benzene undergoes _____ readily

A) Substitution reaction
B) Oxidation reaction
C) Addition reaction
D) Elimination reaction

Q.39 Which of the following is produced by the action of CH_3Cl on benzene in presence of $AlCl_3$ followed by oxidation in the presence of acidified $KMnO_4$ give

A) Toluene
B) m-Xylene
C) o-Xylene
D) Benzoic acid

HYDROGENATION OF BENZENE

Q.40



A) H_2
B) $2H_2$
C) $3H_2$
D) $4H_2$

Q.41 An organic compound X on reduction by consuming 3-molecules of hydrogen gas to product Y. Y is a cyclic saturated hydrocarbon, X is:

A) Vinyl acetylene
B) Divinyl acetylene
C) Benzene
D) Cyclohexane catalyst

Q.42 The conversion of benzene into cyclohexane is _____

A) Exothermic process
B) Endothermic process
C) Isothermic process
D) Both A and B

Q.43 The conversion of benzene to cyclohexane is an example of:

A) Addition reaction
B) Elimination reaction
C) Substitution reaction
D) Polymerization

SIDE CHAIN OXIDATION OF ALKYL BENZENE

Q.44 X is decolourized when alkyl benzene are readily oxidized to benzoic acid, X is

A) Aqueous $KMnO_4$ or $K_2Cr_2O_7$
B) Alcoholic $KMnO_4$ or $K_2Cr_2O_7$
C) Cold dilute alkaline $KMnO_4$ or $K_2Cr_2O_7$
D) Acidified $KMnO_4$ or $K_2Cr_2O_7$

Q.45 Benzoic acid is the only oxidation product along with formation H_2O and CO_2, of an organic compound A, when A is treated with acidified potassium dichromate, A is

A) Ethyl benzene
B) Aniline
C) Benzoyl halide
D) Benzophenone

Q.46 Benzoic acid is the main product when _____ is oxidized by acidified $K_2Cr_2O_7$

A) $C_6H_5CH_3$
B) $C_6H_5CH_2CH_3$
C) $C_6H_5CH_2CH_2CH_3$
D) All of these

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Q.47 The oxidation of toluene by acidified $KMnO_4$ produces

A) Phenol
B) Benzyl alcohol
C) Benzaldehyde
D) Benzoic acid

BENZENE RING, BY 2,4 DIRECTING AND 3,5 DIRECTING GROUPS

Q.48 Most reactive compound among the following:

A) Benzene
B) Nitrobenzene
C) Benzoic acid
D) Ethyl benzene

Q.49 Which group deactivates the benzene ring?

A) $-NH_2$
B) $-OR$
C) $-CHO$
D) $-OH$

Q.50 $X \xrightarrow[FeCl_3]{Cl_2} Y \xrightarrow{HNO_3+H_2SO_4} Z$, **Z in this reaction is possibly**

A) Benzene
B) 3-Chloronitrobenzene
C) Chlorobenzene
D) 2-Chloronitrobenzene

PAST PAPERS QUESTIONS

Q.1 Which one of the following reactions shows combustion of a saturated hydrocarbon?

A) $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$
B) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
C) $CH_4 + \frac{1}{2}O_2 \xrightarrow[400°C,200atm]{Cu} CH_3OH$
D) $C_2H_2 + \frac{5}{2}O_2 \longrightarrow 2CO_2 + H_2O$

Q.2 Catalytic Oxidation of alkanes result in formation of _____:

A) Carboxylic acid
B) Aldehyde
C) Ketone
D) Alcohol

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Q.3 Which of the options show all possible products of combustion of Butene?

A) $CO+CO_2+H_2O$
B) $C+CO+CO_2$
C) CO_2+H_2O
D) $C+CO+CO_2+H_2O$

Q.4 Reaction mechanism of alkanes with halogens is known as

A) Addition
B) Free radical substitution
C) Elimination
D) Propagation

Q.5 Ordre of reactivity of halogen toward alkance is

A) $F_2>I_2>Br_2>Cl_2$
B) $F_2>Br_2>Cl_2>I_2$
C) $F_2>Cl_2>Br_2>I_2$
D) $F_2>Cl_2>I_2>Br_2$

Q.6 Which compound is obtained by the elimination of bromopropane?

A) Butene
B) Ethene
C) Propene
D) Propane

Q.7 Hydrogenation of unsaturated oils is done by using

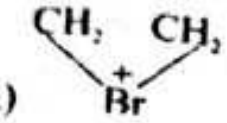
A) Finally divided nickel
B) Vanadium pentaoxide
C) Finally divided iron
D) Copper

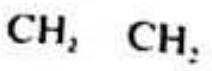
Q.8 Ethene on polymerization, give the product polyethene, this reaction may be called as

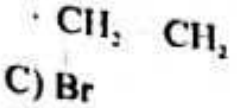
A) Addition
B) Condensation
C) Substitution
D) Pyrolysis

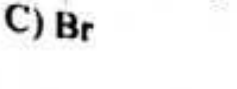
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Q.9 In the reaction of ethene with bromine the intermediate formed is

A) 

B) 

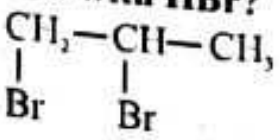
C) 

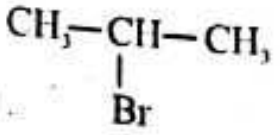
D) 

Q.10 What is the product formed when propene reacts with HBr?

A) $CH_3-CH_2-CH_2Br$

B) $BrCH_2-CH=CHBr$

C) 

D) 

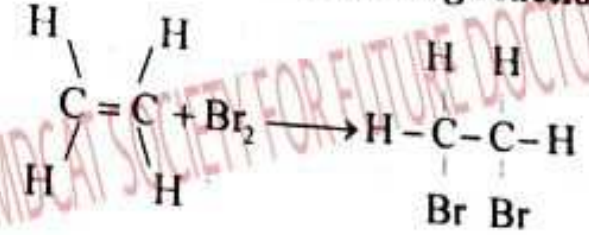
Q.11 Addition of unsymmetrical reagent to an unsymmetrical alkene is governed by

A) Cannizzaro's Reaction
B) Krichoff Rule
C) Aldol condensation
D) Markownikov's Rule

Q.12 Order of reactivity of alkenes with hydrogen halide is

A) HBr > HI > HCl
B) HI > HBr > HF
C) HF > HI > HCl
D) HI > HBr > HCl

Q.13 Bromination of alkene is shown in the following reaction. This reaction is used for



A) identification of primary and secondary alcohols
B) Detection of double bond
C) Detection of aldehydes
D) Detection of ketones

Q.14 Treatment of ethene with cold sulphuric acid followed by reaction with boiling water yields:

A) Ethyne
B) Ethanal
C) Ethane
D) Ethanol

Q.15 Alkenes undergo:

A) Nucleophilic substitution
B) Electrophilic Addition
C) Nucleophilic addition
D) Electrophilic substitution

Q.16 Acetone can be obtained by ozonolysis

A) 2-Batyne
B) iso-butene
C) 2-Butene
D) 1-butene

Q.17 When hydrogen atom is removed from benzene, group left is called:

A) Alkyl group
B) Benzyl group
C) Phenyl group
D) Methyl group

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Q.18 The ratio of σ and π bond is benzene is

A) 4:1
B) 1:3
C) 1:4
D) 3:1

Q.19 The introduction of NO_2 group in the benzene ring is called nitration. The nitration of benzene takes place when it is heated with a 1:1 mixture of ---------- at 50-55°C

A) Conc. HNO_3 and Conc. H_2SO_4
B) Conc. HNO_3 and Conc. Acetic acid
C) Conc. HNO_3 and Conc. HCl
D) Conc. HNO_3 and Conc. H_3PO_4

Q.20 The substitution of –H group by $-NO_2$ group in benzene is called

A) Nitration
B) Sulphonation
C) Ammonolysis
D) Reduction of benzene

Q.21 Which one of the following is a powerful electrophile used to attack on the electrons of benzene ring?

A) $FeCl_2$
B) $FeCl_4^-$
C) Cl^+
D) Cl_2

Q.22 The reaction of benzene with bromine in the presence of $FeBr_3$ follows the mechanism of _____ reaction

A) Electrophilic addition
B) Nucleophilic substitution
C) Electrophilic substitution
D) Nucleophilic addition

Q.23 For halogenation of benzene, which reagent is used

A) H_2SO_4
B) $AlCl_3$
C) HNO_3
D) HCl

Q.24 Chlorination and Bromination mostly uses _____

A) Radiowaves
B) Visible light
C) Infrared radiation
D) U.V light

Q.25 Which one of the following acts as a electrophile in the electrophilic substitution of benzene with bromine

A) Br^+
B) Fe^{+3}
C) $FeCl_4^-$
D) Fe^{+2}

Q.26 Benzene in presence of $AlCl_3$ gives acetophenone when reacts with

A) Acetyl chloride
B) Ethyl benzene
C) Acetic acid
D) Ethanoic acid

Q.27 The introduction of $R-\overset{O}{\overset{\|}{C}}$ group in benzene is called

A) Acylation
B) Carbonyl reduction
C) Alkylation
D) Formylation

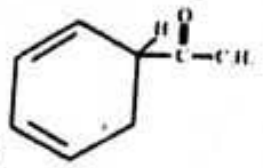
Q.28 The introduction of an alkyl group in benzene takes place in the presence of $AlCl_3$ and:

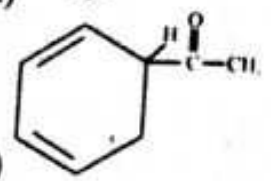
A) $R-\overset{O}{\overset{\|}{C}}-OH$
B) $R-Cl$
C) $R-\overset{O}{\overset{\|}{C}}-Cl$
D) $R-\overset{O}{\overset{\|}{C}}-O-$

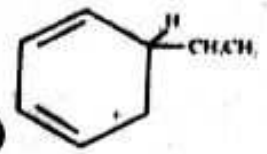
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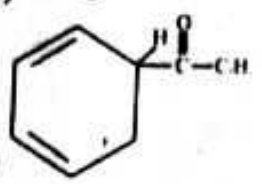
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Q.29 Intermediate product formed when propanoyl chloride reacts with benzene is

A) 

B) 

C) 

D) 

Q.30 When benzene reacts with Acetyl chloride (CH_3COCl) in the presence of $AlCl_3$ acetophenone is formed. The electrophile in this reaction will be

A) CH_3C^+O
B) $AlCl_3$
C) C^+H_3
D) CH_3COCl

Q.31 In Friedal Craft's Chlorination of Benzene, Iron III chloride acts as a catalyst, which is the initial reaction in the generation of an electrophile?

A) $Cl_2 + FeCl_3 \rightarrow Cl^+ + FeCl_3^-$
B) $Cl_2 + FeCl_3 \rightarrow 2Cl^+ + FeCl_2^-$
C) $Cl_2 + FeCl_3 \rightarrow Cl^- + FeCl_4^+$
D) $Cl_2 + FeCl_3 \rightarrow Cl^+ + FeCl_4^-$

Q.32 Which of the following species are 3,5(meta) directing groups when second group is introduced into the benzene ring

I = – NH_2 II = – CHO III = – COOH IV = – CH_3

A) II, III and IV
B) II and III
C) I and IV
D) I, II and IV

Q.33 Which derivative of benzene shows maximum reactivity in electrophilic substitution reactions?

A) Benzaldehyde
B) Benzoic acid
C) Methyl benzene
D) Nitrobenzene

Q.34 Which of the following compound react slower than benzene in electrophilic substitution reaction

A) Nitrobenzene
B) Aniline
C) Phenol
D) Toulene

Q.35 Which catalyst is used in oxidation of benzene ring?

A) $FeBr_3$
B) $Fe+Al_2O_3$
C) V_2O_5
D) Raney Ni

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ANSWER KEY

1	C	11	A	21	B	31	B	41	C
2	C	12	C	22	A	32	A	42	A
3	B	13	C	23	B	33	D	43	A
4	A	14	A	24	A	34	B	44	D
5	C	15	D	25	D	35	B	45	A
6	D	16	D	26	C	36	D	46	D
7	A	17	C	27	C	37	C	47	D
8	A	18	C	28	D	38	A	48	D
9	B	19	C	29	C	39	D	49	C
10	C	20	D	30	A	40	C	50	D

PAST PAPER QUESTIONS

1	B	6	C	11	D	16	B	21	C	26	A	31	D
2	A	7	A	12	D	17	C	22	C	27	A	32	B
3	D	8	A	13	B	18	D	23	B	28	B	33	C
4	B	9	A	14	D	19	A	24	D	29	D	34	A
5	C	10	D	15	B	20	A	25	A	30	A	35	C

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EXPLANATORY NOTES

Q.1

$$CH_4 + X_2 \longrightarrow CH_3X + HX$$

$$CH_4 + 2X_2 \longrightarrow CH_2X_2 + 2HX$$

$$CH_4 + 3X_2 \longrightarrow CHX_3 + 3HX$$

$$CH_4 + 4X_2 \longrightarrow CX_4 + 4HX$$

A) and B) control rate of reaction.

Q.2 Propagation step involves

i) Attack of free radical on molecule
ii) Homolytic fission in molecule
iii) Bond formation
iv) Formation of new molecule
v) Formation of new free radical

$$R^\circ + Cl_2 \longrightarrow R - Cl + Cl^\circ$$

$$Cl^\circ + R - H \longrightarrow HCl + R^\circ$$

Q.3 Termination step in free radical substitution mechanism involves

i) Attack of free radical on other free radical
ii) Bond formation
iii) Formation of a molecule

$$Cl^\circ + Cl^\circ \longrightarrow Cl_2$$

$$R^\circ + X^\circ \longrightarrow R - X$$

$$R^\circ + R^\circ \longrightarrow R - R$$

Q.4 $CH_4 + Cl_2 \longrightarrow CH_3Cl + HCl$

Q.5 $CH_4 + Cl_2 \longrightarrow CH_3Cl + HCl$

Q.6 $CH_4 + Cl_2 \longrightarrow CH_3Cl + HCl$

$CH_3Cl + Cl_2 \rightarrow CH_2Cl_2 + HCl$

$CH_2Cl_2 + Cl_2 \rightarrow CHCl_3 + HCl$

$CHCl_3 + Cl_2 \rightarrow CCl_4 + HCl$

Q.7 The initiation propagation and termination of halogenation of alkane involves free radicals.

Initiation step $Cl_2 \longrightarrow 2Cl^\circ$

Propagation step $Cl^\circ + CH_4 \longrightarrow HCl + \dot{C}H_3$

Termination step $\dot{C}H_3 + Cl^\circ \longrightarrow CH_3Cl$

Q.8 The dehydration of alcohols is an elimination reaction which involves C – O cleavage.

Ease of dehydration $\propto$ Ease of C – O cleavage $\propto$ number of β - carbon in alcohol.

3 β – C in tertiary alcohol, 2 β –C in secondary alcohol and 1 β –C in primary alcohol.

Ease of dehydration $\propto$ Ease of C – O cleavage $\propto$ Size of R in alcohol

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Q.9 Concentration H_2SO_4 180°C causes β-elimination reaction

$$C_2H_5OH \xrightarrow[180°C]{\text{conc } H_2SO_4} H_2C=CH_2 + H_2O$$

But concentration H_2SO_4 causes condensation elimination reaction at 140°C.

$$2C_2H_5OH \xrightarrow[140°C]{\text{conc } H_2SO_4} C_2H_5-O-C_2H_5$$

Q.10 This is β-elimination reaction which involves removal of X from α–C and removal of β–H from β–C.

$$-\overset{H}{\underset{|}{C}}-\overset{X}{\underset{|}{C}}- + KOH \xrightarrow{\text{alcohol}} -C=C- + KX + H_2O$$

Dehalogenation is removal of X from α–C and β–H from β–C.

Q.11 In alcoholic medium OH becomes a base strong base hence it attacks on β–H instead of replacing X from RX. Therefore, alkene is produce from RX by β-elimination reaction.

$$OH^- + -\overset{H}{\underset{|}{C}}-\overset{X}{\underset{|}{C}}- + KOH \xrightarrow{\text{alcohol}} -C=C- + KX + H_2O$$

Q.12 At low temperature (140°C) ethanol is dehydrated by condensation elimination reaction but at high temperature (180°C) ethanol gets dehydrated by β-elimination reaction.

Q.13 Dehydration of alcohols need dehydrating agents like concentrated H_2SO_4, P_2O_3 or P_4O_{10}, H_3PO_4 and Al_2O_3.

HNO_3 is not a dehydration agent at all.

Q.14 Ethene is an unsaturated hydrocarbon. So, it becomes saturated reduced by the addition of hydrogen gas.

$$C_2H_4 + H_2 \xrightarrow[\Delta]{Ni} C_2H_6$$

Q.15 Bromine water ($Br_{2(aq)}$) is reddish brown in colour. It is used to detect unsaturation in hydrocarbon when any unsaturated hydrocarbon (1-Pentene / 2-Methyl-1-pentene) come across it. Bromine water is decolourized.

Q.16 Alkane is saturated hydrocarbon while alkene is an unsaturated one. The presence of unsaturation is detected by bromine water test and hydroxylation (using Baeyer's reagent). Ozonolysis is used to locate position of double bond.

Q.17

$$-C=C- + 2KMnO_4 - H_2O \xrightarrow{\text{cold}} -\overset{OH}{\underset{|}{C}}-\overset{OH}{\underset{|}{C}}- + 2MnO_2 + 2KOH$$

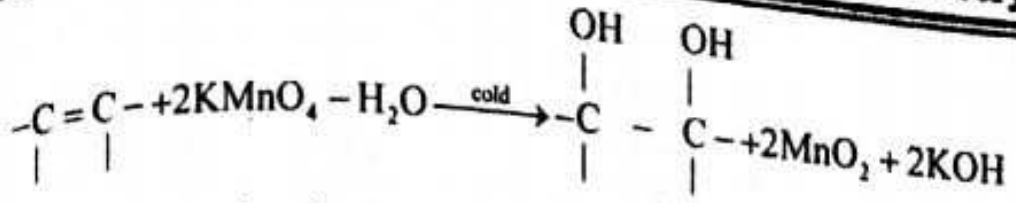
Q.18 Vegetable ghee is prepared from vegetable oil which is tri-ester of unsaturated fatty acids with glycerol.

The unsaturation can be vanished by hydrogenation in presence of Ni at high temperature.

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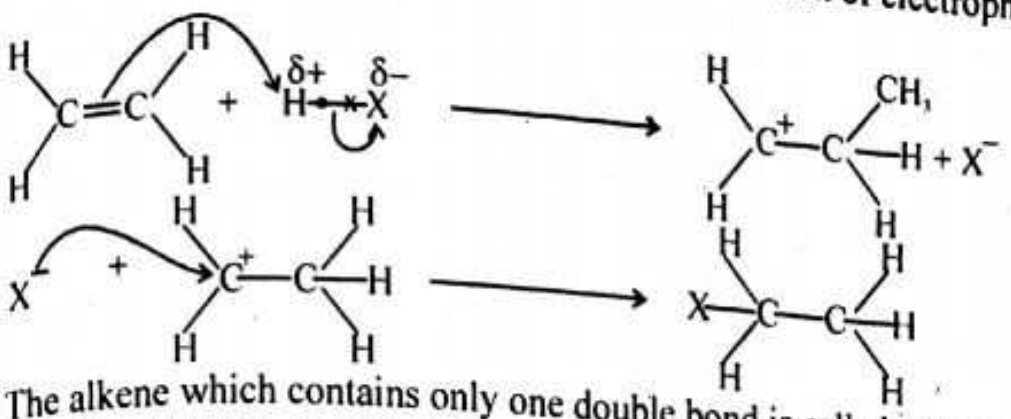
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Q.19



Q.20 Markownikove's rule is obeyed by unsymmetrical alkenes. Symmetrical alkanes like $CH_3CH = CHCH_3$ having no binding to obey the rule because both doubly bonded carbon atoms have same number of hydrogen atom.

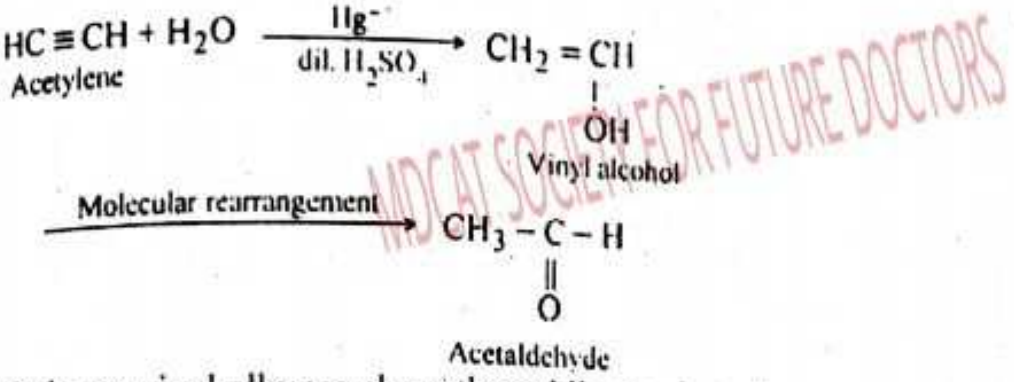
Q.21 In case of alkenes, the addition is started by the attack of electrophile.



Q.22 The alkene which contains only one double bond is called monoene.

Q.23 Alkaline $KMnO_4$ is called Baeyer's reagent which is used in the laboratory for the detection of double bond.

Q.24



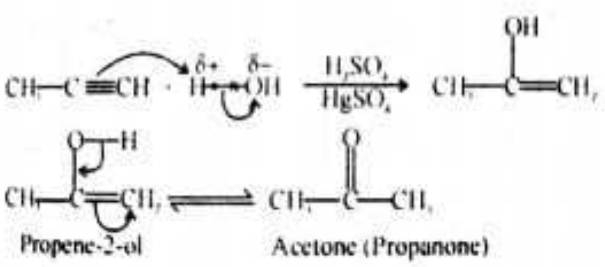
Q.25 Only terminal alkynes show the acidic character because sp hybridized carbon atoms of a terminal alkyne pulls the elelctrons more strongly making the attached hydrogent atom slightly acidic. 2-Butyne is not acidic because it is not terminal alkyne.

Q.26 Reactivity order of alkane, alkene and alkyne is given below
Alkene > Alkyne > Alkane

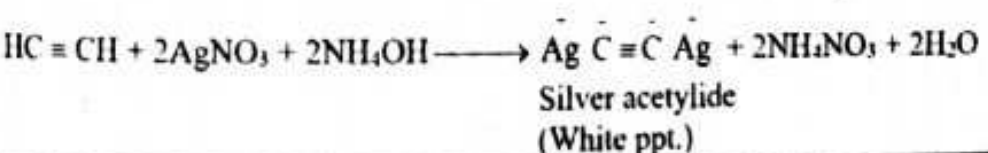
Q.27 General formula of alkyne is C_nH_{2n-2}

Q.28 Only terminal alkynes show the acidic character because sp hybridized carbon atoms of a terminal alkyne pulls the elelctrons more strongly making the attached hydrogent atom slightly acidic.

Q.29



Q.30



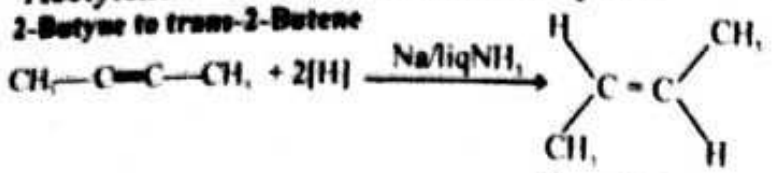
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Q.31

$$HC \equiv CH + 2Na \longrightarrow \dot{N}a\ \bar{C} \equiv \bar{C}\ \dot{N}a + H_2$$

Acetylene — Sodium acetylide

Q.32 2-Butyne to trans-2-Butene

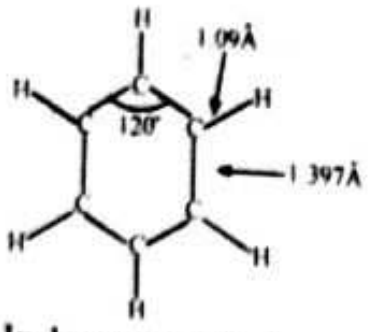


Trans-2-Butene

Q.33 Benzene consists of six sp^2-hybridized carbon atoms each sp^2-carbon atoms has $3sp^2$ hybrid orbital therefore the total number of hybrid orbitals in benzene would be 18.

Q.34 Resonance energy of benzene is +150.5 $kJmol^{-1}$

Q.35



Q.36 In benzene all six carbon atoms are sp^2-hybridized, so each carbon atom is having one half filled un-hybrid orbital that involved in partially overlapped with adjacent un-hybrid orbitals of p to form π –electrons cloud of 6 electron clouds.

Q.37 In Friedal Craft's reaction $AlCl_3$ is a catalyst. It acceleration the speed of reaction between C_6H_6 an R–X like CH_3Cl.

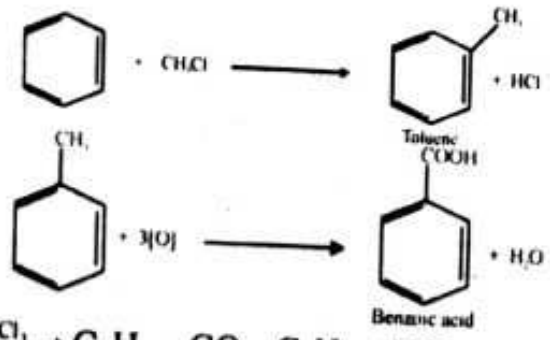


Toluene

Q.38 Benzene is unique is its behaviour.

- It is highly unsaturated compound but very stable molecule as well.
- Its stability is due to the extensive delocalization of π-electrons.
- It resembles alkenes when it gives addition reactions.
- Its substitution does not involve free radicals but follow electrophilic substitution reactions.
- It requires drastic conditions as compared to alkenes.
- It is also resistant to oxidation.

Q.39

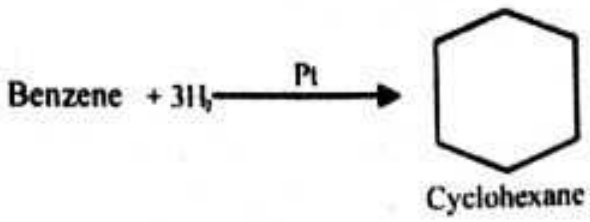


$$C_6H_6 + C_6H_5COCl \xrightarrow{AlCl_3} C_6H_5 - CO - C_6H_5 + HCl$$

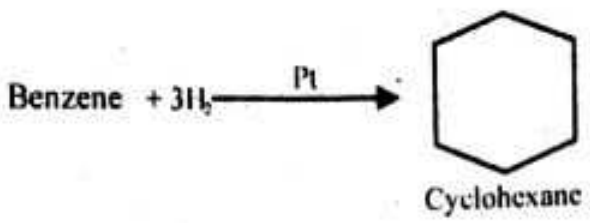
$$C_6H_6 + CH_3CH_2CH_2 - Cl \xrightarrow{AlCl_3} C_6H_5 - C_3H_7 + HCl$$

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Q.40

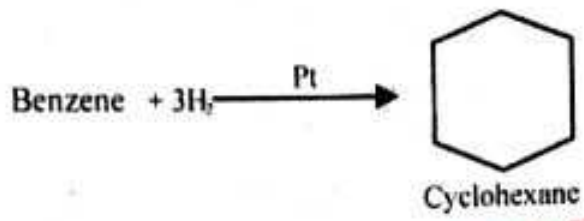


Q.41



Q.42 The conversion of benzene to cyclohexane is hydrogenation. This process of hydrogenation is an exothermic by 208kJ/mol.

Q.43



Theoretical value = -358.5 kJ/mole (calculated heat of hydrogenation)

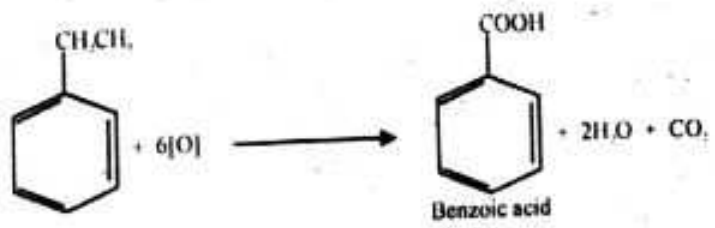
Experimental value = -208.0 kJ/mole (observed heat of hydrogenation)

Difference = -150.5 kJ/mole (resonance energy)

Q.44 Alkyl benzene are oxidized to benzoic acid by nascent oxygen which is produce by reacting purple coloured $KMnO_4$ with H_2SO_4 or orange red coloured $K_2Cr_2O_7$ during this production colour is discharged.

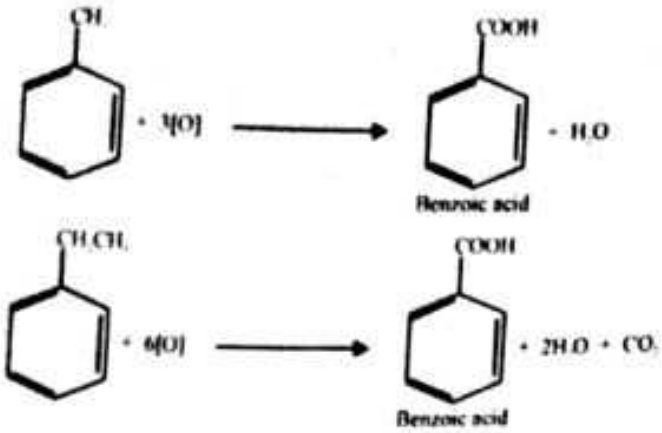


Q.45



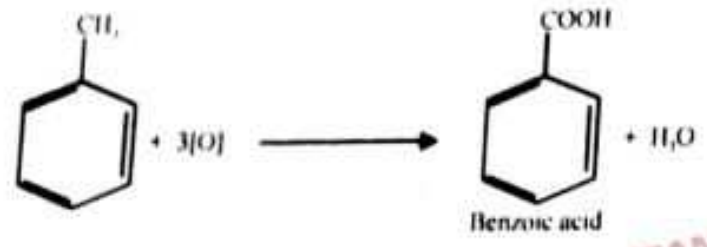
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Q.46



Whatever the length of an alkyl group may be, it gives only one carboxyl group. Moreover the colour of $KMnO_4$ is discharged. Therefore, this reaction is used as a **test for alkylbenzenes**.

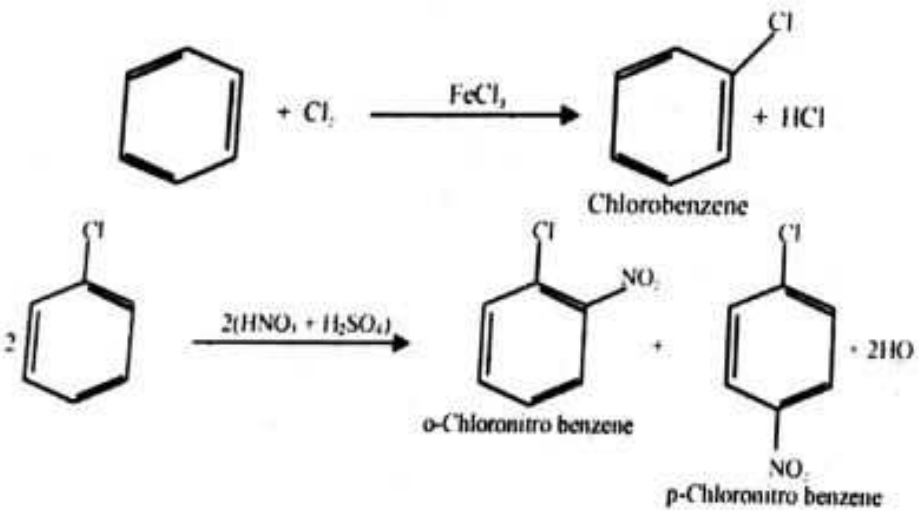
Q.47



Q.48 In ethyl benzene, ethyl group is ortho, para directing groups which activate the benzene ring.

Q.49 -*CHO* is meta directing group which deactivates the benzene rings While $-NH_2$, -OR and -*OH* are activate the benzene ring.

Q.50



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Topic 15

ALKYL HALIDES

PRACTICE EXERCISE

NOMENCLATURE AND CLASSIFICATION OF ALKYL HALIDES

Q.1 **Which of the following is alkyl halide**

A) CH_3Cl
B) CH_2Cl_2
C) $C_2H_4Cl_2$
D) All of these

Q.2 **Which one is monohaloalkane**

A) CH_2Cl_2
B) $CHCl_3$
C) $CH_3 — CH_3 — CH_2 — Cl$
D) CCl_4

Q.3 **In primary alkyl halides, the halogen atom may attached to a carbon, which is further attached to how many carbon atoms**

A) Two
B) One
C) Three
D) Four

Q.4 **The IUPAC name of given compound is**

$$CH_3 - \underset{\displaystyle CH_3}{\overset{|}{CH}} - CH_2 - Cl$$

A) 1-chloro-2-methylbutane
B) Iso-butylchloride
C) 1-chloro-2-methylpropane
D) 3-chloro-2-methylpropane

Q.5 **Which of the following is primary alkyl halide**

A) Iso-propyl halide
B) Ter. butyl halide
C) Sec. butyl halide
D) Neo-pentyl halide

Q.6 **Which is the correct name of the given compound**

$$H_3C - \underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}} - CH_2\text{-}I$$

A) Tertiary pentyl iodide
B) Neo pentyl iodide
C) Secondary butyl iodide
D) n-pentyl iodide

REACTIONS OF ALKYL HALIDES + SN REACTIONS AND MECHANISMS

Q.7 **Elimination bimolecular reactions involve:**

A) 1st order kinetics
B) Zero order kinetics
C) 2nd order kinetics
D) None of these

Q.8 **Which one among the following is not a good leaving group?**

A) HSO_4^-
B) OH^-
C) Cl^-
D) Br^-

Q.9 **Alkyl halides are considered to be very reactive compounds towards nucleophile because**

A) They have an electrophilic carbon
B) They have an electrophilic carbon and a good leaving group
C) They have an electrophilic carbon and a bad leaving group
D) They have a nucleophilic carbon and a good leaving group

Q.10 **Order of S_N1 reaction**

A) 1
B) 2
C) 1.5
D) 3

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Q.11 Which of the following is correct about S_N1 reactions:
A) Retention of the configuration of the alkyl halide molecule
B) Unimolecular reactions
C) Reaction rate is a function of the [alkyl halide]
D) All of these

Q.12 β-elimination reactions are due to:
A) Attack of the incoming nucleophile on alpha hydrogen
B) Attack of the incoming nucleophile on beta hydrogen
C) Attack of the incoming nucleophile on beta carbon
D) Attack of incoming nucleophiles on electrophilic carbon

Q.13 Tertiary alkyl halides give
A) S_N1 and E1 reaction
B) S_N2 and E1 reaction
C) S_N2 and E2 reaction
D) None of the above

Q.14 Which of the following is correct about S_N2 reactions:
A) Breakage of C—X and formation C—Nu bonds are simultaneous
B) Inversion of the configuration of the alkyl halide molecule
C) 2nd order kinetics
D) All of these

Q.15 Which statement is incorrect about reactivity of alkyl halides with respect to nucleophile
A) Greater the bond energy of R-X, lesser the reactivity
B) Greater the bond polarity of R-X, lesser the reactivity
C) Greater the bond energy of R-X, smaller the stability
D) Greater E.N difference of R- X, greater the stability

Q.16 Which statement is incorrect about nucleophilic substitution reaction
A) Incoming nucleophile must be stronger than the leaving one
B) Leaving nucleophile must be stronger than incoming nucleophile
C) Tertiary alkyl halides generally give S_N1 reactions
D) S_N2 is a single step mechanism

Q.17 In β -Elimination the resulting product is?
A) Alcohol
B) Alkyl halide
C) Alkane
D) Alkene

Q.18 Which compound is most reactive through SN_2 mechanism
A) CH_3–Cl
B) CH_3–CH_2–Cl
C) CH_3–CH_2–CH_2–Cl
D) All have same reactivity

Q.19 Thioalcohol is prepared when alkyl halide is reacted with
A) $O\bar{H}$
B) NO_2^-
C) $S\bar{H}$
D) I^-

Q.20 Whether an alkyl halide follows SN1 or SN2 mechanism depends on
A) Steric hindrance
B) Inductive effect
C) Stability of carbocation
D) All of these

Q.21 Ter. butyl bromide refers to follow which mechanism during substitution reactions
A) SN1
B) Both A and C
C) SN2
D) It does not show SN reactions

Q.22 If an nucleophile is the attacking reagent which one would be the most reactive one
A) R – F
B) R – Br
C) R – Cl
D) R – I

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Q.23 The rate of E_2 reaction depends on
A) Concentration of substrate
B) Concentration of nucleophile
C) Concentration of both substrate and nucleophile
D) Polarity of solvent

Q.24 During SN2 mechanism of alkyl halides C – X bond undergoes
A) Homolytic cleavage
B) Heterolytic cleavage
C) Sometimes homolytic, sometimes heterolytic
D) C–X bond is not cleaved in SN2 reactions

Q.25 CH_3 – Cl can show which of the following reaction with easiness
A) SN_2
B) E_2
C) SN_1
D) Both A) and B)

Q.26 Which of the following is true about R – I
A) They are most reactive alkyl halide for a given alkyl group
B) They show maximum boiling point for a given alkyl group
C) Cannot be prepared directly by reaction of alkanes with I_2
D) All are true

Q.27 Which of the following reactions is not shown by R – X
A) Substitution reactions
B) Elimination reactions
C) Reduction
D) It shows all of above mentioned reactions

Q.28 Most common reactions shown by alkyl halides are
A) Substitution
B) Reduction
C) Elimination
D) Polymerization

Q.29 2° alkyl halides show both SN_1 and SN_2 reactions depending upon
A) Nature of functional group
B) Nature of solvent
C) Temperature
D) All of these

Q.30 Ammonia reacts with excess of alkyl halide to form
A) 1°- amine
B) 3°-amine
C) 2°-amine
D) Mixture of 1°, 2° and 3° amines

Q.31 The main factor which decides the reactivity of (R – X) is
A) C°–X bond strength
B) Both C – X bond strength and polarity
C) C – X bond polarity
D) Boiling point of the given R– X

Q.32 Higher polarizable nucleophiles favour
A) Substitution reactions
B) Elimination reactions
C) Favour both substitution and elimination reactions equally
D) Cannot be predicted

Q.33 $CH_3 - Cl \xrightarrow[KOH]{Alc.} A$ **. "A" product is**
A) $CH_3 - OH$
B) CH_4
C) $CH_3 - O - CH_3$
D) No reaction will occur

Q.34 High temperature favours elimination reactions over substitution reactions due to
A) More reorganization of bonds in E-reactions
B) Weak polarizability of electrons rich specie
C) Attack on β-hydrogen instead of α- carbon
D) Formation of unsaturated product

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Q.35 Which among CH_3X, $R-CH_2-X$, R_2CHX, R_3CX is most reactive towards SN_2 reaction

A) R_3CX
B) R_2CHX
C) RCH_2X
D) CH_3X

Q.36 Consider the following haloalkanes

1. CH_3F
2. CH_3Br
3. CH_3Cl
4. CH_3I

The increasing order of reactivity in SN reactions is

A) 4 < 3 < 2 < 1
B) 1 < 2 < 3 < 4
C) 1 < 3 < 2 < 4
D) 1 < 2 < 4 < 3

Q.37 3°-Alkyl halides are practically inert to SN_2 mechanism because of

A) Insolubility
B) Inductive effect
C) Instability
D) Steric hindrance

Q.38 The organic chloro compound which shows complete stereo chemical inversion during S_N2 reaction is

A) $(C_2H_5)_2CHCl$
B) $(CH_3)_2CHCl$
C) $(CH_3)_3CCl$
D) CH_3-Cl

Q.39 Second step of which of the following pair of reaction is same

A) E_1 + SN1
B) SN1 + SN2
C) E_2 + SN1
D) None of these

Q.40 Which of the following is the most stable carbocation

A) Secondary
B) Tertiary
C) Primary
D) All have same stability

Q.41 Which reagent is a good nucleophile?

A) NH_3
B) Br_2
C) HBr
D) BH_3

Q.42 $CH_3-CH_2-OH + Alc.NH_3 \longrightarrow$

A) $CH_3CH_2-NH_2$
B) CH_2-CH_2
C) CH_3-CH_2-H
D) $CH_3-CH_2-CH_3$

Q.43 Which C–X bond has highest bond energy per mole

A) C–Br
B) C–Cl
C) C–F
D) C–I

Q.44 Which alkyl halide out of the following may follow both S_N1 and S_N2 mechanism

A) CH_3-X
B) $(CH_3)_2CH-X$
C) $(CH_3)_3C-X$
D) $(CH_3)_3C-CH_2-X$

Q.45 Rate of E_1 reaction depends upon

A) Concentration of nucleophile
B) Concentration of substrate as well as alkyl halide
C) Concentration of substrate only
D) None of these

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Q.46 **In β-elimination reaction, nucleophile attacks on**

A) α-hydrogen
B) β-hydrogen
C) α-carbon
D) β-carbon

Q.47 **An alkyl halide may be converted to alcohol by**

A) Addition
B) Substitution
C) Addition
D) Elimination

Q.48 **Neutral nucleophile among the following is**

A) CN^-
B) Cl^-
C) $:NH_3$
D) $C_2H_5O^-$

Q.49 **100% inversion of configuration take place during**

A) S_N1
B) S_N2
C) E_1
D) E_2

Q.50 **$CH_3CH_2–Br+CN^- \longrightarrow$?**

A) $CH_3CH_2–Br$
B) $CH_3CH_2–CN$
C) $CH_2 = CH_2$
D) No reaction take place

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PAST PAPERS QUESTIONS

Q.1 **CFC's are organic compounds, which are derivatives of saturated hydrocarbons. They have high bond dissociation values therefore they are inert and non-toxic for the living organisms. The word CFS's stands for;**

A) Carboflourochlorines
B) Chlorofluorocarbons
C) Chlorofluorcarbides
D) Chlorofluoridecarbons

Q.2 **Organic compound carbon tetra chloride is used as**

A) Lubricant
B) Oxidant
C) Solvent
D) Plastic

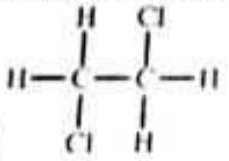
Q.3 **The suspected liver carcinogenic which also has a negative reproduction and developmental effects in human is**

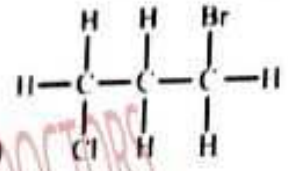
A) Iodoform
B) Chloroform
C) Bromoform
D) Tropoform

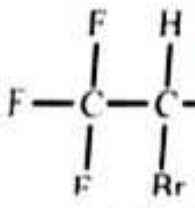
Q.4 **The IUPAC name of halothane is**

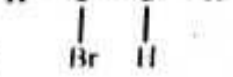
A) 1- Bromo-1-chloro-2,2,2- trifluoroethane
B) 1,1,1-Trifluoro-2 bromo-2-chloroethane
C) 2-Bromo-2-chloro-1,1,1-trifluoroethane
D) 2-Chloro-2- bromo -1,1,1- trifluoroethane

Q.5 **Which one of the followings is Halothane?**

A) 

C) 

B) 

D) 

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Q.6 **The non-stick lining of pans is _____**

A) Difluoroethene
B) Chlorofluoroethene
C) Chloroethene
D) Tetrafluoroethene

Q.7 **Halothane is a halo derivative of**

A) Ethane
B) Methane
C) Ethanol
D) Methanol

Q.8 **Which one of the following is the structure of Teflon?**

A) $(-CF_2-CCl_2-)n$
B) $(-CF_2-CH_2-)n$
C) $(-CH_2-CH_2-)n$
D) $(-CF_2-CF_2-)n$

Q.9 **Which halide ion has the capacity to act as both very good nucleophile and good leaving group in nucleophilic substitution reactions?**

A) I^-
B) F^-
C) Br^+
D) Cl^-

Q.10 **Which product is obtained by the hydrolysis of 1 – chlorobutane with the aqueous sodium hydroxide?**

A) 1-butanol
B) 1-butene
C) 1-butanal
D) Butanone

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Q.11 During S_N2 reaction, configuration of alkyl halide molecule is

A) Remains same
B) Gets inverted
C) Depends upon carbon atom
D) Depends upon electronegativity of halide

Q.12 The alkaline hydrolysis of bromoethane shown below gives alcohol as the product

$$CH_3 - CH_2 - Br \longrightarrow CH_2CH_2OH$$

The reagent and the condition used in this reaction may be

A) H_2O at room temperature
B) Ethanol, heat
C) KOH is alcohol
D) Dilute $NaOH_{(aq)}$, warm

Q.13 In substitution reaction, secondary halogenoalkane give/show

A) S_N1 mechanism
B) S_N2 mechanism
C) Both E_1 and E_2
D) Both S_N1 and S_N2

Q.14 The order of reactivity of alkyl halides towards nucleophile is

A) RI > RBr > RF > RCl
B) RF > RBr > RCl > RI
C) RI > RBr > RCl > RF
D) RF > RCl > RBr > RI

Q.15 If halogenalkanes are mixed with an excess of ethanoic ammonia and heated under pressure amine are formed. Which amine is formed in the following reaction?

$$CH_3CH_2Br + NH_3 \longrightarrow \text{Amine}$$

A) $CH_3—CH_2—NH—CH_2—CH_3$
B) $CH_3—CH_2—NH_2$
C) $CH_3—CH_2—CH_2—NH_2$
D) $H_2N—CH_2—CH_2—NH_2$

Q.16 The average bond energy of C-Br is

A) 228 $KJmol^{-1}$
B) 200$KJmol^{-1}$
C) 250$KJmol^{-1}$
D) 290$KJmol^{-1}$

Q.17 During the S_N1 reaction, the fast reaction involves

A) Breakage of covalent bond
B) Formation of carbocation
C) Transition state
D) Attack of nucleophile

Q.18 Which is an intermediate compound in S_N1

A) Ethoxide ion
B) Alkyl halide
C) Alkene
D) Carbocation

Q.19 Among the alkyl halides, which always follows S_N2 mechanism

A) Primary alkyl halides
B) Secondary alkyl halides
C) Tertiary alkyl halide
D) Both A & B

Q.20 What is the order of increasing reactivity of alkyl halides?

A) Fluoroalkane > chloroalkane > bromoalkane > iodoalkane
B) Fluoroalkane < chloroalkane < bromoalkane < iodoalkane
C) Fluoroalkane < chloroalkane > bromoalkane > iodoalkane
D) Fluoroalkane < chloroalkane < bromoalkane < iodoalkane

Q.21 Which type of alkyl halides gives SN_2 mechanism?

A) Secondary alkyl halides
B) Vinyl halides
C) Tertiary alkyl halides
D) Primary alkyl halides

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Q.22 When purely alcoholic solution of sodium/potassium hydroxide and halogen alkane are refluxed an alkene is formed :

CH_3-CH_2-Br (in presence of alcoholic KOH)→ CH_2=CH_2

What is the mechanism of the reaction

A) Elimination
B) Debromination
C) Dehydration
D) Nucleophilic substitution

Q.23 Consider the reaction given below:

$CH_3CH_2CH_2CH_2Br$ → I $CH_3CH_2CH_2CH_2OH$

→ II $CH_3CH_2CH=CH_2$

which statement is true?

A) Reagent for I is KOH in alcohol
B) Reaction II is elimination
C) Reagent for II is KOH in aqueous medium
D) Reaction I is debromination

Q.24 Consider the reaction given below:

$$CH_3-CH_2Br \xrightarrow[\text{alc. ethanol}]{KOH} H_2C=CH_2 + HBr$$

Mechanism followed by the reaction is

A) E2
B) E1
C) S_N1
D) S_N2

Q.25 In elimination reaction, alcoholic KOH is used. OH^- in this case will act as

A) Electrophile
B) Base
C) Leaving group
D) Acid

Q.26 In elimination reaction, alcoholic KOH is used. OH^- in this case will act as

A) Electrophile
B) Base
C) Leaving group
D) Acid

Q.27 In elimination reaction, _____ is used

A) Acidic $K_2Cr_2O_7$
B) $CuCl_2$
C) Acidic NaOH
D) Alcoholic KOH

Q.28 In the reaction sequence

$$H_3C-CH_2-CH_2-Br + AlcKOH \longrightarrow C \xrightarrow[H_2O]{H_2SO_4} D$$

Product D will be

A) Mixture of methanol and ethanol
B) 2-propanol
C) 1-Propanol
D) Propanoic acid

Q.29 In the reaction sequence given here

$H_3C-CH_3 + Br_2 \xrightarrow{hv} A \xrightarrow{AlcKOH} B$ **The end product is an unsaturated hydrocarbon. Identify the nature of reaction in the two steps.**

A) Step I is a nucleophilic substitution and step II is elimination
B) Step I is addition and step II is nucleophilic substitution
C) Step I is free radical substitution and step II nucleophilic substitution
D) Step I is free radical substitution and step II is elimination

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ANSWER KEY

1	A	11	D	21	A	31	B	41	A
2	C	12	B	22	D	32	A	42	A
3	B	13	A	23	C	33	D	43	C
4	C	14	D	24	B	34	C	44	B
5	D	15	A	25	D	35	D	45	C
6	B	16	B	26	D	36	B	46	B
7	C	17	D	27	D	37	D	47	B
8	B	18	A	28	A	38	D	48	C
9	B	19	C	29	D	39	D	49	B
10	A	20	D	30	A	40	B	50	B

PAST PAPER QUESTIONS

1	B	6	D	11	C	16	D	21	D	26	B
2	C	7	A	12	D	17	D	22	A	27	D
3	B	8	D	13	D	18	D	23	B	28	B
4	C	9	A	14	C	19	A	24	A	29	D
5	B	10	A	15	B	20	B	25	B		

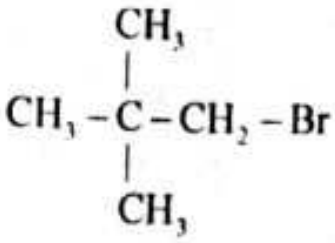
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EXPLANATORY NOTES

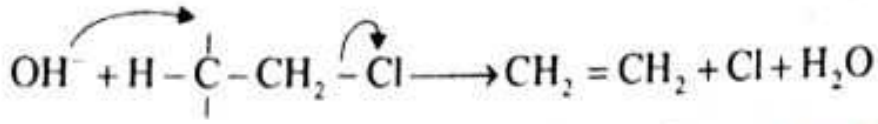
Q.1 Alkyl halides are monohalo alkanes only $C_nH_{2n+1}X$

Q.2 Monohalo alkanes have only one halogen attached to hydrocarbon chain and follow general formula $C_nH_{2n+1}X$.

Q.5 Neo-pentyl bromide is a primary alkyl halide



Q.7 A bimolecular reaction involves 2 molecules in rate determing step.



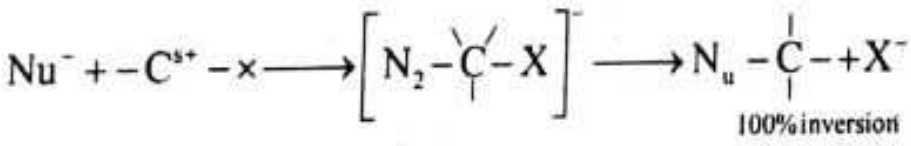
$R = K\,[C_2H_5Cl]\,[OH^-]$

Order = 1+1 = 2

Q.8 OH^- is very strong nucleophile and due to its high charge to size ratio it is strongly attached to carbon and hence a poor leaving group.

Q.9 Electrophilic α-carbon of alkyl group makes it a good substrate for nucleophile attach which is aided by good leaving groups.

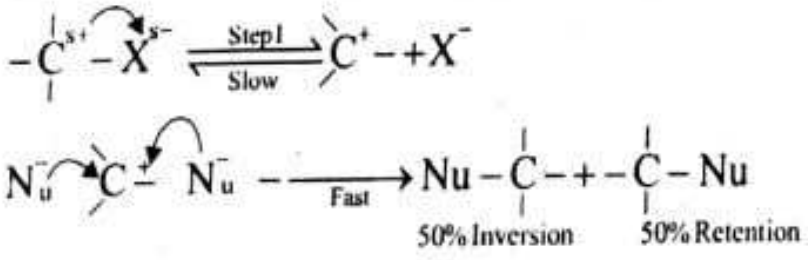
Q.10



$R = k\,[Nu^-]\,[R\text{–}X]$

Order = 1 + 1= 2

Q.11 SN1→Unimolecular nucleophilic substitution



$R = k\left[-\overset{|}{\underset{|}{C}}-X\right]$

Order = 1

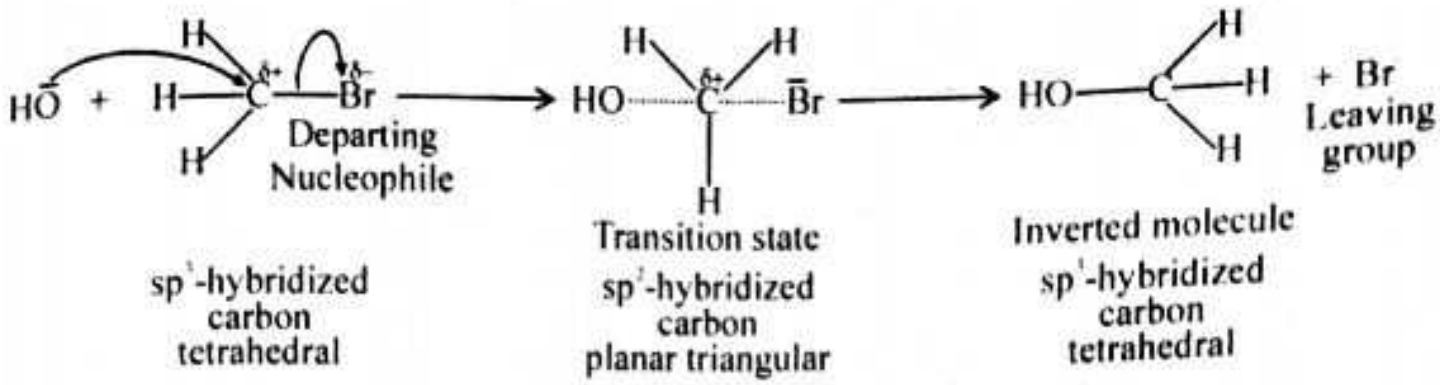
Q.12 β-Elimination involves attack of strong base (e.g. OH^-) on β-hydrogen.

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Q.13 Tertiary alkyl halides can be ionized relatively easily due to stable carbocation hence giving S_N1 and E_1 mechanism in both first and the rate determing step involves ionization of $R - X$ to R^+.

Q.14



$$\text{Rate} = k\,[\text{alkyl halide}]^1\,[\text{Nucleophile}]^1$$

Q.15

Reactivity of $R-X$ $\propto$ C–X bond polarity

$\propto$ C–X bond length

$\propto \dfrac{1}{\text{C–X bond energy}}$

$\propto \dfrac{1}{\text{Stability}}$

So greater stability means higher B.E

Q.16 SN reactions are favoured by a good leaving and stronger incoming group.

$R \rightarrow \propto$ Strength of incoming Nu^-

$R \rightarrow \propto \dfrac{1}{\text{Strength of leaving } Nu^-}$

Q.17 β-Elimination reaction produces alkenes from alcohol or alkyl halides.

$$R-CH_2-CH_2-X \xrightarrow{\text{Koltaic}} R-CH_2=CH_2+HX$$

$$R-CH_2-CH_2-OH \xrightarrow[180^\circ C]{\text{conc. } H_2SO_4} R-CH_2=CH_2+H_2O$$

(Alkene)

Q.18 Reactivity through S_N2 mechanism

$$\propto \frac{1}{\text{Size of R}}$$

Hence the order

$CH_3X > C_2H_5 - X > C_3H_7X$

Q.19 Thioalcohol = $R - SH$

$$R-Br + SH^- \longrightarrow R-SH + Br^-$$

Q.20 Greater steric hinderance, greater stability of R^+ and greater inductive effect favours S_N1.

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Q.21 Ter. Butyl bromide is a tertiary alkyl halide, and tertiary alkyl halides favours S_N1.

Q.22 Reactivity of $R - X \propto \frac{1}{C-X \text{ bond energy}}$

Reactivity order

$R - I > R - Br > R - Cl > R - R$

E_2 is bimolecular reaction.

$R = K[R - X][OH^-]$

Order = 1 + 1 = 2

Q.24 In heterolytic cleavage one of the atoms leaves with both of the shared electrons in S_N2 mechanism leaving X^- gets both electron.

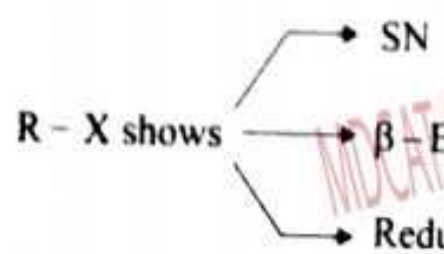
Q.25 $CH_3 - Cl$ does not offer steric hindrance to attacking group also its carbocation is unstable hence attack and removal occur simultaneously giving S_N2.

Q.26 (i) Due to low bond energy reactivity is highest.

(ii) Greater polarizability of "I" increases boiling point.

(iii) R – I are highly reactive so cannot be prepared directly.

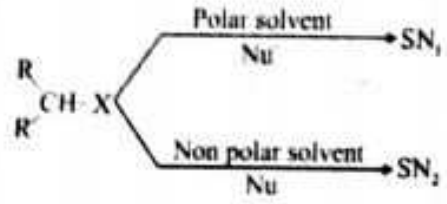
Q.27



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Q.28 $R^{3°}X^{3°}$ are good substrate for nucleophile attack of α-carbon giving mostly SN reaction.

Q.29



In polar solvent formation of carbocation is favoured which allows S_N1 mechanism.

Q.30 When R – X is excess, these are enough R – X molecules to react with NH_3 and make 1°, 2° and 3° amines.

Q.31 C – X bond has to be broken in order to another Nu^- to replace X^-. So bond energy is major factor.

Q.32 Higher polarizable nucleophile gives off electron easily to electrophilic carbon favouring substitution while it does not favour elimination as it is weak base.

Q.33 KOH in alcoholic medium favour β-elimination, as $CH_3 - Cl$ lack β-hydrogen so no reaction may occur.

Q.34 C – H bond energy is higher so attack on B – H is favoured at higher temperature.

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Q.35 Reactivity order towards S_N2 $CH_3X > RCH_2X > R_2CHX > R_3CX$ increase in R – groups increases steric hindrance.

Q.36 Reactivity of $R-X \propto \frac{1}{\text{B.E of } C-X}$

Bond energy order

$C-F > C-Cl > C-Br > C-I$

Hence reactivity order

$CH_3F < CH_3Cl < CH_3Br < CH_3I$

Q.37 Three bulky R-groups in tertiary R – X produce high hindrance to attacking nucleophile making only S_N1 possible instead of S_N2.

Q.38 CH_3Cl gives only S_N2 reaction giving complete inversion.

Q.39 First step is same in S_N1 and E_2 i.e. ionization to form carbocation. While 2nd step is different in all S_N1, S_N2, E_1 and E_2.

Q.40 Order of stability of carbocations

Tertiary > Secondary > Primary

Stability of $R^+ \propto$ Number of β-hydrogens

Q.41 NH_3 has a lone pair to donate which makes it a good nucleophile.

Q.42 $CH_3-CH_2-Br + Alc.NH_3 \xrightarrow{S_N2} CH_3CH_2-NH_2 + H_2O$

Q.43 Bond energy $\propto \frac{1}{\text{B.L}}$

Order of B.E $C-F > C-Cl > C-Br > C-I$

Q.44 Secondary alkyl halides can give both S_N1 and S_N2.

Q.45 For E_1 reaction $R = K[R–X]$ unimolecular mechanism.

Q.46 In β-elimination reaction nucleophile is a base e.g. OH^- hence attack occurs on β-hydrogen.

Q.47 $R-X + OH^-_{(aq)} \xrightarrow{SN} R-OH + X^-$

X^- is substituted by OH^-

Q.48 NH_3 has no net charge.

Q.49

$$Nu^- + -C^{\delta+} - x \longrightarrow \left[N_2 - \overset{\diagdown}{\underset{|}{C}}\overset{\diagup}{} - X \right]^- \longrightarrow N_u - \underset{|}{\overset{|}{C}} - + X^-$$

100% inversion

$R = k\,[Nu^-]\,[R–X]$

Order = 1 + 1 = 2

Q.50 $CH_3-CH_2-Br + CN^- \xrightarrow{S_N2} CH_3-CH_2-CN + Br^-$

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Topic 16 ALCOHOLS AND PHENOLS

PRACTICE EXERCISE

NOMENCLATURE AND CLASSIFICATION OF ALCOHOLS

Q.1 Which of the following can be used for alcohol denaturing

A) Methanol
B) Pyridine
C) Acetone
D) All of these

Q.2 Absolute alcohol is

A) 100% C_2H_5OH
B) 95% C_2H_5OH
C) 100% CH_3OH
D)15% C_2H_5OH

Q.3 The carbon to which functional group in alcohols is attached is

A) ∝-Carbon
B) Saturated carbon
C) β-Carbon
D) Both A and C

Q.4 Alcohol in which hydroxyl is attached to carbon which is further attached to two alkyl groups is

A) Primary alcohol
B) Secondary alcohol
C) Tertiary alcohol
D) None of these

Q.5 Alcohol in which – OH group is attach to carbon which is further attached to only one alkyl group is

A) Primary alcohol
B) Secondary alcohol
C) Tertiary alcohol
D) Aromatic alcohol

Q.6 Isobutyl alcohol and isopentyl alcohol are

A) Primary alcohols
B) Secondary alcohols
C) Tertiary alcohol
D) All

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Q.7 Identify a tertiary alcohol

A) 2–Pentanol
B) 2,2–Dimethyl –1 – propanol
C) 2 – Methyl – 2 – butanol
D) 3– Methyl – 2– butanol

PREPARATIONS AND REACTIONS OF ALCOHOL

Q.8 Dehydration of alcohols with conc. H_2SO_4 at 180°C gives:

A) Ethers
B) Alkenes
C) Esters
D) Alkyl halides

Q.9 Among alkenes which one produces t°-butyl alcohol on acid hydration

A) $(CH_3)_2 - C = CH_2$
B) $CH_3 - CH_2 - CH = CH_2$
C) $CH_3 - CH = CH - CH_3$
D) $CH_3 - CH = CH_2$

Q.10 During hydration of alkenes to form alcohols, alkenes are first dissolved in

A) Water
B) Dilute H_2SO_4
C) Concentration H_2SO_4
D) Both B and C can be used

Q.11 The addition of water to an alkene in the presence of catalytic amount of strong acid lead to the formation of

A) Alkoxy alkanes
B) Hydroxy alkane
C) Haloalkanes
D) Alkanoic acid

Q.12

$$CH_2 = CH_2 + H_3PO_4 \longrightarrow CH_3 - CH_2 - OPO_3H_2 \xrightarrow{H2O} CH_3 - CH_2 - OH + H_3PO_4$$

The compound in the centre of above series of reaction is called

A) Alkyl hydrogen sulphate
B) Alkyl phosphate
C) Alkyl phosphoric acid
D) Alkyl dihydrogen phosphate

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Q.13 Primary alcohols upon oxidation with acidified dichromate gives:
A) Aldehydes
B) Branched alkenes
C) Ketones
D) All of these

Q.14 Tertiary alcohols with acidified dichromate gives:
A) Aldehydes
B) Alkenes
C) Ketones
D) Alkynes

Q.15 Which of the following reacts with aqueous alkaline iodine:
A) 1-Propanol
B) Methanol
C) Ethanol
D) 2-Methyl-2-propanol

Q.16 When alcohols react with Na metal, the alkoxide ion thus formed is a strong
A) Electrophile
B) Acid
C) Nucleophile
D) Free radical

Q.17 An organic compound X is prepared by the oxidation of ethanol. This X reacts with ethanol to produce an ester, what is X likely to be:
A) Methanoic acid
B) Propanoic acid
C) Ethanoic acid
D) Butanoic acid

Q.18 Which inorganic reagent may be used to distinguish between phenol and methanol
A) Alkaline aqueous I_2
B) Aqueous $NaHCO_3$
C) $K_2Cr_2O_7$ in dil. H_2SO_4
D) Na metal

Q.19 $K_2Cr_2O_7/H_2SO_4$ generates
A) O_2
B) [O]
C) H_2
D) [H]

Q.20 Esterification takes place when an alcohol reacts with
A) Organic acid
B) Both organic and inorganic acids
C) Inorganic acid
D) Ethers

Q.21 During preparation of ester, the bridge oxygen is from
A) Alcohol
B) Ether alcohol or acid
C) Acid
D) Catalyst

Q.22 Which of the following is incorrect
A) 1° alcohol oxidizes to form aldehyde which is further oxidized to carboxylic acid
B) 2° alcohol oxidizes to form ketone, which is further oxidized to carboxylic acid
C) 3° alcohol is not oxidized in presence of $K_2Cr_2O_7/H_2SO_4$
D) All are correct statements

Q.23 Alcohols react with Na metal to produce
A) R–ONa
B) H_2 gas
C) Both A and B
D) No reaction takes place

Q.24 When an alcohol reacts with PX_5, the order or reactivity of alcohol is
A) 1° > 2° > 3°
B) 1° > 2° > 3°
C) 3° > 2° > 1°
D) Both B and C are correct

Q.25 When alcohols are oxidized the nature of products depends on
A) Nature of alcohol only
B) Reaction conditions only
C) Both A and B
D) It does not depend on any of A and B

Q.26 There are four alcohols P, Q, R and S with 3,2,1 and zero ∝-hydrogens which will not respond to $Na_2Cr_2O_7/H_2SO_4$
A) P
B) R
C) Q
D) S

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Q.27 **Alkanol + [o]** $\xrightarrow{K_2Cr_2O_7 + H_2SO_4}$ **A** $\longrightarrow$ **B**

The correct products are

A) $A = C_nH_{2n}O$, $B = C_nH_{2n}O_2$

B) $A = C_nH_{2n}O_2$, $B = C_nH_{2n}O$

C) $A = C_nH_{2n+2}O$, $B = C_nH_{2n}O_2$

D) $A = C_nH_{2n}O$, $B = C_nH_{2n+2}O$

Q.28 **When ethanol reacts with sodium metal than**

A) C—O bond breaks

B) O—H bond breaks

C) C—C bond breaks

D) C—H bond breaks

Q.29 **The number of moles of diol are required to produce one mole of hydrogen gas.**

A) 1

B) 2

C) 3

D) 4

Q.30 **Rasberry flavoured compound is produced by a condensation process. The process may be**

A) Addition

B) Elimination

C) Evaporation

D) Esterification

Q.31 **The one of the functional group isomer of alkoxy alkane reacts with alkanoic acid to produce**

A) Alkyl alkanoate

B) Alkoxy alkanoate

C) Alkane alkanoic acid

D) Alkyl alkoxy alkane

Q.32 **In esterification reaction, which one of the following bonds of alcohol undergo cleavage**

A) C — H

B) O — H

C) C — O

D) C — C

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Q.33 **Excess alcohol at low temperature in presence of conc. of H_2SO_4 produce**

A) Ether

B) Ester

C) Organic acid

D) Alkene

Q.34 **Compound which gives most stable carbonium ion on dehydration is**

A) $(CH_3)_2 - CH - CH_2 - OH$

B) $CH_3(CH_2)_4OH$

C) $(CH_3)_3C - OH$

D) $CH_3CH(OH)CH_2CH_3$

Q.35 **Order of easiness of dehydration of alcohol is**

A) $3^\circ > 2^\circ > 1^\circ$

B) $2^\circ > 3^\circ > 1^\circ$

C) $1^\circ > 2^\circ > 3^\circ$

D) All are correct

Q.36 **After dehydration of 2-Butanol, the major product will be**

A) 1-Butene

B) Both are produced in equal amount

C) 2-Butene

D) 1-Butyne

Q.37 **$ROH + PCl_5 \longrightarrow RCl + POCl_3 + HCl$**

The type of above reaction is

A) Electrophilic substitution

B) Nucleophilic substitution

C) Addition

D) Elimination

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PHYSICAL PROPERTIES AND REACTIONS OF PHENOL

Q.38 **Phenol reacts with aqueous bromine and decolorizes aqueous bromine forming the white precipitates of:**
A) 2, 4-Dibromophenol
B) 2, 4, 6-Tribromophenol
C) 2-Bromophenol
D) 3-Bromophenol

Q.39 **Picric acid can be prepared from phenol by**
A) Halogenation
B) Oxidation
C) Nitration
D) Sulphonation

Q.40 **Which one can be used as test for phenol**
A) $C_6H_5OH + CH_3COCl$ in the presence of aq. NaOH
B) $C_6H_5OH + HCHO$ in the presence of NaOH
C) $C_6H_5\bar{O}Na^+ + CH_3CH_2Br$
D) $C_6H_5OH + Br_2$ (excess)

Q.41 **Phenol on treatment with dil. HNO_3 at low temperature give**
A) o-Nitrophenol
B) p-Nitrophenol
C) m-Nitrophenol
D) Mixture of o-Nitrophenol

Q.42 **Phenol + $Br_{2(aq)} \rightarrow$?**
A) o and p- Bromophenol
B) No reaction takes place
C) 2,4,6-Tribromophenol
D) Both A and C are produced

Q.43 **Phenol can be distinguished from alcohol by**
A) Tollen's reagent
B) $NaHCO_3$
C) $Br_{2(aq)}$
D) HCl

Q.44 **The reaction of carbolic acid with aqueous bromine can be used as _____ from alcohols**
A) Identification test
B) Distinguish test
C) Confirmatory test
D) Tollen's test

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Q.45 **The reaction of carbolic acid with caustic soda is used to produce colorless product. The molecular formula of the product is**
A) C_6H_6ONa
B) C_6H_4OH
C) C_7H_6O
D) C_6H_5ONa

Q.46 **Phenol and ethanol can be distinguish by all except**
A) Iodoform test
B) Aq. Br_2
C) Na–metal
D) Lucas-reagent

Q.47 **The reaction of phenol in which ring is involved except**
A) Nitration
B) Sulphonation
C) Esterification
D) Bromination

RELATIVE ACIDITY OF WATER, ETHANOL AND PHENOL

Q.48 **What is correct order for acidity of water, phenol and ethanol**
A) $C_6H_5OH > H_2O > C_2H_5OH$
B) $C_6H_5OH > C_2H_5OH > H_2O$
C) $H_2O > C_2H_5OH > C_6H_5OH$
D) $H_2O > C_6H_5OH > C_2H_5OH$

Q.49 **Conjugation between unshared electron pair on oxygen and aromatic ring in phenoxide ion results in**
A) Shorter C – O bond distance
B) Stronger acidic character
C) Stable base
D) All of these

Q.50 **The alcohol more acidic in nature is**
A) Methanol
B) Ethanol
C) Propanol
D) Butanol

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PAST PAPERS QUESTIONS

Q.1 Which of the following is secondary alcohol?

A) $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\underset{|}{\overset{|}{CH}}}}-OH$

C) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-OH$

B) $CH_3-CH_2-CH_2-OH$

D) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-\underset{\displaystyle OH}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-CH_3$

Q.2 The following structure is of

$$R-\overset{\displaystyle R}{\overset{|}{\underset{|}{C}}}-OH$$

A) Secondary alcohol
B) Primary alcohol
C) Tertiary alcohol
D) Carboxylic acid

Q.3 Primary, secondary and tertiary alcohols can be identified and distinguished by

A) Lucas test
B) Iodoform test
C) Bayer's test
D) Silver mirror test

Q.4 $(CH_3)_3C$-OH. Which one of the following is proper classification of the above formula?

A) Primary
B) Secondary
C) Tertiary
D) Polyhydric

Q.5 Alcohol in which carbon atom bonded to –OH group is further attached with three alkyl group is

A) Aromatic alcohol
B) Secondary alcohol
C) Primary alcohol
D) Tertiary alcohol

Q.6 Which one the following compounds is known as tertiary alcohol?

A) 2-Methyl-1-propanol
B) 2-Propanol
C) 2-Methyl-2-propanol
D) 1-Propanol

Q.7 Which enzyme is involved in fermentation of glucose

A) Zymase
B) Urease
C) Invertase
D) Diastase

Q.8 The dehydration of ethyl alcohol with concentrated H_2SO_4 at 140°C gives

A) Ethene
B) Diethyl ether
C) Alcohol
D) Carboxylic acid

Q.9 To produce absolute alcohol (100%) from rectified spirit (95.6% alcohol), the remaining 4.4% water must be removed by a drying agent such as

A) Calcium oxide
B) Calcium chloride
C) Calcium carbonate
D) Carbon monoxide

Q.10 $C_2H_5-SO_4H \xrightarrow[Warm]{H_2O} C_2H_5-OH + H_2SO_4$ choose the correct type for this reaction from the following?

A) Reduction
B) Oxidation
C) Hydroxylation
D) Hydration

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Q.11 Which of the following reactions is used for the production of alcohols on industrial scale?

A) Hydrohalogenation of alkenes
B) Hydration of alkenes
C) Hydroxylation of alkenes
D) Hydrogenation of alkenes

Q.12 Industrially water gas is converted into methanol by using catalyst(NUMS RC 2019)

A) $CuO + ZnO$
B) $Al_2O_3 + ZnO$
C) $CuO + Cr_2O_3$
D) $ZnO + Cr_2O_3$

Q.13 Ethanol reacts with ammonia to form ethyl amine. The catalyst used for this reaction is

A) $ZnCl_2$
B) C_5H_5N
C) ThO_2
D) Cr_2O_3

Q.14 An alcohol is converted into an aldehyde with same number of carbon atoms in the presence of K_2CrO_4/H_2SO_4. the alcohol is

A) $CH_2C(CH)_2OH$
B) $(CH_3)_3COH$
C) $CH_3CH_2CH_2OH$
D) $(CH_3)_2CHOH$

Q.15 Ethanol can be converted in to ethanoic acid by

A) Oxidation
B) Fermentation
C) Hydration
D) Hydrogenation

Q.16 Consider the following reaction

$$C_2H_5OH + PCl_5 \rightarrow ?$$

What product (s) may be formed?

A) C_2H_5Cl, $POCl_3$ and HCl
B) C_2H_5Cl only
C) C_2H_5Cl and HCl
D) C_2H_5Cl and $POCl_3$

Q.17 Which one of the following groups is indicated when HCl is formed by reaction of ethanol with phosphorus pentachloride?

A) Amino group
B) Hydroxyl group
C) Halide group
D) Hydride group

Q.18 $CH_3-CH_2-OH+PCl_5 \longrightarrow CH_3-CH_2Cl+POCl_3+HCl$ **formation of HCl is test for the presence of ___ in a compound**

A) Alkyl group
B) Hydroxyl group
C) Saturated alkyl group
D) Acid H^+ ion

Q.19 Which one of the following alcohol is indicated by formation of yellow crystals in iodoform tests?

A) Methanol
B) Ethanol
C) Butanol
D) Proponal

Q.20 How will you distinguish between methanol and ethanol?

A) By lucas test
B) By silver mirror test
C) By oxidation
D) By iodoform test

Q.21 Which one of the following is an appropriate indication of positive iodoform test?

A) Formation of H_2O
B) Release of H_2 gas
C) Brick red precipitate
D) Yellow crystal

Q.22 Distinction between ethanol and phenol can be ascertained by

A) Lucas test
B) Tollen's test
C) Benedict's test
D) Reaction with bromine

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Q.23 **When ethanol is warmed with ethanoic acid in the presence of strong acid catalyst, an ester ethyl ethanoate is formed**

$$CH_3CH_2OH + CH_3CO_2H \longrightarrow CH_3CO_2CH_2CH_3$$

During this reaction

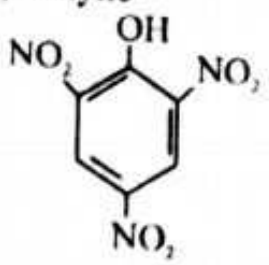
A) Alcohol is reduced
B) O–H bond in ethanoic acid is broken
C) O–H bond in ethanol is broken
D) Acid is oxidized

Q.24 $C_2H_5OH + CH_3\text{-}COOH \overset{H_2SO_4}{\rightleftharpoons}$ **? what will be the exact product**

A) Diethyl ether
B) Methyl propyl ether
C) Ethyl acetate
D) Butyl alcohol

Q.25 **Dehydration of ethanol at 180°C in the presence of conc-H_2SO_4 gives**

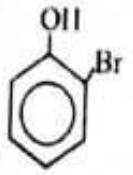
A) Ethene
B) Ethyne
C) Ethane
D) Ether

Q.26  **is named as**

A) Nitro phenol
B) Benzoic acid
C) Malonic acid
D) Picric acid

Q.27 **Aqueous phenol decolorizes bromine water to form a white precipitate. What is the structure of the white precipitate formed?**

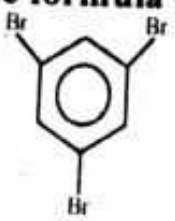
A) 

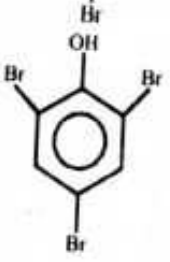
B) 

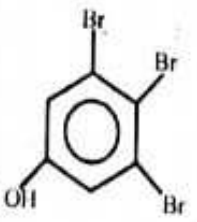
C) 

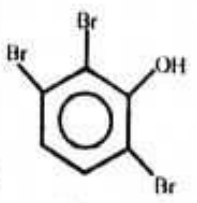
D) 

Q.28 **The formula of 2, 4, 6-Tribromophenol is**

A) 

B) 

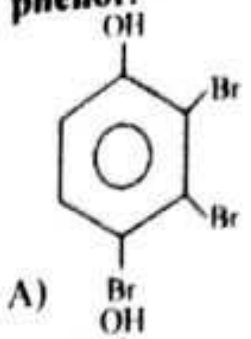
C) 

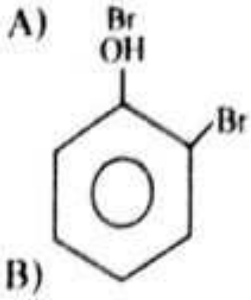
D) 

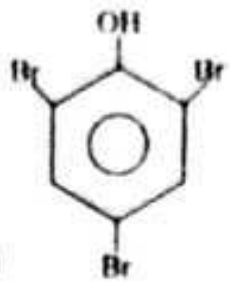
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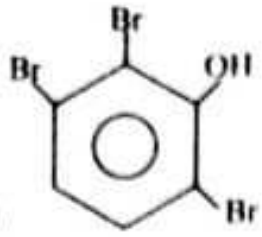
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Q.29 Which one of the following is an appropriate structure of product of bromination of phenol?

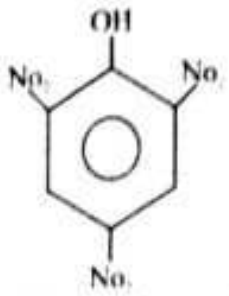
A) 

B) 

C) 

D) 

Q.30



Which one of the following is an appropriate name of above compound?

A) 1,3,6 trinitrophenol
B) m-nitrophenol
C) Tartaric acid
D) Picric acid

Q.31 At 25^{0}C with phenol 2-4 Dinitrophenol is formed by the reaction of:

A) (HNO_3+H_2SO_4) with benzene
B) (HNO_3+H_2SO_4) with phenol
C) NaOH with Benzene sulphonic acid
D) Sodium phenoxide with HCl

Q.32 Dissociation constant of phenol is

A) 1.2×10^{-10}
B) 1.3×10^{10}
C) 1.2×10^{10}
D) 1.3×10^{-10}

Q.33 The phenoxide ion is more stable than ethoxide ion as

A) Lone pair on oxygen atom overlaps with the delocalized π-bonding system in benzene
B) Oxygen atom is directly bonded with benzene ring in phenoxide ion
C) The negative charge is localized on oxygen atom of phenoxide ion
D) The negative charge is delocalized on oxygen atom of ethoxide ion

Q.34 The acidity of phenol is due to its_____:

A) Nature of Benzene
B) Double bond in benzene ring
C) Nature of phenoxide
D) Hydroxyl group

Q.35 Phenol react with CH_3COCl to give

A) Acid
B) Aldehyde
C) Ester
D) Ketone

Q.36 Methanol is prepared from CO and H_2. The catalyst used for this reaction is.

A) ZnO + CoO_2
B) ZnO + CuO
C) ZnO + Cr_2O_3
D) ZnO + Ag_2O

Q.37 Which one of the following was used as one of the earliest antiseptic and disinfectant?

A) Phenol
B) Ether
C) Ethanol
D) Methanol

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Q.38 Which one of the following is NOT able to denature the ethanol?

A) Methanol
B) Lactic acid
C) Pyridine
D) Acetone

Q.39 Reaction of alcohol with hydrogen chloride yields_____:

A) Ketone
B) Carboxylic
C) Aldehyde
D) Ester

Q.40 Sodium phenoxide on treating with hydrochloric acid yields:

A) Benzene
B) Benzoic
C) Phenol
D) Benzaldehyde

ANSWER KEY

1	D	11	B	21	A	31	A	41	A
2	A	12	D	22	D	32	B	42	C
3	A	13	A	23	C	33	A	43	C
4	B	14	B	24	C	34	C	44	B
5	A	15	C	25	A	35	A	45	D
6	A	16	C	26	D	36	C	46	C
7	C	17	C	27	A	37	B	47	C
8	B	18	C	28	B	38	B	48	A
9	A	19	B	29	A	39	C	49	D
10	C	20	A	30	D	40	D	50	A

PAST PAPER QUESTIONS

1	A	6	C	11	B	16	A	21	D	26	D	31	B	36	C
2	A	7	A	12	D	17	B	22	D	27	A	32	D	37	A
3	A	8	A	13	C	18	B	23	C	28	B	33	A	38	B
4	C	9	A	14	C	19	B	24	C	29	C	34	C	39	C
5	D	10	D	15	A	20	D	25	A	30	D	35	C	40	C

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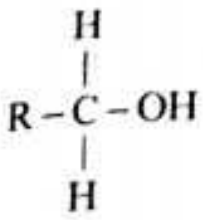
EXPLANATORY NOTES

Q.1 Denatured alcohol is poisonous to user methanol, acetone and pyridine all are poisonous compounds.

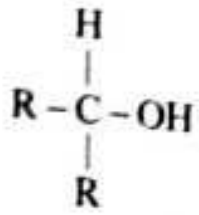
Q.2 Absolute alcohol is pure ethanol.

Q.3 $-\overset{\gamma}{C}-\overset{\beta}{C}-\overset{\alpha}{C}-F.G$

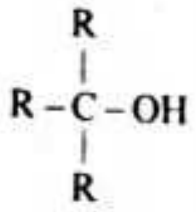
Q.4



Primary alcohol

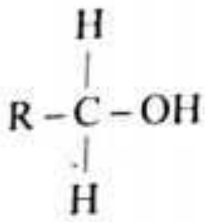


Secondary alcohol

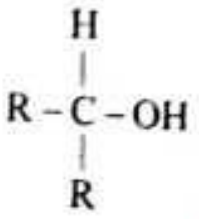


Tertiary alcohol

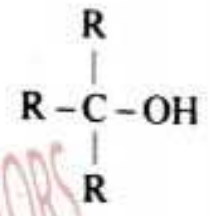
Q.5



Primary alcohol

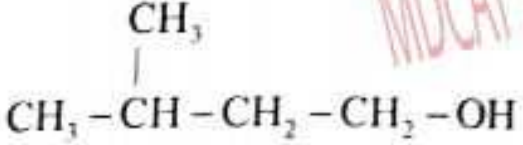


Secondary alcohol

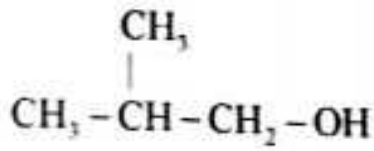


Tertiary alcohol

Q.6



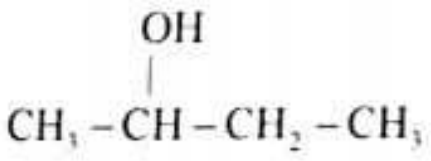
Iso-pentyl alcohol



Iso-butyl alcohol

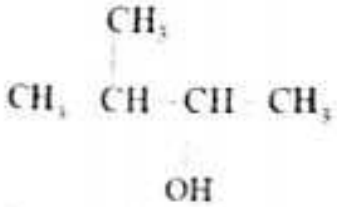
in both –OH is attached to primary carbon.

Q.7

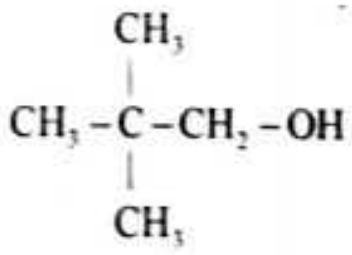


2-Pentanol

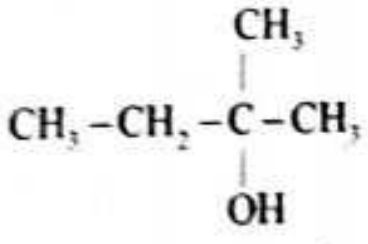
(2°-alcohol)



3-Methyl-2-Butanol



2,2-Dimethyl-1-propanol



2-Methyl-2-Butanol

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Q.8 $CH_3-CH_2-OH \underset{180°}{\overset{conc\ H_2SO_4}{\rightleftharpoons}} CH_2=CH_2+H_2O$

At high temperature β-elimination is promoted.

Q.9

$$CH_3-\underset{\displaystyle CH_3}{\overset{|}{C}}=CH_2+H_2O \xrightarrow[Markownikoff's]{conc\ H_2SO_4} CH_3-\underset{\displaystyle OH}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-CH_3$$

Q.10 $CH_2=CH_2+H_2SO_4 \rightleftharpoons CH_3-CH_2-SO_4H \overset{H_2O}{\rightleftharpoons} CH_3-CH_2-OH+H_2SO_4$

Q.11 Hydroxy alkane = Alcohol

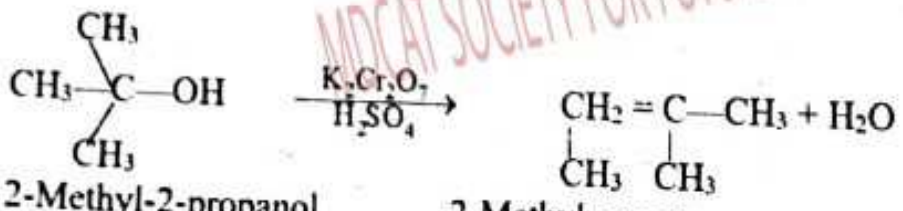
Q.12 In $CH_3–CH_2–OPO_3H_2$. Dihydrogen phosphate is attached to an alkyl group.

Q.13

$$R-CH_2-OH+[O] \xrightarrow{K_2Cr_2O_7/H_2SO_4} R-\overset{\displaystyle O}{\overset{\|}{C}}-H+H_2O$$

Alcohol Aldehyde

Q.14 Tertiary alcohol do not undergo oxidation instead they undergo β-elimination to give alkenes.



2-Methyl-2-propanol 2-Methylpropene

Q.15 The only primary alcohol to give iodoform test is ethanol.

Q.16 $R–O^-$ is an electron efficient specie hence a strong nucleophile.

Q.17

$$CH_3-CH_2-OH \xrightarrow{oxidation} CH_3-\overset{\displaystyle O}{\overset{\|}{C}}-H \xrightarrow{oxidation} CH_3COOH$$

Ethanol ethanoic acid

(X)

$$CH_3COOH+C_2H_5OH \overset{H_2SO_4}{\rightleftharpoons} CH_3-C-OC_2H_5+H_2O$$

(X) ester

(X) = Ethanoic acid

Q.18 Methanol gets oxidized by acidified $K_2Cr_2O_7$ but phenol does not.

Q.19 $K_2Cr_2O_7+4H_2SO_4 \longrightarrow K_2SO_4+Cr(SO_4)_3+4H_2O+3[O]$ esterification.

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Q.20 $RCOOH + R'OH \underset{}{\overset{H_2SO_4}{\rightleftharpoons}} RCOOR' + H_2O$

Organic acid Alcohol Ester

Q.21 –OH group of acid is replaced by RO^- of alcohol giving SN reaction. So, bridge oxygen comes from alcohol.

Q.22

$$R-CH_2-OH \xrightarrow[-H_2O]{\text{oxidation}} R-\overset{\overset{O}{\|}}{C}-H \xrightarrow{\text{oxidation}} \underset{\text{acid}}{RCOOH}$$

$$R-\overset{R'}{\underset{|}{CH}}-OH \xrightarrow[-H_2O]{\text{oxidation}} \underset{R'}{\overset{R}{\diagdown}}C=O \xrightarrow{(O)} RCOOH + R'COOH$$

ketone

Tertiary Alcohol are not oxidized

Q.23 $2ROH + 2Na \longrightarrow 2R-ONa + H_2$

Q.24 Reaction of alcohol with PX_5 is nucleophilic substitution reaction in which OH^- is replaced by X^- and C–O bond is broken hence the order 3° > 2° > 1°.

Q.25

Primary alcohhols $\xrightarrow{\text{oxidation}}$ Aldehydc

Secondary alcohols $\xrightarrow{\text{oxidation}}$ Ketones

Tertiary alcohols $\longrightarrow$ No oxidation

Q.26 Zero α-hydrogen means "S" is tertiary alcohol. hence it does not undergo oxidation.

Q.27 Alkanol $\xrightarrow{\text{oxidation}}$ Aldehyde $\xrightarrow{\text{oxidation}}$ Carboxylic acid

A B

$C_nH_{2n}O$ $C_nH_{2n}O_2$

Q.28 $2C_2H_5OH + 2Na \longrightarrow C_2H_5ONa + H_2$

It is replaced by Na^+ by breaking O–H bond.

Q.29 $HO-CH_2-CH_2-OH \xrightarrow{2Na} NaO-CH_2-CH_2-ONa + H_2$

Q.30 Esters give off particular flavours.

Isobutyl formate = Raspberry flavour.

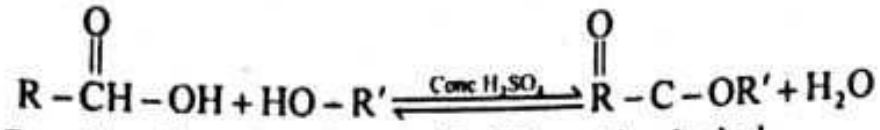
Iso-Butyl alcohol + Formic acid $\underset{}{\overset{\text{Esterification}}{\rightleftharpoons}}$ Isobutyl formate.

Q.31 Functional group of alkoxy alkanes (ethers) is alkano (alcohol) which reacts with alkanoic acids (carboxylic acids) to give esters (alkoxy alkanoate).

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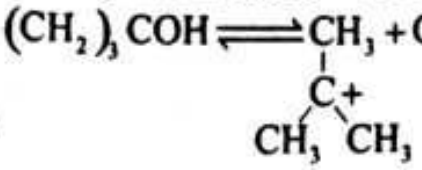
Q.32



Reaction shows breakage of O–H bond in alcohol

Q.33 Low temperature favours formation of ethers by dehydration of alcohols, while high temperature favours β-elimination to form alkenes.

Q.34 Tertiary carbocation > Secondary carbocation > Primary carbocation



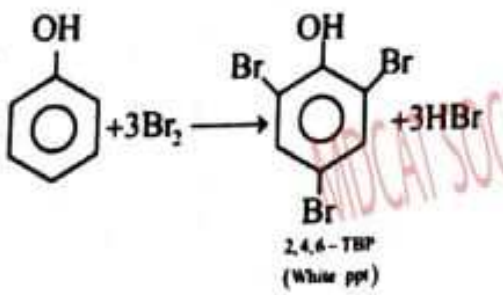
Q.35 Ease of dehydration ∝ Number of β-hydrogens, tertiary alcohols have greater β-hydrogens.

Q.36 Formation of alkene with greater alkyl substituents at C = C is more favoured during dehydration.

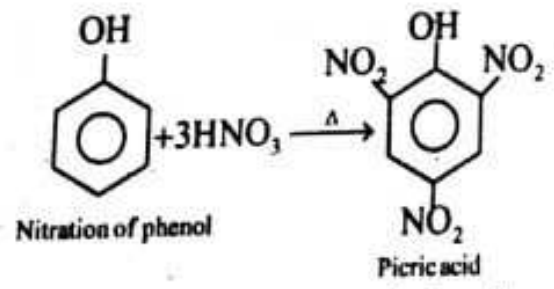


Q.37 OH^- is replaced by Cl^-, hence reaction is nucleophilic substitution.

Q.38

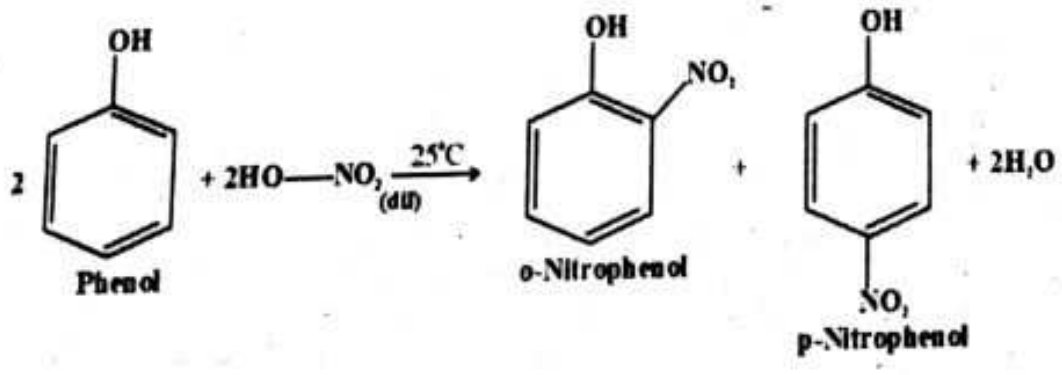


Q.39



Q.40 Phenol can be tested by bromine water test, as it gives white ppt of 2,4,6-Tribromophenol.

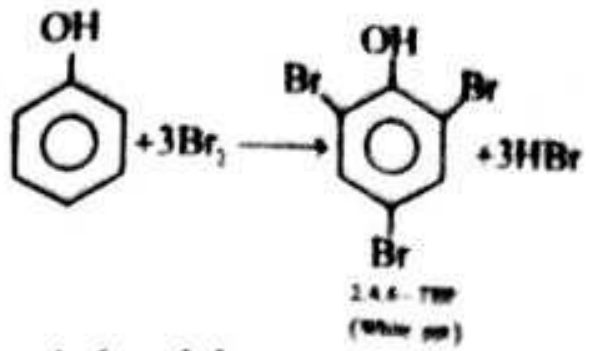
Q.41



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Q.42



2,4,6-TBP
(White ppt)

Q.43 Both alcohols and phenol do not give Tollen's test, $NaHCO_3$ test and reaction with HCl. However, phenol reacts with Br_2, to give white ppt but alcohol does not.

Q.44 Phenol can be tested by bromine water test, as it gives white ppt of 2,4,6-Tribromophenol.

Q.45 Phenol reacts with alkalis to form salts e-g;



Sodium Phenoxide

Q.46

Test	Phenol	Ethanol
Iodoform	✗	✓
Br_2 water	✓	✗
Na-Metal	✓	✓
Lucas-test	✗	✓

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Hence, Na-metal cannot distinguish between phenol and ethanol.

Q.47 Esterification is due to OH group and not the ring.

Q.48 Phenol is more acidic due to resonance in phenoxide, then comes water and alcohol is least acidic due to unstable alkoxide ion.

Q.49 Conjugation between O^- and benzene ring gives C–O bond a double bond characters that leads to

i) Shorter bond length

ii) Resonance give stability to phenoxide

iii) Stability of conjugate base $\propto$ Acidic strength

Q.50 Alcohol that gives stable alkoxide ion are more acidic stability order of $R–O^-$.

$$CH_3O^- > C_2H_5 - O^- > C_3H_7O^- > C_4H_4O^-$$

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Topic 17 ALDEHYDES AND KETONES

PRACTICE EXERCISE

STRUCTURE OF ALDEHYDE AND KETONES

Q.1 The clear fact for the structural difference between aldehyde and ketone is

A) A ketone has one R group attached on carbonyl group
B) An aldehyde has two R groups attached on carbonyl group
C) An aldehyde has one R and a ketone has two R groups attached to carbonyl group
D) Both "A" and "C"

Q.2 General formula of aldehyde is

A) $C_nH_{2n}O$
B) $C_nH_{2n}OH$
C) C_nH_{2n}
D) C_nH_{2n+2}

Q.3 Which of the following is true regarding an aldehyde?

A) Contains carbonyl carbon within carbon chain
B) Contains carbonyl oxygen within carbon chain
C) Contains carbonyl group within carbon chain
D) Contains carbonyl carbon at terminal of carbon chain

Q.4 Select the incorrect option regarding formaldehyde and acetone

A) Both have same molecular geometry
B) Both contains sp^2-hybridized carbon atom
C) Both belong to carbonyl compounds
D) Both have same general molecular formula

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Q.5 The incorrect statement regarding carbonyl compounds is

A) Both have general formula $C_nH_{2n}O$
B) Both have general formula R–COH
C) Both have general formula RCOR
D) Both B) and C)

Q.6 Carbonyl group is bonded to _____ in ketones

A) sp^2-hybridized oxygen atom
B) Only one carbon atom
C) Only one hydrogen atom
D) At least two carbon atoms

Q.7 In carbonyl compounds carbonyl carbon is bonded to _____

A) Oxygen atom through single bond
B) Oxygen atom through pi-bond
C) Oxygen atom through peptide bond
D) Oxygen atom through a double bond

Q.8 Which of the following is correct statement regarding carbonyl compounds

A) Carbonyl carbon contain no lone pair
B) Carbonyl group contains two lone pairs
C) Carbonyl oxygen contains two lone pair
D) All of these

Q.9 The planar trigonal geometry is associated with

A) Formaldehyde
B) Acetaldehyde
C) Crotanaldehyde
D) Butyraldehyde

Q.10 Which of the following is unsymmetrical ketone

A) $(CH_3)_2CO$
B) $C_2H_5OC_2H_5$
C) $C_3H_7COCH_2CH_2CH_3$
D) $C_2H_5CO(CH_2)_2CH_3$

Q.11 Which one is aldehyde

A) Benzaldehyde
B) Ethanal
C) Crotonaldehyde
D) All of these

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PREPARATION OF ALDEHYDES AND KETONES

Q.12 Which of the following can be used for the oxidative preparation of aldehydes from alcohols
A) Pt-asbestos
B) $Na_2Cr_2O_7$ and H_2SO_4
C) FeO and Mo_2O_3
D) All of these

Q.13 Which of the following compound is oxidized to get methyl ethyl ketone
A) 2-Propanol
B) 2-Butanol
C) 1-Butanol
D) Tertiary butyl alcohol

Q.14 Formation of acetaldehyde by ethanol is known as
A) Reduction
B) Oxidation
C) Substitution
D) Elimination

Q.15 Formaldehyde is prepared by passing _____ and air over platinized asbestos catalyst at 300°C
A) Formalin vapour
B) Ethanol vapour
C) Acetone vapour
D) Methanol vapour

Q.16 Air oxidation of methanol vapour is achieved on passing over _____ at 300°C to get formalin
A) Platinized asbestos
B) Nickel
C) Copper
D) Both A) and B)

Q.17 Acidified sodium dichromate oxidizes ethanol to ethanal by producing
A) Molecular oxygen
B) Nascent oxygen
C) Ozone
D) Dichromate ions

Q.18 Methanol vapours can be oxidized to methanal with molecular oxygen by using
A) FeO and Mo_2O_3 catalyst at 500°C
B) Silver catalyst at 500°C
C) Platinized asbestos at 300°C
D) All of these

Q.19 Which of the following is true regarding oxidation of an ethanol to an ethanal
A) $-CH_3$ is oxidized to CH_2-OH
B) $>CH_2$ is oxidized to –CHO group
C) –OH is oxidized to –CO group
D) $-CH_2OH$ is oxidized to –CHO

Q.20 During the oxidation of all the primary alcohols, ____ is oxidized to aldehydic group
A) –OH
B) $-CH_3$
C) $-CH_2-OH$
D) None of these

Q.21 $H-\boxed{CH_2OH} \xrightarrow[[O]]{Na_2Cr_2O_7/H_2SO_4} H-\boxed{X}$ **X is**
A) An aldehyde group
B) A hydroxyl group
C) A carbonyl group
D) A carboxyl group

Q.22 Acetaldehyde is purified by which method when prepared by alcohol in laboratory
A) Solidification
B) Re-distillation
C) Chromatography
D) Steam distillation

Q.23 Isobutyl alcohol on oxidation converts to a carbonyl compound A. A is
A) Butanone
B) 2-Methyl propanal
C) Butanal
D) All of the above

REACTION OF ALDEHYDES AND KETONES

Q.24 Formation of yellow or orange/red precipitates with 2, 4-DNPH refers to the identification of
A) Aldehydes
B) Pure alcohols only
C) Ketones
D) Both A) and C)

Q.25 The reduction of a ketone using $NaBH_4$ gives:
A) Primary alcohol
B) Tertiary alcohol
C) Secondary alcohol
D) Phenol

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Q.26 **Addition of HCN to acetaldehyde in the presence of dilute mineral acid and sodium cyanide forms**

A) Formaldehyde cyanohydrin
B) Acetone cyanohydrins
C) Acetaldehyde cyanohydrin
D) Butanone cyanohydrin

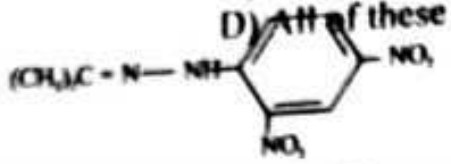
Q.27 **What will be the product in following reaction?**

$CH_3CH = CHCH_2COCH_3 \xrightarrow{NaBH_4} ?$

A) $CH_3CH_2CH_2CH_2COCH_3$
B) $CH_3CH_2CH_2CH_2CH(OH)CH_3$
C) $CH_3CH = CHCH_2CH(OH)CH_3$
D) All of these

Q.28 **Which of the following has maximum reactivity in nucleophilic addition reactions?**

A) Formaldehyde
B) Acetaldehyde
C) Propanone
D) All of these

Q.29 $X + 2,4\text{-DNPH} \xrightarrow[H_2O]{H^+}$  **, the X will be?**

A) CH_3COCH_3
B) CH_3CHO
C) HCHO
D) $C_2H_5OCH_3$

Q.30 **Formation of cyanohydrin form an aldehyde is an example of**

A) Nucleophilic substitution
B) Nucleophilic addition
C) Electrophilic addition
D) Electrophilic substitution

Q.31 **Reducing agent which attack carbonyl compound in $NaBH_4$ is**

A) $\dot{H}$
B) H^+
C) H^-
D) H_2

Q.32 **Catalytic reduction of acetone will produce**

A) Methyl alcohol
B) Ethyl alcohol
C) Isopropyl alcohol
D) Neopentyl alcohol

Q.33 **For which one of the following pairs of compounds can be distinguished by means of Tollen's tests.**

A) HCHO and CH_3CHO
B) CH_3CHO and CH_3COCH_3
C) CH_3COCH_3 and $CH_3COCH_2CH_3$
D) CH_3COOH and CH_3COCH_3

Q.34 **Which substance does not oxidize easily**

A) CH_3CH_2CHO
B) CH_3CHO
C) HCHO
D) CH_3COCH_3

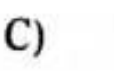
Q.35 **Which one of the following set of compounds oxidize aldehydes as well as ketones**

A) $CuSO_4$ + NaOH + Citric acid
B) $CuSO_4$ + NaOH + Tartaric acid
C) $AgNO_3 + NH_4OH$
D) $K_2Cr_2O_7$ + Conc. H_2SO_4

Q.36 **An aldehyde when boiled with Fehling solution gives brick red precipitate, red colour is due to**

A) Ag
B) Cuprous oxide
C) Cupric oxide
D) Sodium carboxylate

Q.37 **Strongest reducing agent that can reduce the Tollen's reagent is**

A) HCHO
B) CH_3CHO
C) 
D) CH_3COCH_3

Q.38 **Which of the following carbonyl compound can give aliphatic, saturated alcohol using $NaBH_4$**

A) Acetophenone
B) 2-Butene, 2-ol
C) Benzaldehyde
D) 3-Methyl 2-pentanone

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Q.39 **Mixture of air and methanol can form a compound that reacts with Fehling's solution if mixture is passed over copper heated at**

A) 500°C
B) 100°C
C) 300°C
D) 25°C

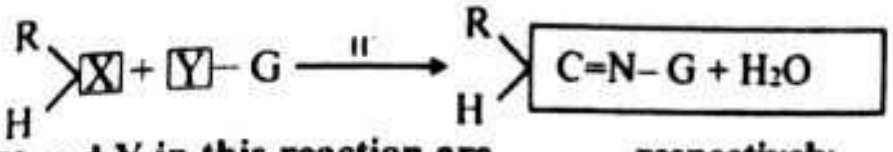
Q.40 **Acetaldehyde gives which salt by reacting with ammonical silver nitrate**

A) Sodium acetate
B) No salt formed
C) Ammonium acetate
D) Silver chloride

Q.41 **Which of the following pair cannot be distinguished by haloform test**

A) Ketons from methyl ketons
B) Methanol from alkanols
C) Acetaldehyde from aldehydes
D) 2-Propanol from 1-propanol

Q.42



X and Y in this reaction are _____ respectively

A) $-NH_2$ and $-CHO$
B) $> C = O$ and $-NH_2$
C) $-CHO$ and $-NH_2$
D) $-CH_2OH$ and $-NH_2$

Q.43 **Formalin is _____% solution of formaldehyde in water**

A) 10%
B) 40%
C) 20%
D) 60%

Q.44 **Which of the following carbonyl compounds shows rapid reaction with sodium nitroprusside**

A) Formaldehyde
B) Benzaldehyde
C) Acetaldehyde
D) Acetone

Q.45 **Cannizzaro's reaction is not given by**

A) Formaldehyde
B) Benzaldehyde
C) Acetaldehyde
D) Trimethyl acetaldehyde

Q.46 **Which of the following do not give aldol condensation reactions**

A) Formaldehyde
B) Diemthyl ketone
C) Acetaldehyde
D) Propionaldehyde

Q.47 **Which of the following will not give addition reaction with $NaHSO_3$**

A) HCHO
B) CH_3-CH_2-CHO
C) CH_3CHO
D) $CH_3CH_2 - OH$

Q.48 **For aldol condensation the conditions necessary**

A) α-C
B) Basic medium
C) α -H
D) All of these

Q.49 **Which of the following does not give aldol condensation**

A) Methanal
B) Propanone
C) Ethanal
D) 2-pentanone

Q.50 **Which of the following compound can be used for the separation of ethanal from the mixture of ethanal and ethanol**

A) $NaHSO_3$
B) NH_2NH_2
C) HCN
D) Aldol

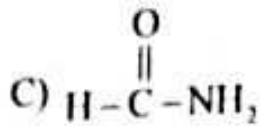
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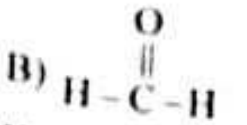
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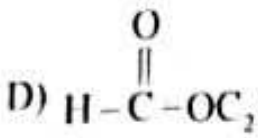
PAST PAPERS QUESTIONS

Q.1 Which of the following compounds belong to homologous series of aldehydes

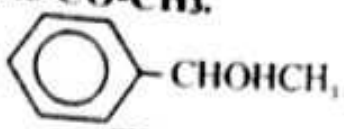
A) 

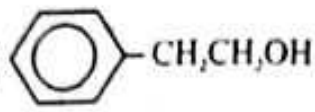
C) 

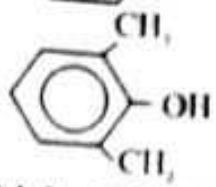
B) 

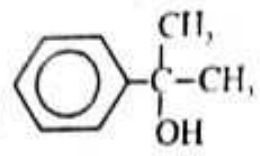
D) 

Q.2 What is the structure of alcohol which on oxidation with acidified $Na_2Cr_2O_7$ gives C_6H_5-CO-CH_3.

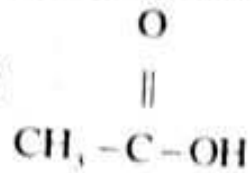
A) 

C) 

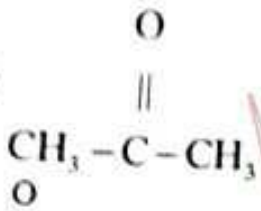
B) 

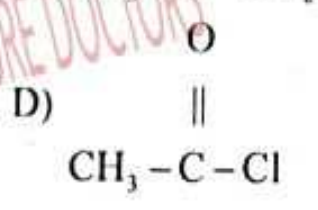
D) 

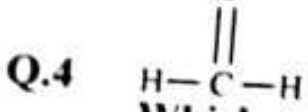
Q.3 Which of the following is the structure of a ketone?

A) 

C) 

B) 

D) 

Q.4 

Which one of the following is IUPAC name of the above given structure?

A) Proopanaldehyde
B) Methanone
C) Acetaldehyde
D) Methanal

Q.5 Hybridization of carbon in –CHO group is

A) sp
B) sp^3
C) sp^2
D) dsp

Q.6 Dry distillation of mixture of calcium salts of acetic acid and formic acid results into formation of

A) Acetaldehyde
B) Formaldehyde
C) Calcium acetate
D) Sodium acetate

Q.7 $Na_2Cr_2O_7$, what the product will be, when secondary alcohols are oxidized in same conditions?

A) Alkenes
B) Alkynes
C) Alkyl halides
D) Ketones

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Q.8 **A student mixed ethyl alcohol with small amount of sodium dichromate and added it to the hot solution of dilute sulphuric acid. A vigorous reaction took place. He distilled the product formed immediately. What was the product?**

A) Acetone
B) Acetic acid
C) Dimethyl ether
D) Acetaldehyde

Q.9 **In the reaction, "?" represents which one of the following products:**

$$\text{Primary Alcohol} + [O] \xrightarrow[H_2SO_4]{K_2Cr_2O_7} ? \xrightarrow{[O]} \text{Carboxylic Acid}$$

A) Ketone
B) Aldehyde
C) Formic acid
D) Ether

Q.10 **2-propanal on Oxidation gives _____:**

A) Aldehyde
B) Ketone
C) Carboxylic Acid
D) Alcohol

Q.11 **Why is it necessary to distill aldehyde formed from oxidation of primary alcohol through acidified per dichromate (VI) solution or acidified sodium dichromate (VI) solution?**

A) Aldehyde formed is unstable and decompose back to original precursor i.e. primary alcohol
B) Aldehyde formed may react with primary alcohol, the original reactant
C) Aldehyde may be oxidized further to a ketone
D) Aldehyde formed may be oxidized further to carboxylic acid

Q.12 **Ketones can be made by oxidation of**

A) Primary Alcohols
B) Tertiary Alcohols
C) Secondary Alcohols
D) Aldehydes

Q.13 **Select the reagent X from the following choices for this conversation;**

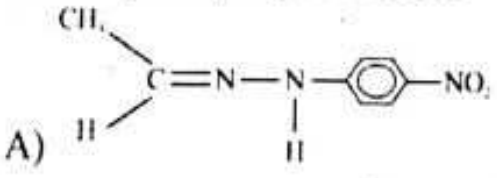
$$CH_3CH(OH)CH(CH_3)_2 \xrightarrow{\text{Reagent X}} CH_3COCH(CH_3)_2$$

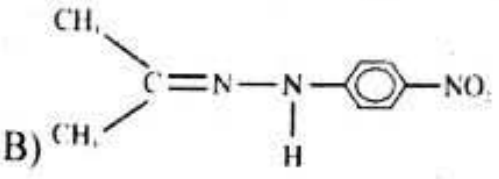
A) Acidified Phosphoric acid
B) Acidified Potassium dichromate (VI)
C) Acidified Potassium hydroxide
D) Acidified Oxalic acid

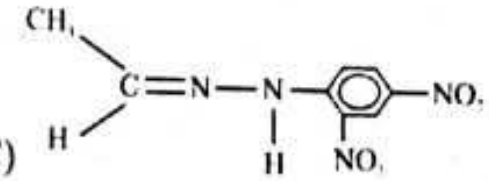
Q.14 **Which mechanism of reaction is shown by carbonyl compounds?**

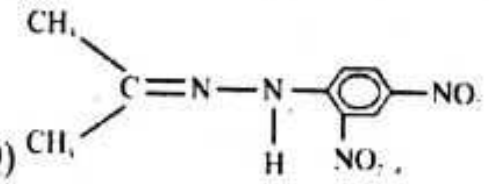
A) Electrophilic substitution
B) Electrophilic addition
C) Free radical substitution
D) Nucleophilic addition

Q.15 **The structure of formula of the product of reaction of acetone with 2, 4-dinitrophenyl hydrazine is**

A)


B)


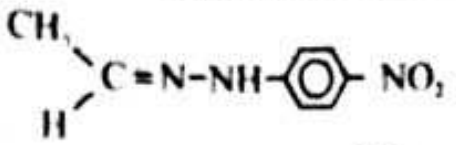
C)


D)


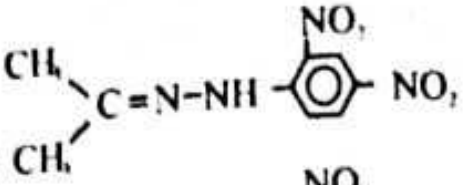
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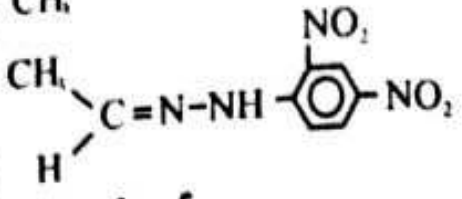
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Q.16 When acetaldehyde reacts with 2,4–dinitrophenylhydrazine (2,4-DNPH), which one of the following products is formed

A) 

B) 

C) 

D) 

Q.17 $R-CH=N-NH-C_6H_3(NO_2)_2$ It is a general formula of

A) 2,4 Dinitrophenyl hydrazine
B) 1,3 Dinitrophenyl hydrazone
C) Phenyl hydrazone
D) 2,4 Dinitrophenyl hydrazine

Q.18 Which one of the following test is given by both aldehyde and ketone?

A) Silver mirror test
B) Fehling's solution test
C) 2,4 DNPH test
D) Benedict's solution test

Q.19 The reaction of aldehydes and ketones with ammonia derivative $G-NH_2$ to form compounds containing the group $\diagdown C = N - G$ and water is known as _____ reaction.

A) Nucleophilic addition
B) Nucleophilic substitution
C) Electrophilic addition
D) Addition Elimination

Q.20 Both aldehyde and ketones give _____:

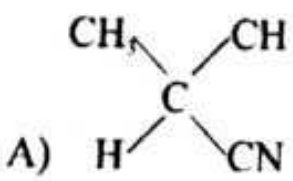
A) Tollen's Test
B) 2,4-DNPH test
C) Benedict's solution test
D) Sodium nitroprusside test

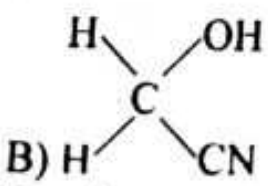
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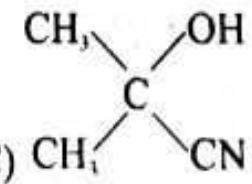
Q.21 $HCHO + HCN \longrightarrow \underset{\displaystyle OH}{\underset{|}{H_2C}} - CN$ **in the above reaction nucleophile is**

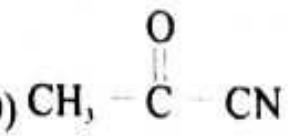
A) CN^-
B) Cl^-
C) HCl
D) OH^-

Q.22 Formaldehyde reacts with HCN (NaCN + HCl) to give a compound

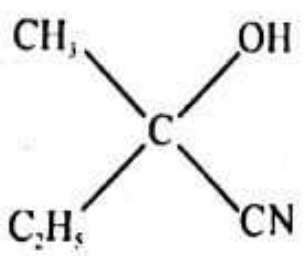
A) 

B) 

C) 

D) 

Q.23 For the reaction:

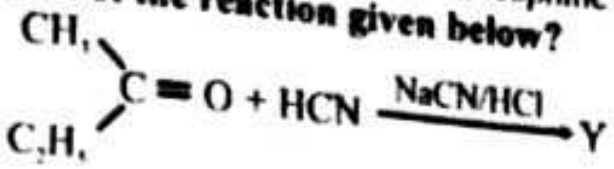
$? + HCN \xrightarrow{Base}$ 

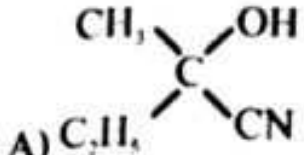
A) $C_2H_5COCH_3$
B) $C_2H_5CH(CH_3)OH$
C) CH_3COCH_3
D) $C_2H_5CH_2CHO$

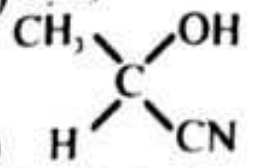
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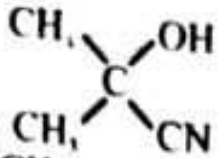
Q.24 **Ethanal reacts with HCN to form cyanohydrin. It is an example of**
A) Nucleophilic addition
B) Electrophilic addition
C) Electrophilic substitution
D) Nucleophilic substitution

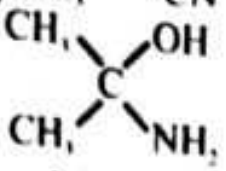
Q.25 **What will be the product of the reaction given below?**



A) 

B) 

C) 

D) 

Q.26 **Both aldehydes and ketones are planer to the neighborhoods of carbonyl** $\left(\overset{\backslash}{\underset{/}{C}}=O\right)$ **group. Which one of the following bonds is distorted towards the oxygen atoms?**
A) π bond of C and O
B) Sigma bond of C and H
C) Sigma bond of C and O
D) Sigma bond of C and C

Q.27 **Which type of reaction takes place when a carbonyl compound is treated with a mixture of NaCN and an acid?**
A) Electrophilic addition reaction
B) Displacement reaction
C) Nucleophilic addition reaction
D) Substitution reaction

Q.28 **Carbonyl group undergo**
A) Electrophilic addition reaction
B) Electrophilic substitution reaction
C) Nucleophilic addition reaction
D) Nucleophilic substitution reaction

Q.29 **Which reagent is responsible for the conversion of ketone to secondary alcohol:**
A) $NaAlH_4$
B) $NaBH_4$
C) Al
D) Red P

Q.30 **Which of the following compounds will give a secondary alcohol after reaction with $NaBH_4$?**
A) CH_3COCH_3
B) CH_3CH_2COOH
C) CH_3CH_2CHO
D) CH_3COOCH_3

Q.31 **Brick red precipitate are formed when aldehyde reacts with**
A) Sodium borohydride
B) Sodium bisulphate
C) Fehling solution
D) Formaldehyde

Q.32 **Consider the following reaction:**
$R\text{-}CHO + 2[Ag(NH_3))_2]OH \longrightarrow RCOONH_4 + 2Ag + 2NH_3 + H_2O$
this reaction represents which of the following tests
A) Fehling test
B) Ninhydrin test
C) Benedict test
D) Tollen's test

Q.33 **To distinguish aldehyde from ketone which solution is used**
A) Alkaline solution
B) Fehling's solution
C) A solution containing $K_2Cr_2O_7$
D) A solution containing acid only

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Q.34 Which one of the following reagents is used to distinguish between aldehydes and ketones?

A) Tollen's reagent
B) 2,4-DNPH
C) Bromine
D) Alkaline iodine

Q.35 Which of the following will give a positive test with Tollen's reagent?

A) Tertiary Alcohols
B) Aldehydes
C) Ketones
D) Carboxylic Acids

Q.36 Identification test for functional groups of organic compounds are associated with specific observations. Tollen's reagent is ammonical silver nitrate solution, which is used for the identification of a functional group X with an observation O. Identify X and O.

A) X = Aldehyde O = Red precipitate
B) X = Aldehyde O = Silver mirror
C) X = Ketone O = Silver mirror
D) X = Ketone O = Grey precipitate

Q.37 Iodoform test will not be positive with

A) $CH_3-CH_2-\overset{\overset{O}{\|}}{C}-CH_2-CH_3$
C) C_2H_5OH
B) $CH_3-CH_2-\overset{\overset{O}{\|}}{C}-CH_3$
D) $CH_3-\overset{\overset{O}{\|}}{C}-H$

Q.38 Which group gives a yellow precipitate of triiodomethane when warmed with alkaline aqueous iodine?

A) An amide group, $CH_3-\overset{\overset{O}{\|}}{C}-NH_2$

B) Ethyl ketone group, $C_2H_5-\overset{\overset{O}{\|}}{C}-NH_2$

C) A primary alcohol group as in propanol, $CH_3CH_2CH_2OH$

D) Methyl ketone group, $CH_3-\overset{\overset{O}{\|}}{C}-$

Q.39 Identify the compound, which give iodoform test:

A) Methanol
B) Methyl ketone
C) 3- Hexanol
D) Propionaldehyde

Q.40 Which of the following compounds will produce a yellow precipitate with I_2 dissolved in $NaOH_{(aq)}$?

A) $HCOOCH_2CH_2$
B) CH_3OH
C) $CH_3CH_2CO\,CH_3$
D) CH_3CH_2CHO

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ANSWER KEY

1	C	11	D	21	C	31	C	41	B
2	A	12	D	22	B	32	C	42	B
3	D	13	B	23	B	33	B	43	B
4	A	14	A	24	D	34	D	44	D
5	D	15	D	25	C	35	D	45	C
6	D	16	A	26	C	36	B	46	A
7	D	17	B	27	C	37	A	47	D
8	D	18	D	28	A	38	D	48	D
9	A	19	D	29	A	39	C	49	A
10	D	20	C	30	B	40	C	50	A

PAST PAPERS QUESTIONS

1	B	6	A	11	D	16	D	21	A	26	A	31	C	36	B
2	A	7	D	12	C	17	D	22	B	27	C	32	D	37	A
3	B	8	D	13	B	18	C	23	A	28	C	33	B	38	D
4	D	9	B	14	D	19	D	24	A	29	B	34	A	39	B
5	C	10	B	15	D	20	B	25	A	30	A	35	B	40	C

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EXPLANATORY NOTES

Q.1 The structural formula of aldehyde is $R-\overset{\overset{O}{\|}}{C}-H$ and that of ketone is $R-\overset{\overset{O}{\|}}{C}-R$

Q.2 General formula of saturated aliphatic aldehydes is $C_nH_{2n}O$ so answer is **A**

Q.3 $H-\overset{\overset{O}{\|}}{C}-H$, $H_3C-\overset{\overset{O}{\|}}{C}-H$, $H_3C-CH_2-\overset{\overset{O}{\|}}{C}-H$

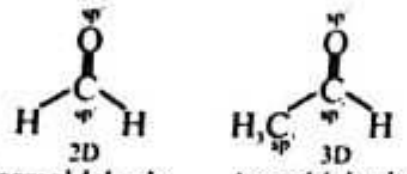
in the all the given examples of aldehydes, the carbonyl carbon is at position 1or at the terminal of carbon chain

Q.4

$CH_3-\overset{\overset{O}{\|}}{C}-CH_3$, $CH_3-CH_2-\overset{\overset{O}{\|}}{C}-CH_3$, $CH_3-CH_2-\overset{\overset{O}{\|}}{C}-CH_2-CH_3$

In all the given examples of ketones, the carbonyl carbon is within carbon chain

Q.5



Formaldehyde Acetaldehyde

In formaldehyde both the carbonyl carbon and carbonyl oxygen atoms are sp^2 hybridized while in acetaldehyde one carbon atom is sp^3 hybridized

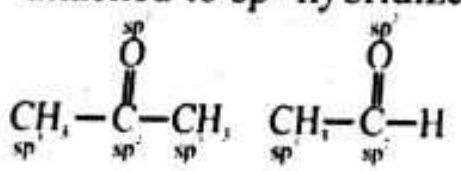
So, formaldehyde is planar trigonal while acetaldehyde is planar trigonal at C#1 and tetrahedral at C#2. Therefore both formaldehyde and acetaldehyde don't have same molecular geometry

Q.6 Carbonyl compounds include aldehyde and ketones. Aldehydes have structural formula $R-\overset{\overset{O}{\|}}{C}-H$ while ketones have $R-\overset{\overset{O}{\|}}{C}-R$ or $R-\overset{\overset{O}{\|}}{C}-R'$. Therefore both aldehydes and ketones don't have same general structural formula.

Q.7 In aldehydes the structural formula is $R-\overset{\overset{O}{\|}}{C}-H$ in which R can be a hydrogen atom is true for $H-\overset{\overset{O}{\|}}{C}-H$ while R is an alkyl group and its true for $H_3C-\overset{\overset{O}{\|}}{C}-H$ or $H_3C-CH_2-\overset{\overset{O}{\|}}{C}-H$.

Q.8 The general structure is formula of ketone is $R-\overset{\overset{O}{\|}}{C}-R$. The carbonyl group >C = O is bonded to two alkyl groups means to C atoms

Q.9 Mostly in saturated and aliphatic carbonyl compounds the carbonyl carbon is bonded to one or two sp^3 hybridized carbon atoms through single bond (sigma bond) while it is also attached to sp^2 hybridized oxygen atom through a double bond



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Q.10 The unsymmetrical ketones have two different alkyl groups on either side of carbonyl group like $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_2-CH_2-CH_3$

Q.11 All compounds have –CHO group. Therefore all the compounds are aldehydes

Q.12 $2CH_3OH+O_2 \xrightarrow[300°C]{Fe(MoO_4)} 2HCHO+2H_2O$

$2CH_3OH+O_2 \xrightarrow[300°C]{Pt\text{-}Asbestos} 2HCHO+2H_2O$

$CH_3-CH_2-OH+[O] \xrightarrow[H_2SO_4]{Na_2Cr_2O_7} CH_3CHO+H_2O$

FeO, Mo_2O_3 and Pt-asbestos are catalysts used for air oxidation of alcohols to aldehydes while $Na_2Cr_2O_7 + H_2SO_4$ combination is used for the production of nascent oxygen which is used to oxidize alcohols to carbonyl compounds.

Q.13 Methyl ethyl ketone is a 4-C ketone. So, it requires a 4-C secondary alcohols

$$H_3C-\underset{OH}{\underset{|}{CH}}-CH_2-CH_3 + [O] \xrightarrow[H_2SO_4]{Na_2Cr_2O_7} CH_3-\overset{O}{\overset{\|}{C}}-CH_2-CH_3$$

Q.14 $CH_3-CH_2-OH+[O] \xrightarrow[H_2SO_4]{Na_2Cr_2O_7} CH_3-CHO$

This reaction is involving oxidation of ethanol

Q.15 $2CH_3OH_{(g)} + O_{2(g)} \xrightarrow[300°C]{Pt\text{-}Asbestos} 2HCHO_{(g)} + 2H_2O_{(g)}$

Q.16 $2CH_3OH + O_2 \xrightarrow[300°C]{Pt[\text{Asbestos or } Cu} 2HCHO + 2H_2O$

Q.17 $Na_2Cr_2O_7+4H_2SO_4 \longrightarrow Na_2SO_4+Cr_2(SO_4)_3+4H_2O+3[O]$

$3C_2H_5OH+3[O] \longrightarrow 3CH_3CHO+3H_2O$

Q.18 $2HCHO+O_2 \xrightarrow[300°C]{Fe(MoO_4) \text{ or } Ag} 2HCHO+2H_2O$

$2HCHO+O_2 \xrightarrow[500°C]{Pt\text{- Asbestos}} 2HCHO+2H_2O$

Q.19 $H_3C-\boxed{CH_2-OH}+[O] \xrightarrow[H_2SO_4]{Na_2Cr_2O_7} H_3C-\boxed{CHO}+H_2O$

Q.20 $R-\boxed{\overset{a}{C}H_2-OH}+[O] \xrightarrow[H_2SO_4]{Na_2Cr_2O_7} H_3C-\boxed{CHO}+H_2O$

Primary alcohol — Aldehyde group

Q.21 $H-\boxed{\overset{a}{C}H_2-OH}+[O] \xrightarrow[H_2SO_4]{Na_2Cr_2O_7} H-\boxed{CHO}+H_2O$

Aldehyde group

Q.22 During the oxidation of ethanol to get a acetaldehyde, acetaldehyde is immediately distilled off to avoid its oxidation. This distillate (mixture of ethanol, water and acetaldehyde) is then condensed. To get pure acetaldehyde, it is redistilled

Q.23 Isobutyl alcohol is primary alcohol

$$H_3C-\underset{CH_3}{\underset{|}{CH}}-CH_2-OH + [O] \xrightarrow[H_2SO_4]{Na_2Cr_2O_7} H_3C-\underset{CH_3}{\underset{|}{CH}}-CHO$$

2-Methyl propanal

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Q.24 The aldehydes and ketones give yellow or orange colour crystals (2,4-dinitrophenylhydrozone)

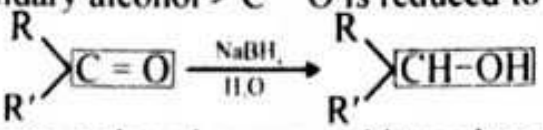


Yellow or Orange

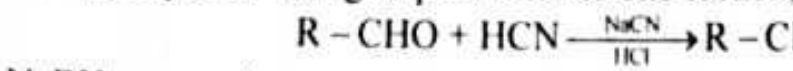


Yellow or Orange

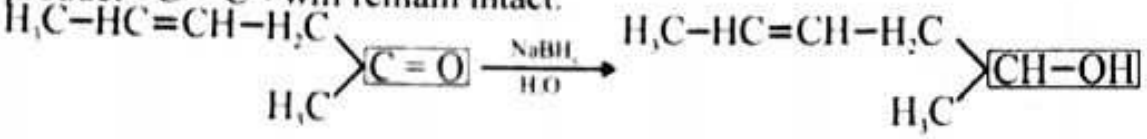
Q.25 The reduction of any ketone by $NaBH_4$, $LiAlH_4$ or H_2 (in presence of Ni / Pt / Pd catalyst) produces secondary alcohol > C = O is reduced to > CH – OH



Q.26 When HCN is added to any carbonyl compound it produces an adduct which contain both –CN group and –OH group attached to one carbon, called cyanohydrin.



Q.27 $NaBH_4$ can reduce >C = O group to >CH–OH group but cannot reduce >C=C<. So, in product >C = C< will remain intact.



Q.28

$$\text{Reactivity of carbonyl compound} \propto \frac{1}{\#\text{ of R groups}}$$

$$\text{Reactivity of carbonyl compound} \propto \frac{1}{\text{Size of R groups}}$$

$$\text{Reactivity of carbonyl compound} \propto \frac{1}{\#\text{ of C-atoms}}$$

Reactivity order:

Aldehyde > Ketone

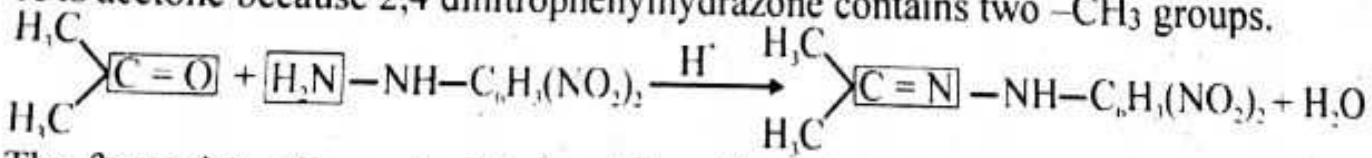
Small aldehyde > large aldehyde

Small ketone >large ketone

Unsymetrical ketone > symmetrical ketone

Aliphatic aldehyde / ketone > aromatic aldehyde / ketone

Q.29 X is acetone because 2,4 dinitrophenylhydrazone contains two $-CH_3$ groups.



Q.30 The formation of cyanohydrin is achieved by addition of HCN to carbonyl compounds. As this addition is initiated by the attack of $-CN^-$ to carbonyl carbon of carbonyl compound. Therefore, it is a nucleophilic addition reaction.

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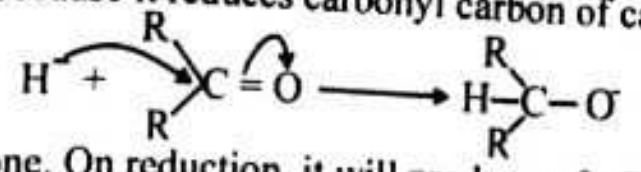
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Q.31

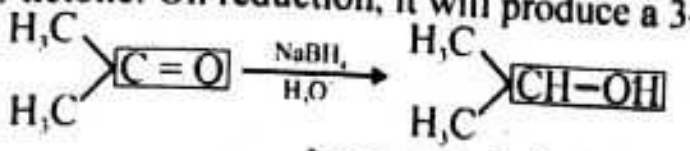
$$NaBH_4 \longrightarrow Na^+ + BH_4^-$$

$$BH_4^- \longrightarrow BH_3 + H^-$$

H^- is reducing agent because it reduces carbonyl carbon of carbonyl compound.



Q.32 Acetone is a 3–C ketone. On reduction, it will produce a 3–C secondary alcohol.



Isopropyl alcohol / 2-Propanol

Q.33 All the aliphatic aldehydes gives positive test (silver mirror formation on the inner side of test tube) while ketones don't. So, any aliphatic aldehyde can be distinguished from ketones by Tollen's test.

Q.34

$$\text{Reactivity of carbonyl compound} \propto \frac{1}{\#\text{ of R groups}}$$

$$\text{Reactivity of carbonyl compound} \propto \frac{1}{\text{Size of R groups}}$$

$$\text{Reactivity of carbonyl compound} \propto \frac{1}{\#\text{ of C-atoms}}$$

Reactivity order:

Aldehyde > Ketone

Small aldehyde > large aldehyde

Small ketone >large ketone

Unsymetrical ketone > symmetrical ketone

Aliphatic aldehyde / ketone > aromatic aldehyde / ketone

Q.35 A, B, C are mild oxidizing agent, so they can oxidize aldehydes only (due to high reactivity than ketone) but not ketones but the combination of $K_2Cr_2O_7$ and H_2SO_4 produces nascent oxygen which is very strong oxidizing agent. So, it can oxidize both aldehydes and ketones.

Q.36 Fehling's solution is alkaline solution containing cupric tartarate complex ion. This cupric ion reduced to brick red coloured cuprous oxide (Cu_2O) by an aliphatic aldehyde.

Q.37 Aliphatic aldehydes are reactive than aromatic aldehydes and ketones so, a small aliphatic aldehyde can reduce Tollen's reagent

Q.38 3-Methyl-2-pentanone gives 3-Methyl-2-pentanol on reduction with $NaBH_4$

$$CH_3CH_2CH(CH_3)COCH_3 \xrightarrow{NaBH_4} CH_3CH_2CH(CH_3)CH(OH)CH_3$$

Q.39 $$2HCHO + O_2 \xrightarrow[300°C]{Cu} 3CH_3OH + 2H_2O$$

Q.40 $$CH_3CHO + 2\left[Ag(NH_3)_2\right]OH \longrightarrow CH_3COONH_4 + 2Ag + 2NH_3 + H_2O$$

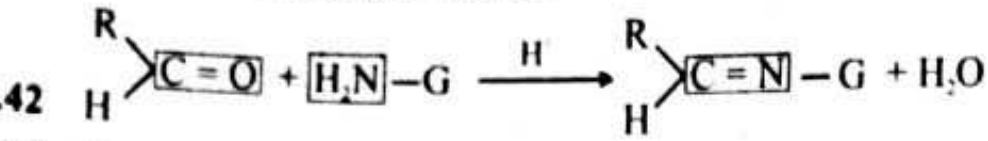
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Q.41 Ethanol out of all primary alcohols, 2-alkanols out of all secondary alcohols, acetaldehyde out of all aldehydes and methyl ketone out of all ketones gives haloforms test

Methanol cannot give this test

Q.42



Q.43 Formalin contains 40% formaldehyde, 8% methanol and 52% water.

Q.44 Ketones produce a wine red or orange red colour on adding alkaline sodium nitroprusside solution dropwise. Aldehydes don not give this test.

Q.45 Aldehydes that have no α-hydrogen atoms undergo cannizzaro's reaction. Acetaldehyde possess α-hydrogen therefore it does not give Cannizzaro's reaction.

Q.46 Aldehydes and ketones possessing α-hydrogen atoms react with a cold dilute solution of an alkali to form addition products known as aldols. Formaldehyde has no α-hydrogen therefore it does not give aldol condensation reaction.

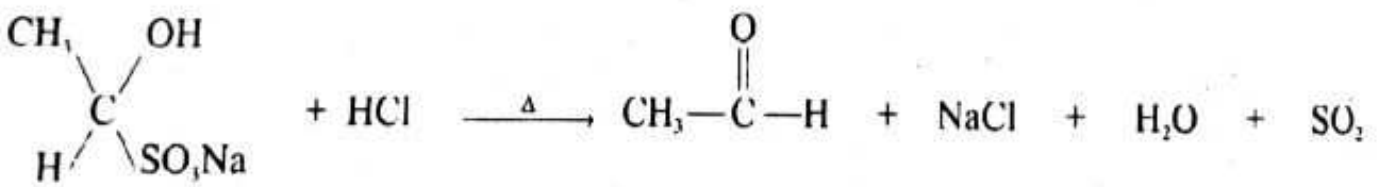
Q.47 Aldehydes and small methyl ketones react with a saturated aqueous solution of sodium bisulphite to form a crystalline white precipitate of sodium bisulphite adduct. Alcohols do not react with $NaHSO_3$.

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Q.48 Aldehydes and ketones possessing α-hydrogen atoms react with a cold dilute solution of an alkali to form addition products known as aldols.

Q.49 Aldehydes and ketones possessing α-hydrogen atoms react with a cold dilute solution of an alkali to form addition products known as aldols. Methanol has no α-hydrogen therefore it does not give aldol condensation reaction.

Q.50



Bisulphite addition product Acetaldehyde

This reaction is used for the separation and purification of carbonyl compounds from non-carbonyl compounds such as alcohols.

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Topic 18

CARBOXYLIC ACIDS

PRACTICE EXERCISE

CLASSIFICATION AND PHYSICAL PROPERTIES OF CARBOXYLIC ACIDS

Q.1 General formula for carboxylic acid is

A) $C_nH_{2n}O_3$
B) $C_nH_{2n}O_2$
C) $C_nH_nO_2$
D) $C_nH_{2n}O$

Q.2 Which of the following is an unsaturated carboxylic acid

A) Malonic acid
B) Succinic acid
C) Oxalic acid
D) Maleic acid

Q.3 Acetic acid exists as dimer in benzene due to

A) Presence of hydrogen at α-carbon
B) Presence of carboxylic group
C) Condensation reaction
D) Hydrogen bonding

Q.4 An acid with unpleasant smell

A) Formic acid
B) Propionic acid
C) Acetic acid
D) Butyric acid

Q.5 Glacial acetic acid at low temperature is a

A) Semi solid
B) Viscous liquid
C) Ice like solid
D) Dilute liquids

Q.6 Which of the following is unsaturated aliphatic organic acid

A) Maleic acid
B) Phthalic acid
C) Terephthalic acid
D) Adipic acid

Q.7 Which one is carboxylic acid

A) Carbolic acid
B) Carbonic Acid
C) Picric Acid
D) Palmitic acid

PREPARATIONS AND REACTIONS OF CARBOXYLIC ACIDS

Q.8 Organic acid which cannot obtained by hydrolysis of fats

A) Succinic acid
B) Butyric acid
C) Acetic acid
D) Propionic acid

Q.9 By oxidation of which compound carboxylic acid cannot be obtained.

A) 2-Methyl-2-propanol
B) 2-Butanol
C) 1-Butanol
D) 2-Propanol

Q.10 A compound is oxidized to x, by further oxidation of x if resulting compound is butyric acid, starting compound can be:

A) Butanol
B) Butanone
C) Butanoic acid
D) All of these

Q.11 Alkane nitriles on boiling with which type of acid gives organic acids

A) Organic
B) Alcohol
C) Phenol
D) Mineral acids

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Q.12 If ethanoic acid is to be prepared by hydrolysis of alkane nitriles, which of the following can be the reagent to be hydrolyzed

A) CH_3CN
B) HCN
C) CH_3CH_2CN
D) NaCN + HCl

Q.13 Hydrolysis of CH_3CH_2CN will synthesize

A) Ethanoic acid
B) Methanoic acid
C) Propanoic acid
D) Glutamic acid

Q.14 Alkane nitriles can be prepared by treating alkyl halide with

A) Alcohol
B) Potassium cyanide
C) Alcoholic potassium cyanide
D) Water

Q.15 Ethanoic acid can be prepared by hydrolysis of

A) Methyl chloride
B) Ethanol
C) Ethane nitrile
D) Ethyl chloride

Q.16 Propanoic acid is produced from _____ on acidic hydrolysis

A) 1-propanol
B) n-propyl cyanide
C) Isopropyl cyanide
D) Ethyl cyanide

Q.17 $CH_3CN + H_2O \xrightarrow{H^+} A \xrightarrow[H_2O]{H^+} CH_3COOH$ **. Predict "A" among the following**

A) $CH_3CH_2NH_2$

B) $NH_2-\overset{\overset{O}{\|}}{C}-NH_2$

C) $CH_3-\overset{\overset{O}{\|}}{C}-NH_2$

D) $CH_3-\overset{\overset{O}{\|}}{C}-OH$

Q.18 Hydrolysis of ethane nitrile in presence of HCl produces carboxylic acid. Identify the by product produced during reaction

A) NH_4NO_3
B) NH_4Cl
C) $(NH_4)_2SO_4$
D) All of these

Q.19 Potassium carbonate is decomposed by acetic acid and release a gas, the nature of gas is

A) Basic
B) Acidic
C) Neutral
D) Unpredictable

Q.20 Which group of carboxylic acids is active for reaction with alkali metal carbonates?

A) H-atom
B) Hydroxyl group
C) Carbonyl group
D) Carboxylic group

Q.21 Which reaction can be used in artificial juices formation with carboxylic acids

A) Hydration
B) Hydrolysis
C) Esterification
D) Salt formation

Q.22 The addition of ethyl alcohol in protonated acetic acid is

A) Electrophilic substitution
B) Nucleophilic substitution
C) Nucleophilic addition
D) Oxidation

Q.23 Benzyl alcohol and acetic acid give a compound with _____ fragrance

A) Banana
B) Apricot
C) Pineapple
D) Jasmine

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Q.24 Ammonium acetate converts to acetamide by
A) Cooling
B) Dehydration
C) Heating
D) Both B and C

Q.25 Which of the following represent acid amide
A) CH_3COONH_4
B) CH_3CN
C) CH_3COCl
D) CH_3CONH_2

Q.26 Which sequence of groups replace OH of carboxylic acid to halides, esters and amides respectively
A) OH, X, NH_2
B) NH_2, H, X
C) X, OR, NH_2
D) X, OR, NO_2

Q.27 Which gas release during acid halide formation with the help of thionyl chloride and carboxylic acid
A) CO_2
B) SO_2
C) NO
D) SO_3

Q.28 Which of the following can be the reagent to produce acetyl chloride from ethanoic acid
A) $SOCl_2$
B) NaCl
C) PCl_5
D) Both "A" and "C"

Q.29 During the formation of an acid amide from ethanoic acid, what actually happens
A) Displacement of the –H from the acid by –Cl
B) Displacement of the –OH from the acid by $-NH_2$
C) Attachment of $-NH_2$ with the carbonyl oxygen
D) Displacement of the –H from the acid by $-NH_2$

Q.30 Carboxylic acids react with active metals (Na, K, Ca and Mg) to form their salt and
A) H_2O
B) H_2O and CO_2
C) CO_2 only
D) H_2 gas

Q.31 Which pair can be used as a reactant for the preparation of acetyl chloride
A) CH_3COOH, HCl
B) CH_3COOH, $SOCl_2$
C) CH_3COOH, PCl_5
D) Both "B" and "C"

Q.32 For producing a carboxylic acid derivative. The reaction of nucleophile to carboxyl group is always followed by displacement of
A) –COOH group
B) H atom
C) –OH group
D) OR

Q.33 Which statement is incorrect about formation of ester
A) When carboxylic acids are heated with alcohols, esters are formed
B) Esters have fruity smell
C) Esters are used as artificial flavours
D) Ester are formed in the presence of NaOH

Q.34 Which ester is used as orange flavour
A) Amyl acetate
B) Benzyl acetate
C) Octyl acetate
D) Isobutyl formate

Q.35 Esters are
A) Acidic
B) Basic
C) Neutral
D) None of these

Q.36 The work of concentrated H_2SO_4 in esterification process is as
A) Dehydrating agent and catalyst
B) Dehydrating agent
C) Hydrolyzing agent
D) Catalyst

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Q.37 **Acetyl chloride is soluble in which solvent**
A) Water
B) Acetone
C) Ether
D) Both 'A' and 'B'

Q.38 **Which of the following is not an example of electrophilic substitution reaction**
A) Reaction of CH_3COOH with Na
B) Reaction of CH_3COOH with Na_2CO_3
C) Reaction of CH_3COOH with $NaHCO_3$
D) Reaction of CH_3COOH with PCl_5

Q.39 **Identify reversible reaction among the following**
A) Esterification
B) Acid Amide formation
C) Acid Halide formation
D) Acid anhydride formation

Q.40 **During formation of acid halide, –OH of carboxylic acid is replaced by**
A) $-NH_2$
B) $-OR$
C) $(CO)_2O<$
D) $-X$

Q.41 **Ethyl butyrate is an ester formed by combination of _____ and butyric acid**
A) Ethyl alcohol
B) Butyl alcohol
C) Propyl alcohol
D) Methyl alcohol

Q.42 **By product produced during hydrolysis of alkane nitrile in basic medium is**
A) NH_3
B) NH_4Cl
C) $(NH_4)_2SO_4$
D) NH_4NO_3

Q.43 **Which of the following bond undergoes cleavage when carboxylic acid reacts with Na**
A) C–O
B) O–H
C) C–C
D) H–H

Q.44 **$2CH_3COOH + xCa \longrightarrow Ca(OCOCH_3)_2 + H_2O$. Calculate value of "x".**
A) 1
B) 2
C) 3
D) 4

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ACIDIC STRENGTH AND REACTIVITY OF DERIVATIVES

Q.45 **Which of the following carboxylic acid derivative is least reactive?**
A) Acyl halide
B) Acid amide
C) Acid anhydride
D) Ester

Q.46 **The stronger acid among the following is**
A) Cl_3CCOOH
B) $Cl_2CHCOOH$
C) $ClCH_2COOH$
D) CH_3COOH

Q.47 **The strength of the organic acids and chloro substituted acids is measured by pK_a scale such that smaller value of pK_a corresponds to**
A) Stronger acid
B) Mild acid
C) Weaker acid
D) Very weak acid

Q.48 **Identify strongest acid among the following**
A) α-chlorocarboxylic acid
B) β - chlorocarboxylic acid
C) γ-chlorocarboxylic acid
D) Carboxylic acid

Q.49 **Organic acids (Carboxylic acids) are considered as**
A) Strong acids
B) Mild acids
C) Weak acids
D) Mineral acids

Q.50 **Identify strongest conjugate base among the following**
A) OH^-
B) ^-OR
C) $RCOO^-$
D) PhO^-

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Q.1 In $CH_3 - {}^3CH(CH_3) - {}^2CH(CH_3) - {}^1COOH$ which one is α–carbon atom?

A) 1
B) 3
C) 2
D) 4

Q.2 The dilute solution of _____ is called vinegar

A) Formic acid
B) Benzoic acid
C) Acetic acid
D) Oxalic acid

Q.3 Which of the following is not a fatty acid?

A) Phenyl acetic acid
B) Palmitic acid
C) Stearic acid
D) Oleic acid

Q.4 Which one of the following compounds can exist in the form of cyclic dimers?

A) Benzene
B) Ozonide
C) Acetals
D) A carboxylic acid

Q.5 Consider the following reaction

$CH_3COOH + Mg(metal) \rightarrow$?What product will form

A) Magnesium formate
B) Magnesium acetate
C) Magnesium ion
D) Carboxylate ion

Q.6 The formation of ester from acetic acid in presence of acid and ethanol is a

A) Nucleophilic addition reaction
B) Electrophonic substitution reaction
C) Nucleophilic substation reaction
D) Electrophonic addition reaction

Q.7 Organic compound 'X' and 'Y' both can react with Na-metal to evolve hydrogen gas. 'X' and 'Y' if react with each other form an organic compound 'Z' which gives fruity smell. What types of compounds 'X' , 'Y' and 'Z' are?

	X	Y	Z
A)	Alcohol	Ester	Acetic Acid
B)	Alcohol	Ester	Mineral Acid
C)	Alcohol	Acetic Acid	Ester
D)	Alcohol	Mineral Acid	Ester

Q.8 $CH_3COOH + CH_3CH_2OH \rightleftharpoons CH_3COOC_2H_5 + H_2O$

Which one of the following will act as a catalyst in above reaction?

A) HNO_3
B) H_2SO_4
C) Acidified potassium dichromate
D) $SOCl_2$

Q.9 Which one of the following reaction of carboxylic acid is reversible?

A) Esterification
B) Salt formation
C) Reaction with PCl_5
D) Reaction with $SOCl_2$

Q.10 During esterification, the bond from alcohol that breaks is between

A) Carbon and Oxygen
B) Oxygen and hydrogen
C) Carbon and carbon
D) None of these

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Q.11 $C_2H_5OH + CH_3\overset{\overset{O}{\parallel}}{C}-OH \rightleftharpoons CH_3\overset{\overset{O}{\parallel}}{C}-OC_2H_5 + H_2O$

Which of the following catalyst is used in the above reaction?

A) Pt
B) Pumice stone
C) Ni
D) Conc. H_2SO_4

Q.12 **Which product is formed by the reaction of carboxylic acid with alcohol?**

A) Ester
B) Alkane
C) Aldehyde
D) Ether

Q.13 **Which one of the following compounds act as catalyst when alcohols react with carboxylic acids**

A) Pt
B) Conc. H_2SO_4
C) Ni
D) Conc. HNO_3

Q.14 **What will be the outcome of reaction of methanol with ethanoic acid in the presence of concentrated sulphuric acid?**

A) Propanone is formed
B) Propanoic acid formed
C) Methyl ethanoate is formed
D) Propanol is formed

Q.15 **$CH_3COOH + PCl_5 \rightarrow$ the products of above reaction are**

A) $CH_3COCl + POCl_2 + HCl$
B) $CH_3COCl + POCl_3 + HCl$
C) $CH_3Cl + POCl_3 + HCl$
D) $CH_3COCl + POCl_3 + H_2$

Q.16 **$CH_3COOH + PCl_5 \rightarrow$?**

Which one of the following options shows the products of above reaction?

A) $POCl_2+CH_3COCl_2+HCl$
B) $POCl_3+CH_3COCl_2+H_2$
C) $CH_3COCl+POCl_2+HCl$
D) $POCl_3+CH_3COCl+HCl$

Q.17 **Identify the product X in the following reaction:**

$$CH_3COOH + PCl_5 \xrightarrow{Yields} X + POCl_3 + HCl$$

A) CH_3COCl
B) CH_3COCl_2
C) $CH_3COCH_2Cl_2$
D) CH_2COCl_2

Q.18 **Which balance chemical equation show the formation of ethanoyl chloride using thionyl chloride?**

A) $CH_3CH_2COOH + 2SOCl \rightarrow CH_3CH_2COCl + SO_2 + HCl$
B) $CH_3COOH + SOCl_2 \rightarrow CH_3COCl + SO_2 + HCl$
C) $HCOOH + SOCl_2 \rightarrow HCOCl + SO_2 + HCl$
D) $CH_3CH_2COOH + 2SOCl \rightarrow CH_3CH_2COCl + SO_3 + HCl$

Q.19 **Which of the following reagent is required for preparation of acyl chloride (CH_3COCl) from ethanoic acid?**

A) HCl
B) CH_3Cl
C) PCl_5
D) $POCl_3$

Q.20 **Acetyl chloride (Ethanoyl chloride) is used in the synthesis of organic compounds. It is prepared by treating acetic acid with**

A) $SOCl_2$
B) CH_3Cl
C) HCl
D) $ClNH_2$

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Q.21 **The –NH-CO group is called**

A) Amide group
B) Protein linkage
C) Amino group
D) Peptide linkage

Q.22 **When ethanoyl chloride reacts with methylamine an amide is formed. What is the structure of it amide formed?**

A) $CH_3-CH_2-\overset{\overset{O}{\|}}{C}-NH_2$

B) $CH_3-CH_2-\overset{\overset{O}{\|}}{C}-NHCH_3$

C) $CH_3-\overset{\overset{O}{\|}}{C}-NH_2$

D) $CH_3-\overset{\overset{O}{\|}}{C}-NHCH_3$

Q.23

$$CH_3-\overset{\overset{O}{\|}}{C}-OH+NH_3 \xrightarrow{Heat} ?$$

The final products formed are

A) $CH_3-\overset{\overset{O}{\|}}{C}-NH_2+CO_2$

B) $CH_3-\overset{\overset{O}{\|}}{C}-NH_2+H_2$

C) $CH_3-\overset{\overset{O}{\|}}{C}-NH_2+H_2O$

D) $CH_3-\overset{\overset{O}{\|}}{C}-NH_2+HCl$

Q.24 **Carboxylic acids are rather hard to reduce, which powerful reducing agent can be used to convert them to the corresponding primary alcohol**

A) H_2SO_4 / $HgSO_4$
B) V_2O_5
C) $LiAlH_4$
D) $K_2Cr_2O_7/H_2SO_4$

Q.25 **Carboxylic acids can be reduced into corresponding alcohols. Which of the following reagent can be used for this purpose?**

A) $K_2Cr_2O_4$
B) H_2SO_4
C) $LiAlH_4$
D) $KMnO_4$

Q.26 **Reagent used to reduce a carboxylic acid to an alkance is**

A) Ni/H_2
B) P/HI
C) $NaBH_4$
D) $LiAlH_4$

Q.27 **'Ka' values of few organic acids are given.**

Acid	Ka
CH_3COOH	1.85×10^{-5}
CCl_3COOH	2.3×10^{-2}
$CHCl_2COOH$	5.0×10^{-3}
$CH_2ClCOOH$	1.3×10^{-3}

The order of the acid strength is

A) $CCl_3COOH > CHCl_2COOH > CH_2ClCOOH > CH_3COOH$
B) $CH_3COOH > CHCl_2COOH > CCl_3COOH > CH_2ClCOOH$
C) $CHCl_2COOH > CH_3COOH > CCl_3COOH > CH_2ClCOOH$
D) $CCl_3COOH > CH_3COOH > CHCl_2COOH > CH_2ClCOOH$

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Q.28 Select the correct acidic strength order of chlorosubstituted acids

A) $CH_3COOH > ClCH_2COOH > Cl_2CHOOH > Cl_3CCOOH$
B) $CH_3COH > Cl_2CHCOOH > Cl_3CCOOH > ClCH_2COOH$
C) $Cl_3CCOOH > Cl_2CHCOOH > ClCH_2COOH > CH_3COOH$
D) $Cl_3CCOOH > CH_3COOH > Cl_2CHCOOH > ClCH_2COOH$

Q.29 Which one will be act as a strong acid

A) Dichloroethanoic acid
B) Trichloethanoic acid
C) Ethanoic acid
D) Chloroethanoic acid

Q.30 Which of the following compounds in the form of aqueous solution will produce CO_2 on reaction with sodium carbonate

A) $CH_3COOC_2H_5$
B) $C_2H_5COOCH_3$
C) $C_2H_5COOC_2H_5$
D) $C_2H_5CO\text{-}OH$

Q.31 Relative acidic strength of alcohol , phenol , water and carboxylic acids is

A) Carboxylic acid > Alcohol > Phenol > Water
B) Carboxylic acid > Phenol > Water > Alcohol
C) Phenol > Carboxylic acid > Alcohol > Water
D) Water > Phenol > Alcohol > Carboxylic acid

Q.32 An organic acid 'z' reacts separately with sodium bicarbonate, sodium hydroxide and sodium carbonate. Which one of the following represent the structure of 'z'

A) $HCOOC_2H_5$
B) $CH_3 - CH = CH_2$
C) CH_3CH_2OH
D) $H_3C - CH_2 - COOH$

Q.33 Ethanol, ethanoic acid and phenol all contain acidic functional groups, the order of the acidic strength is Ethanoic acid> phenol>ethanol
This is mainly due to

A) Electron releasing (donating) effect of ethanoic acid is greater than that of ethanol
B) Electron releasing (donating) effect of phenol is greater than that of ethanol
C) Electron with drawing effect of phenol is greater than that of ethanol
D) Electron with drawing effect of ethanoic acid is greater than that of phenol

Q.34 When $CH_3\text{–}CH_2\text{–}OH$ is oxidized in the presence of $K_2Cr_2O_7$ and H_2SO_4, the product formed is

A) $CH_3 - \overset{\overset{O}{\|}}{C} - OH$
B) $H - \overset{\overset{O}{\|}}{C} - OH$
C) $CH_3 - \overset{\overset{O}{\|}}{C} - CH_3$
D) $CH_3 - \overset{\overset{O}{\|}}{C} - OCH_3$

Q.35 Compounds having — C ≡ N group are called

A) Cyano compounds
B) Nitro compounds
C) Carbon nitrogen molecules
D) Nitriles

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ANSWER KEY

1	B	11	D	21	C	31	D	41	A
2	D	12	A	22	C	32	C	42	A
3	D	13	C	23	D	33	D	43	B
4	D	14	C	24	D	34	C	44	A
5	C	15	C	25	D	35	C	45	B
6	A	16	D	26	C	36	A	46	A
7	D	17	C	27	B	37	D	47	A
8	A	18	B	28	D	38	D	48	A
9	A	19	B	29	B	39	A	49	C
10	A	20	D	30	D	40	D	50	B

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1	C	6	C	11	D	16	D	21	A	26	B	31	B
2	C	7	C	12	A	17	A	22	D	27	A	32	D
3	A	8	B	13	B	18	B	23	C	28	C	33	D
4	D	9	A	14	C	19	C	24	C	29	B	34	A
5	B	10	B	15	B	20	A	25	C	30	D	35	D

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EXPLANATORY NOTES

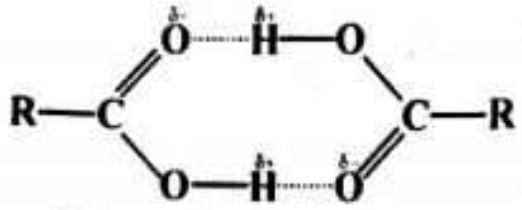
Q.1 The general formula of carboxylic acid is $C_nH_{2n}O_2$

Q.2

$$\begin{array}{l} CH-COOH \\ \| \\ CH-COOH \end{array}$$

have double bond and have open chain structure

Q.3



Dimer of a carboxylic acid

Q.4 The first three aliphatic acids, formic acid, acetic acid, and propionic acid are colourless liquids and have a pungent smell. The next three acids C-4 to C-6 are colourless liquids with somewhat unpleasant smell.

Q.5 The pure acid freezes to an ice like solid at 17°C. Therefore, it is also called **glacial acetic acid.**

Q.6

$$\begin{array}{l} CH-COOH \\ \| \\ CH-COOH \end{array}$$

have double bond and have open chain structure

Q.7 Carbolic acid = Phenol
Carbonic acid = H_2CO_3
Picric acid = 2,4,6 – Trinitrophenol
Palmitic acid = Carboxylic acid

Q.8 Aliphatic monocarboxylic acid is called fatty acid. Fats on hydrolysis give saturated fatty acids. Succinic acid is a dicarboxylic acid so it is not a fatly acid

Q.9 2–Methyl –2– propanol is tertiary alcohol. So it cannot be oxidized to carboxylic acid because it does not contain α-H. Under same conditions it show elimination and give alkene

Q.10

$$CH_3-CH_2-CH_2-CH_2-OH \xrightarrow{[O]} CH_3-CH_2-CH_2-\overset{\overset{O}{\|}}{C}-H \xrightarrow{[O]} CH_3CH_2CH_2COOH$$

Q.11 $RCN + H_2O \xrightarrow[HCl]{\text{Mineral acid}} RCOOH + NH_4Cl$

Q.12

$$CH_3CN \xrightarrow[H^+]{H_2O} CH_3-\overset{\overset{O}{\|}}{C}-NH_2 \xrightarrow[H^+]{H_2O} CH_3COOH$$

Q.13 $CH_3CH_2CN \xrightarrow[H^+]{H_2O} CH_3CH_2COOH$

Q.14 $R-X + KCN \xrightarrow{\text{alcoholic}} R-CN + KX$

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Q.15 $CH_3-CN+H_2O \xrightarrow{H^+} CH_3COOH+NH_4^+$

Q.16 $C_2H_5-CN \xrightarrow[H^+]{H_2O} CH_3CH_2COOH$

Q.17 $CH_3-CN+H_2O \xrightarrow[H_2O]{H^+} CH_3-\overset{\overset{O}{\|}}{C}-NH_2 \xrightarrow[H_2O]{H^+} CH_3COOH$

Q.18 During acidic hydrolysis if acid is
$HCl \longrightarrow NH_4Cl$ salt is produced. $HNO_3 \longrightarrow NH_4NO_3$ salt is produced. $H_2SO_4 \longrightarrow (NH_4)_2SO_4$ salt is produced

Q.19 $K_2CO_3+2CH_3COOH \longrightarrow 2CH_3COOK+CO_2+H_2O$
CO_2 is evolved which is acidic in nature

Q.20 Reaction with carboxylic acid and carbonates are example of E^+ – substitution
$Na+CH_3COOH \longrightarrow CH_3COONa+\frac{1}{2}H_2$. So, O – H bond break

Q.21 Artificial flavours are derived from esters

Q.22 Esterification is an example of Nucleophilic substitution reaction. In which O – H bond of alcohol breaks while C – O of carboxylic acid break

Q.23 $CH_3COOH+C_6H_5CH_2OH \rightleftharpoons[H^+] CH_3COOCH_2C_6H_5+H_2O$

Q.24 $CH_3COONH_4 \xrightarrow{\Delta} CH_3-CO-NH_2+H_2O$. It is a heating and dehydration reaction

Q.25 $CH_3-CO-NH_2 \longrightarrow$ acid amide

Q.26 Acid halides (–OH by – X). Esters (–OH by – OR). Amides (–OH by – NH)

Q.27 $CH_3COOH+SOCl_2 \longrightarrow CH_3COCl+H_2O+SO_2$

Q.28 $CH_3COOH+SOCl_2 \longrightarrow CH_3COCl+H_2O+SO_2$
$CH_3COOH+PCl_5 \longrightarrow CH_3COCl+POCl_3+HCl$

Q.29 –OH replaced by $-NH_2$

Q.30 $RCOOH+$ active metal $\longrightarrow$ Salt $+H_2$

Q.31 $CH_3COOH+SOCl_2 \longrightarrow CH_3COCl+H_2O+SO_2$
$CH_3COOH+PCl_5 \longrightarrow CH_3COCl+POCl_3+HCl$
$3CH_3COOH+PCl_3 \longrightarrow 3CH_3COCl+H_3PO_3$

Q.32 For Nucleophilic substitution reaction of carboxylic acid
$\longrightarrow$ C – O bond breaks
$\longrightarrow$ –OH replace by –OR

Q.33 Esters formation are catalyzed by acids

Q.35 Esters are neutral species because aqueous solution of esters have no effect on litmus paper

Q.36 Mineral acid act as catalyst and dehydrating agent during esterification

Q.37 Acetyl chloride is polar and will dissolve more in polar solvent

Q.38 $CH_3COOH+PCl_5 \longrightarrow CH_3-CO-Cl+POCl_3+HCl$. In this reaction C – O bond of carboxylic acid break so it is Nu substitution reaction

Q.39 $CH_3COOH+C_6H_5CH_2OH \rightleftharpoons[H^+] CH_3COOCH_2C_6H_5+H_2O$

Q.40 In halide formation –OH is replaced by – X

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Q.41

$$C_2H_5-OH + HO-CO-CH_2-CH_2-CH_3 \longrightarrow \underset{\text{Ethyl Butyrate}}{C_2H_5-O-CO-CH_2-CH_2-CH_3} + H_2O$$

Q.42 $R-CN+H_2O \xrightarrow{(H)} RCOOH+NH_3$

Q.43

$CH_3COOH + Na \longrightarrow CH_3COONa + \frac{1}{2}H_2$, O – H bond of carboxylic acid break os it is electrophilic substitution reaction

Q.44

$$2CH_3COOH+Ca \longrightarrow Ca\begin{matrix}OCOCH_3\\OCOCH_3\end{matrix} + H_2O$$

Q.45 Halogens are electron withdrawing group. Greater the number of halogens, more the electron withdrawing effect, strong will be acid

Q.46 Acidity $\propto$ no of halogen atom

Q.47 $pK_a \propto \frac{1}{\text{acidity}}$

Q.48 Closer the halogen to functional group carbon, greater the acidity

Q.49 Carboxylic are weak acid

Q.50

$OH^{-1} + H^+ \longrightarrow H-OH$

$^-OR + H^+ \longrightarrow R-OH$

$RCOO^- + H^+ \longrightarrow RCOOH$

$PhO^- + H^+ \longrightarrow PhOH$

Among these conjugate acids, alcohol is the weakest acid. If acid is weakest, strongest will be conjugate base

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19 MACROMOLECULES

PRACTICE EXERCISE

CLASSIFICATION AND STRUCTURE OF PROTEINS

Q.1 Zigzag and regular coiling of polypeptide linkage forms

A) Primary structure
B) Tertiary structure
C) Secondary structure
D) Quaternary structure

Q.2 The hydrogen bond in secondary structure of protein is present between

A) O – H
B) C – H
C) N – H
D) F – H

Q.3 Primary structure of proteins shows

A) Folding
B) Coiling
C) Sequence of amino acids
D) It is due to hydrogen bonding

Q.4 Which of the following statement is false about protein

A) Peptide bond is a covalent bond
B) It is a polyamide
C) It contain different sequence of amino acids in different proteins
D) Primary structure is due to hydrogen bonding

Q.5 Which one of the following structure of protein is the direct consequence of hydrogen bonding

A) Primary
B) Secondary
C) Tertiary
D) Quaternary

Q.6 Primary structure of protein arises due to which force

A) Hydrogen bonding
B) Amide linkage
C) Covalent bond
D) Dipole-Dipole forces

Q.7 Secondary structure of protein includes

A) α-helix
B) β-sheets
C) Both A) and B)
D) 3-dimensioal folding

Q.8 Which is true about primary structure

A) Result of replication
B) Result of duplication
C) Result of termination
D) Result of translation

Q.9 Which is not present in an α-helix

A) H–Bond
B) Covalent bond
C) Disulphide linkage
D) Amino acids

Q.10 Which carbon of amino acids bond to nitrogen of another in peptide linkage

A) α-Carbon
B) Side chain carbon
C) β Carbon
D) Carbonyl carbon

Q.11 All proteins yield _____upon complete hydrolysis.

A) Nitrogen
B) Carbon and hydrogen
C) Amino acids
D) Sulphur

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Q.12 Protein attached to some non protein group is called

A) Derived protein
B) Proteoses
C) Sample protein
D) Conjugated protein

Q.13 Regular coiling or zigzagging of polypeptide through hydrogen bonding is its.

A) Quaternary structure
B) Tertiary structure
C) Secondary structure
D) Primary structure

Q.14 What common name can be given to lipids, proteins, carbohydrates and nucleic acid polymers

A) Organic polymers
B) Biopolymers
C) Inorganic polymers
D) Synthetic polymers

Q.15 Which one of the following polymers has peptide linkage in it

A) Terylene
B) Protein
C) Nylon 6,6
D) Urea

Q.16 Which factor can not denature the protein

A) pH change
B) Oxidizing condition
C) Increase of temperature
D) Dissolving in H_2O

Q.17 Which of the following elements is not present in all proteins

A) Carbon
B) Sulphur
C) Hydrogen
D) Nitrogen

ENZYMES AS BIOCATALYST

Q.18 Enzymes that catalyze the transfer of groups within molecule are called

A) Isomerases
B) Transferases
C) Lyases
D) Ligases

Q.19 Enzyme used for the treatment of blood cancer in children is

A) Cellulose
B) L-asperginase
C) Urease
D) Lactic dehydrogenase

Q.20 Enzymes from the same organism which catalyze same reaction but are chemically and physically distinct from each other are called

A) Oxidoreductases
B) Isoenzymes
C) Hydrolases
D) Isomerases

Q.21 Rate of enzymatic reaction is directly proportional to the concentration of

A) Enzyme
B) Enzyme and substrate
C) Substrate
D) Enzyme and product

Q.22 The rate of reaction is directly proportional to

A) $[Enzyme]^2$
B) [Enzyme]
C) $[Enzyme]^3$
D) $[\sqrt{[Enzyme]}]$

Q.23 The substrate binds with the enzyme at

A) Polar site
B) Active site
C) Cationic site
D) Anionic site

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Q.24 Many enzymes contain a protein part and a non-protein part, the non-protein part is called_____

A) Apoenzyme
B) Cofactors
C) Coenzyme
D) Both B and C

Q.25 The group of compounds that is primarily responsible for building of body of an animal and its maintenance is called

A) Vitamin
B) Lipids
C) Carbohydrate
D) Proteins

Q.26 Which enzyme is used to catalyze the addition of ammonia, water or carbon dioxide to double bond

A) Phospho-transferase
B) Fumarase
C) Phospho-glyceromutases
D) Succinic thiokinase

Q.27 The activator for chrome oxidase is

A) Fe^{+2}
B) Mg^{+2}
C) Zn^{+2}
D) Fe^{+3}

Q.28 Thrombin is used

A) For treatment of cancer
B) To diagnose heart disease
C) Locally to stop bleeding
D) For treatment of rickets

Q.29 For the treatment of blood cancer in childrens ____enzyme has proved very useful

A) Thrombin
B) L-asparaginase
C) LDH-1
D) Alkaline phosphatase

Q.30 Protein part of the enzyme is called

A) Apoenzyme
B) Cofactors
C) Coenzyme
D) Holoenzyme

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PAST PAPERS QUESTIONS

Q.1 **PVC is an example of**
A) Addition polymer
B) Biopolymer
C) Condensation polymer
D) Thermosetting polymer

Q.2 **Polyvinyl chloride is an example of**
A) Condensation polymer
B) Biopolymer
C) Addition polymer
D) Thermosetting polymer

Q.3 **Polystyrene is an addition polymer. Which one of the following structure represent the monomer of polystyrene?**
A) $CH_2=CH_2$
B) $CH_2=CH-CH_3$
C) $CH_2=CH-Cl$
D) $CH_2=CH-C_6H_5$

Q.4 **Which one of the following polymer is a polystyrene**
A) $\left(CH_2-\underset{\displaystyle C_6H_5}{\underset{|}{CH}}\right)_n$
B) $(CH_2-CH_2)_n$
C) $(CF_2-CF_2)_n$
D) $\left(CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}\right)_n$

Q.5 **Identify the monomers of Polyvinyl chloride**
A) Vinyl acetate
B) Butyl maleate
C) Styrene
D) Vinyl chloride

Q.6 **Among the following, which compound is formed by addition polymerization**
A) Polystyrene
B) Polyester
C) Nylon
D) Both A & B

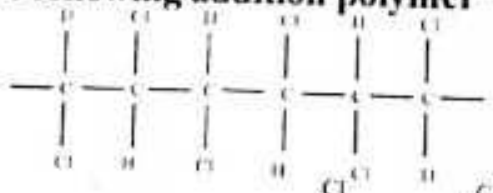
Q.7 **Which is the structure of polyvinyl chloride (polychloroethene)?**
A) $-[H_2C-CH-Cl]-$
B) $[H_2C=CH-Cl]$
C) $-[CCl_2-CCl_2]-$
D) $-[HCCl-CH-Cl]-$

Q.8 **Disposable cups are made of a polymer polystyrene. Polystyrene is:**
A) A condensation polymer
B) A polyamide
C) An addition polymer
D) A polyester

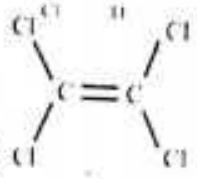
Q.9 **Which of the following compound is additional polymer?**
A) Nylon
B) Polyvinyl chloride
C) Carbohydrate
D) Polyester

Q.10 **Which of the following is addition polymer?**
A) Polyester
B) Acrylic resins
C) Epoxy resins
D) Polyamides

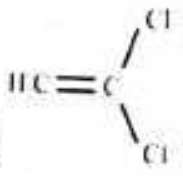
Q.11 **Identify the monomer in the following addition polymer**



A) $H_2C=CH-Cl$



B) $ClCH=CHCl$



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Q.12 The catalyst used for the preparation of acrylonitrile is
A) Al_2O_3 and NH_4Cl
B) Cu_2Cl_2 and NH_4Cl
C) Cu_2Cl_2 and NH_4OH
D) Al_2O_3 and Cu_2Cl_2

Q.13 When hexanedioic acid is heated with hexamethylenediamine the compound formed is
A) Polypeptide
B) Addition polymer
C) Ester
D) Nylon 6, 6

Q.14 Terylene, a polyester is an example of
A) Biopolymer
B) Condensation polymer
C) Lipids
D) Addition polymer

Q.15 Adipic acid and hexamethylene diamine, both of which have _____carbon atoms
A) Seven
B) Eight
C) Six
D) Four

Q.16 Polyvinyl acetate (PVA) is colourless and non-toxic resin used as an adhesive and as a binder for making
A) Emulsion paints
B) Toys
C) Gramophone recorders
D) Compact discs

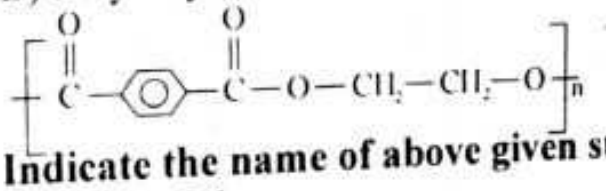
Q.17 Which one of the following is an example of condensation polymer?
A) Polyvinylchloride
B) Polystyrene
C) Polyethene
D) Polyamide

Q.18 Polyamide is formed due to the condensation of hexane-dioic acid with
A) Hexane–1,5–diamine
B) Hexane–1,6–diamine
C) Hexane–1,4–diamine
D) Hexane–2,5–diamine

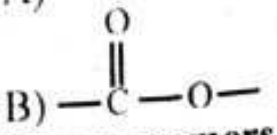
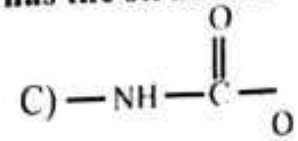
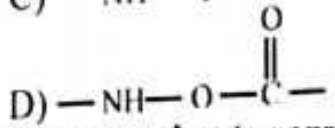
Q.19 Which one of the following is an example of co-polymer?
A) Polyamide
B) Polystyrene
C) Polyvinyl acetate
D) Polyvinyl chloride

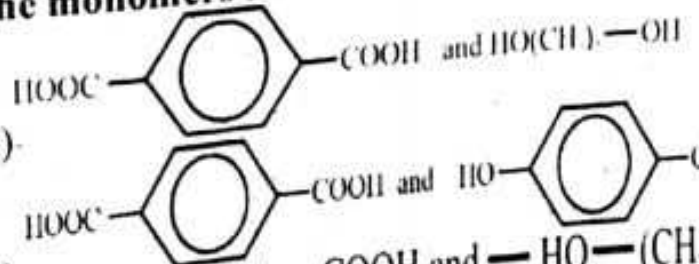
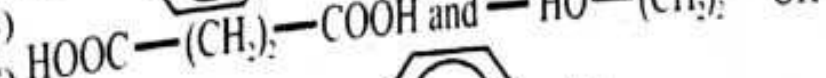
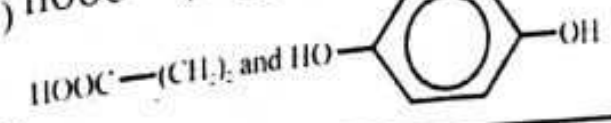
Q.20 Which one of the following polymer is called as Nylon 6,6?
A) Polyester
B) Polyvinylchloride
C) Polyamide
D) Polyvinylacetate

Q.21



Indicate the name of above given structure
A) Nylon 6.6
B) Adipic acid
C) PVA
D) Polyester

Q.22 The amide linkage, present in Nylon-6,6 has the structure
A) 
B) 
C) 
D) 

Q.23 The monomers needed to make "Terylene", i.e. a polyester are
A) 
B) 
C) 
D)

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Q.24 Nylon-6,6 is also called
A) Polystyrene
B) Polyester
C) Polyamide
D) Polyvinyl alcohol

Q.25 Nylon is a condensation that is used as a textile fiber with high strength and elasticity. The repeating functional group in nylon is
A) Ester
B) Amine
C) Carboxylic acid
D) Amide

Q.26 Collagen and albumin are
A) Derived proteins
B) Simple proteins
C) Polyamide
D) Polysaccharide

Q.27 A polymer in which the number of amino acid residue is greater than 100 or the molecular mass is greater than 10,000 is called
A) Protein
B) Dipeptide
C) Polypeptide
D) Tripeptide

Q.28 Haemoglobin is a
A) Genetic protein
B) Building protein
C) Transport protein
D) Structural protein

Q.29 Phosphoprotein comes under the type of proteins
A) Simple protein
B) Conjugated
C) Derived protein
D) Both A & B

Q.30 Which of the following bond is responsible for joining the amino acids in proteins?
A) Metallic Bond
B) Peptide Bond
C) Di sulfide bond
D) Ionic Bond

Q.31 The proteins which give an amino acid and non-protein group on hydrolysis are known as
A) Derived protein
C) Albumins
B) Conjugated simple protein
D)Conjugated protein

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Q.32 Both ribose and deoxyribose are monosaccharides containing _____ carbon atoms.
A) Four
B) Six
C) Five
D) Seven

Q.33 Which one of the following base is not present in RNA?
A) Cytosine
B) Adenine
C) Thymine
D) Guanine

Q.34 Out of these which nitrogen base is NOT present in DNA?
A) Adenine
B) Guanine
C) Uracil
D) Thymine

Q.35 Which one of the following nitrogen base is NOT present in DNA?
A) Adenine
B) Guanine
C) Uracil
D) Cytosine

Q.36 Which one of the followings is the main function of DNA?
A) Making of proteins
C) Breaking of ribose sugar
B) Making of amino acids
D) Carries genetic information

Q.37 The stability in the following structure in due to the
A) Disulfide bridges
B) Presence of unpaired electron in the structure
C) Weak van Der Waal's forces
D) Hydrogen bonding between NH group of one peptide with another peptide

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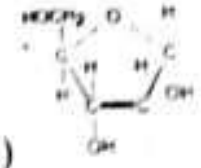
Q.38 According to Watson and Crick's model of DNA, the DNA molecule consists of a double helix. What type of forces are responsible to keep two strands of DNA together?

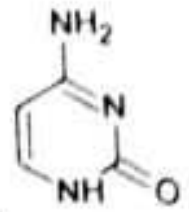
A) Hydrogen bonding
B) Ionic bonding
C) Van der Waal's forces
D) Dipole-induces dipole forces

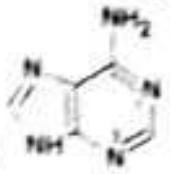
Q.39 The sugar unit in DNA molecule is

A) Ribose
B) 3-Deoxyribose
C) 2-Deoxyribose
D) 2-Deoxyribose

Q.40 Which one of the given structures represents Deoxyribose sugar?

A) 

B) 

C) 

D) 

ANSWER KEY

1	C	11	C	21	C
2	C	12	D	22	D
3	C	13	C	23	B
4	D	14	B	24	D
5	B	15	B	25	D
6	B	16	D	26	B
7	A	17	B	27	A
8	B	18	A	28	C
9	A	19	B	29	B
10	D	20	B	30	A

PAST PAPERS QUESTIONS

1	A	6	A	11	B	16	A	21	D	26	B	31	D	36	D
2	C	7	A	12	B	17	D	22	C	27	A	32	C	37	D
3	D	8	C	13	D	18	B	23	A	28	C	33	C	38	A
4	A	9	B	14	B	19	A	24	C	29	B	34	C	39	C
5	D	10	B	15	C	20	C	25	D	30	B	35	C	40	A

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EXPLANATORY NOTES

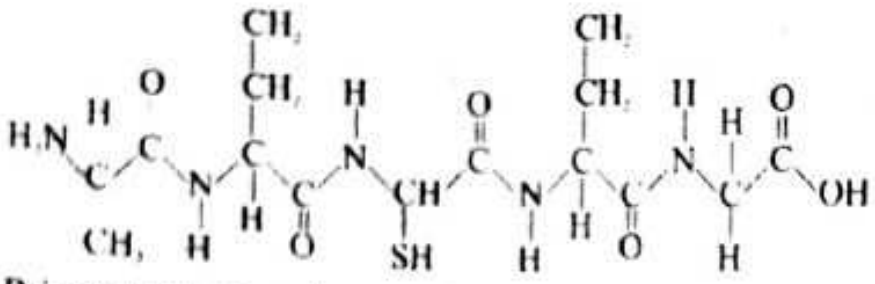
Q.1 The secondary structure of a protein is a regular coiling or zigzagging of polypeptide chains caused by hydrogen bonding between NH and C = O groups of amino acids near each other in the chains.

Q.2

$$C = \overset{\delta^-}{O} - - - \overset{\delta^+}{H} - NH$$

Q.3 A linear sequence of amino acids in a chain is referred as primary structure.

Q.4



Primary structure does not involve hydrogen bonding.

Q.5 α -Helix and β -sheets are due to hydrogen bonding.

Q.6 Amino acids are joined in primary structure by covalent bond,.

Q.7



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Q.8 Formation of polypeptide chain from RNA is called translation.

Q.9 2° structure is due to hydrogen bonding.

Q.10 Peptide linkage is between –COOH and $-NH_2$ groups.

Q.11 High molecular weight organic molecules which yield amino acids upon complete hydrolysis are called proteins. They are the **polymers of amino acids**.

Q.12 In these molecules the protein is attached or conjugated to some non-protein groups which are called **prosthetic groups**.

Example: Phospho-proteins are conjugated with phosphoric acid. Lipoproteins are conjugated with lipid substances like lecithin, cholesterol and fatty acids.

Q.13 The secondary structure of a protein is a regular coiling or zigzagging of polypeptide chains caused by hydrogen bonding between NH and C = O groups of amino acids near each other in the chains.

Q.14 Most biologically important substances are organic compounds built up from skeleton of carbon atoms. Many of them are very large molecules and most of these are polymers. The four major classes of organic compounds in living cells are carbohydrates, lipids, proteins and nucleic acids.

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Q.15 To describe the structure of a protein in an organism it is necessary to specify the three-dimensional shape that the polypeptide chain assumes.

Q.16

The deformation or disruption of protein structure under specific conditions is called denaturation of proteins. Denaturation occurs by

- Heat change
- pH change

Under strong oxidizing or reducing conditions.

Q.17 All proteins contain the elements carbon, hydrogen, oxygen and nitrogen.

Q.18 **Isomerases**

These enzymes catalyze the transfer of groups within molecules to yield isomeric forms of the substrate, for example phospho-glyceromutases.

Q.19 L-asparaginase has proved very useful in the treatment of blood cancer in children.

Q.20 **Isoenzymes**

- These are the enzymes from the same organisms which catalyze the same reaction but are chemically and physically distinct from each other.

Example: α-amylase β-amylase.

Q.21 The rate of an enzymatic reaction is directly proportional to the concentration of the substrate.

Q.22 The rate of reaction is also directly proportional to the square root of the concentration of enzyme.

Q.23 Each enzyme molecule possesses a region known as **active site** and the substrate binds itself with this active site.

Q.24 The protein component of the enzyme is called **apo-enzyme** and the non-protein component is called the **co-enzyme**. The co-enzyme is also known as co-factor.

Q.25 The group of compounds that is primarily responsible for building of body of an animal and its maintenance is called protein.

Q.26 **Lyases**

These enzymes catalyze the addition of ammonia, water or carbon dioxide to double bonds or removal of these to form double bond.

Example: The conversion of fumaric acid to maleic acid in the presence of fumarase enzyme.

Q.27

- Important inorganic co-factors alongwith their respective enzymes include
- Fe^{2+} (chrome oxidase)
- Zn^{2+} (carbonic anhydrase)
- Mg^{2+} (glucose 6-phosphatase), etc.
- Many enzymes contain vitamins as their co-factors.

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Q.28

Alkaline phosphatase is raised in rickets obstructive jaundice.

(ii) Lactic dehydrogenase or LDH-1 is raised in heart diseases.

- Many enzymes have proved very useful as drugs.
  Example: Thrombin is used locally to stop bleeding.
- Many enzymes are used for cancer treatment.
  Example: L-asparaginase has proved very useful in the treatment of blood cancer in children.

Q.29 L-asparaginase has proved very useful in the treatment of blood cancer in children.

Q.30 The protein component of the enzyme is called **apo-enzyme** and the non-protein component is called the **co-enzyme**. The co-enzyme is also known as co-factor.

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Topic 20

ENVIRONMENTAL CHEMISTRY

PRACTICE EXERCISE

AIR POLLUTANTS

Q.1 **Ozone (O_3) is _____ around us**
A) Primary pollutant
B) Not pollutant
C) Secondary pollutant
D) None of these

Q.2 **The combustion of coal is one of the source of SO_2 in air because coal contains**
A) 1–20% sulphur
B) 1–2% sulphur
C) 1–5% sulphur
D) 1–9% Sulphur

Q.3 **The residence time of NO in the atmosphere**
A) 3 years
B) 4 days
C) 3 days
D) 2 days

Q.4 **Which one of the followings is not a pollutant**
A) CO_2
B) CO
C) NO_2
D) SO_2

Q.5 **Which one of the following is secondary pollutant of atmosphere**
A) CO_2
B) SO_3
C) NO_2
D) H_2SO_4

Q.6 **Major sources of NOx pollutants are**
A) UV coming from sun
B) Combustion of coal and oil
C) Extensive use of CFC's
D) Detergents

Q.7 **Paddy fields produce a significant amount of _____ in the atmosphere as a pollutant**
A) CO
B) CH_4
C) CO_2
D) SO_x

Q.8 **Which is the most toxic gas?**
A) CO_2
B) SO_2
C) NO_2
D) CO

Q.9 **Which of the following are the major source of hydrocarbons pollutant**
A) Petroleum
B) Coal
C) Automobiles
D) Wood

Q.10 **Which property of CO given below is incorrect**
A) It is a colourless gas
B) It has pungent odour
C) It is highly toxic gas
D) It is soluble in water

Q.11 **What is the effect of CO inhalation**
A) Sore throat
B) Eye irritation
C) Nose irritation
D) Suffocation

Q.12 **A person is affected with CO gas how can we save him / her by adverse effect of this poisonous gas**
A) Drink dilute solution of CH_3COOH
B) Supply pure O_2 for breathing
C) Give more water for drinking
D) All are correct

Q.13 **The percentage of SO_2 produced by volcanoes eruption is**
A) 62%
B) 65%
C) 63%
D) 67%

Q.14 **Natural source of CH_4 is the anaerobic decomposition of organic matter**
$2CH_2O \xrightarrow{X} CO_2 + CH_4$. **Here X is of**
A) Smoke
B) Bacteria
C) Metal oxide
D) All of these

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Q.15 **NO_x and SO_z are transformed by reaction with O_2 and water into**
A) HNO_2, H_2SO_3
B) HNO_3, H_2SO_4
C) HNO_2, H_2SO_4
D) $HNO_3 + H_2SO_3$

Q.16 **Paddy fields produce a significant amount of _____ in the atmosphere as a pollutant**
A) CO
B) CH_4
C) CO_2
D) SO_x

Q.17 **Select the pair which is not air pollutant**
A) CO_2, H_2
B) SO_2, H_2S
C) SO_2, O_3,
D) CO, NO

Q.18 **Per–oxyacetyl nitrate (PAN) is an irritant to human beings and if affects**
A) Eyes
B) Stomach
C) Ears
D) Nose

Q.19 **CO is a pollutant and its major source is**
A) Absence of methane in atmosphere
B) Fuel burning
C) Forest fires
D) Incomplete combustion of CO_2

CHEMISTRY AND CAUSES OF ACID RAIN

Q.20 **SO_2 and SO_3 through various reactions in the atmosphere form**
A) Acid rain
B) Acid deposition
C) Sulphate aerosols
D) All of these

Q.21 **In some countries there is temporary acid rain, is due to**
A) Release of HCl by volcanic eruption
B) Release of NO by volcanic eruption
C) Release of SO_2 by volcanic eruption
D) Release of CH_4 by volcanic eruption

Q.22 **Acid rain**
A) Has pH 5.6
B) Is controlled by basic rain
C) Effects big marble constructions
D) Is produced in thermosphere

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Q.23 **Which one of the following is not affect of acid rain**
A) It decreases the pH of natural rain
B) It damages the buildings
C) It leaches metals like aluminium mercury and lead from soil
D) It increase the percentage of CO_2 in the atmosphere

Q.24 **The source of acid rain**
A) Acidic oxides
B) Basic oxides
C) Amphoteric oxides
D) Neutral oxides

Q.25 **Acid which must be present in the natural rain in different extent**
A) H_2SO_4
B) H_2CO_3
C) HNO_3
D) HCl

Q.26 **The pH of normal rain is less than 7 is due to**
A) CO_2
B) NO_2
C) SO_2
D) All of these

Q.27 **Which of the following is not the demerit of acid rain**
A) Damages buildings
B) Leach nutrients
C) Skin cancer
D) Make soil acidic

Q.28 **Acid rain does not cause**
A) Leach nutrient
B) Can damage building material
C) Increased pH of soil
D) Reduce forest growth

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Q.29 The metal leached by acid rain of soil and causes suffocation in gills of fishes
A) Calcium
B) Magnesium
C) Aluminium
D) Iron

Q.30 Acid deposition
(i) Involves both wet and dry deposition
(ii) Makes soils acidic i.e. increase the in pH of soil
(iii) Has pH less than 5
(iv) Is due to C, N, S oxides
A) I, II, III
B) I, II, III, IV
C) II, III, IV
D) I, III, IV

Q.31 The pH range of acid rain is
A) 7–6.5
B) 6–5.6
C) 6.5–6
D) Less than 5

Q.32 One of the followings is not the effect of acid rain
A) It increases the plant capability to resist against cold disease
B) It decreases the pH of natural rain
C) It causes leaching of metals
D) It deprives trees from nutrients

Q.33 SO_2 and NO_2 cause pollution by increasing
A) Alkalinity
B) Buffer action
C) Acidity
D) Neutrality

Q.34 Which of the following is not a source of SO_2:
A) Decomposition of organic matter
B) Combustion of crude oil
C) Volcanoes
D) Exhaust of auto mobile

OZONE AND CHLORFLUOROCARBONS (CFC's)

Q.35 The amount of ozone is less in the regions near to:
A) Tropical regions
B) South pole
C) North pole
D) Equator

Q.36 The main cause of ozone depletion is:
A) Acid rain
B) Use of CFCs
C) Global warming
D) Burning of solid waste

Q.37 The function of the ozone layer:
A) Filtering UV radiations in the sunlight
B) Increasing photosynthesis in plant
C) Increasing vitamin D contents in the sunlight
D) Decreasing global warming

Q.38 The high thickness of ozone layer is observed in
A) 25 to 50 km
B) 3 km only
C) 25 to 28 km
D) 1 km only

Q.39 The normal amount of overhead ozone is
A) 300 DU
B) 400 DU
C) 350 DU
D) 450 DU

Q.40 A single chloride free radical can destroy upto _____ ozone molecules.
A) 100
B) 100,000
C) 10,000
D) 100,0000

Q.41 Chlorofluro carbons (CFCs) decomposes in the stratosphere into some free radicals. Which is possibly not responsible for depletion process of ozone
A) $CFCl_2^{\bullet}$
B) $Cl^{\bullet}$
C) $ClO^{\bullet}$
D) $O^{\bullet}$

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Q.42 All of the following statements about ozone layer are correct except
A) It depletes every year during Sep-Nov
B) It ranges from 25–28 Km high in stratosphere
C) It's normal overhead amount is 250 DU
D) It is an allotropic form of oxygen

Q.43 Chloroflurocarbons plays an effective role in removing O_3 in the
A) Troposphere
B) Polar region
C) Stratosphere
D) Equator

Q.44 Ozone hole is very dangerous. It is
A) The formation of complex of O_3 with hydrocarbon
B) The depletion in total amount of O_3 stratosphere region
C) The decomposition of O_2 to O_3 in sunlight
D) The increase in concentration of O_3 in tropical region

Q.45 O_3 is produced in most of tropical region by reaction
$O_2 \rightarrow O + O$ and $O_2 + O \rightarrow O_3$ **It is**
A) Photochemical reaction
B) Addition oxidation reaction
C) Redox reaction
D) Oxidation reaction

Q.46 Ozone is a
A) Low boiling point gas
B) High boiling point liquid
C) Low boiling point liquid
D) High boiling point gas

Q.47 Ozone concentration is measured in
A) Debye units
B) Dupent units
C) Debackle units
D) Dobson units

Q.48 Ozone layer filters most of the harmful _____ rays present in the sunlight
A) Ultra violet
B) X-rays
C) Infrared
D) Cosmic rays

Q.49 Which of the following is not the true fact about ozone
A) Damages eyes
B) It is produced in tropical region
C) Concentration of O_3 is more in region close to equators
D) It is disinfectant

Q.50 CFC's destroys O_3 is stratosphere. Which of the following is not a source of CFC's
A) Refrigerator
B) Volatile hydrocarbons
C) Air fresheners
D) Air conditioners

PAST PAPERS QUESTIONS

Q.1 Peroxyacetylene is an irritant to human beings and it effects
A) Ears
B) Eyes
C) Nose
D) Stomach

Q.2 Anaerobic decomposition of organic matter i.e. glucose by bacteria in water sediments produce
A) Propane
B) Methane
C) Ethane
D) Butane

Q.3 _____ is an eye irritant.
A) Peroxyacetyl nitrate
B) Peroxyacetyl nitrite
C) Paramethoxy aniline
D) Peroxyacetyl aniline

Q.4 Which one of the following pollutants can cause death of a person by binding with haemoglobin in red blood cells?
A) Chlorofluorocarbons
B) Oxides of sulphur
C) Carbon monoxide
D) Oxides of nitrogen

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Q.5 The gas which is mainly produced in landfills from the waste is
A) CH_4
B) CO_2
C) SO_2
D) Cl_2

Q.6 Which of the following is secondary pollutant?
A) CO
B) PAN
C) SO_2
D) NO_2

Q.7 The unpolluted rain water is slightly acidic due to reaction of rain water with
A) Sulphur dioxide
B) Carbon dioxide
C) Oxides of nitrogen
D) Hydrocarbons present in air

Q.8 The biggest source of acid rain is the oxides of
A) N
B) S
C) O
D) C

Q.9 Which agent is responsible for the acid rain_____
A) O_2
B) $Ca(SO_4)$
C) NO_2
D) HNO_3 & H_2SO_4

Q.10 Which of these pollutants is produced by during of coal and causes acid rain
A) CO_2
B) NO
C) SO_2
D) CO

Q.11 Which of the following are all harmful effects of acid rain?
A)
- Causes thunder storms
- Causes global warming
- Damages building and statues

B)
- Affects aquatic life
- Causes global waring
- Damages buildings and statues

C)
- Affects aquatic life
- Leaches nutrients from the soil
- Damages buildings and statues

D)
- Causes thunder storms
- Leaches nutrients from soil
- Damages buildings and statues

Q.12 Ozone concentration is measured in
A) Debye units
B) Dupent units
C) Debackle units
D) Dobson units

Q.13 _____ is the major source of acid deposition in the atmosphere
A) SiO_2
B) CO_2
C) SO_2
D) Al_2O_3

Q.14 The energy from the ultraviolet light is sufficient to break the _____ bond in CCl_2F_2
A) Cl – Cl
B) C – Cl
C) Cl – F
D) C – F

Q.15 Which of the following would react with ozone in the atmosphere?
A) $F^\bullet$
B) $O^\bullet$
C) O_2
D) $Cl^\bullet$

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Q.16 Which of following compounds is responsible for the depletion of ozone layer?

A) Carbon tetrachloride
B) Methane
C) Hydroflorocarbons
D) Choroflorocarbons

Q.17 Chlorofluorocarbons (CFCs) are important compounds which are used as refrigerants but these are also responsible for Ozone layer depletion. If a Chlorofluorocarbon $CFCl_3$ is present in stratosphere, which of it's reaction intermediates are actually responsible for the breakdown of Ozone molecule?

A) $Cl^{\cdot}$ and $ClO^{\cdot}$
B) $CFCl_2^{\cdot}$ and $CFCl_3$
C) $CFCl_2^{\cdot}$ and $Cl^{\cdot}$
D) $CFCl_2^{\cdot}$ and $ClO^{\cdot}$

Q.18 A single chloride free radical can destroy ozone molecule upto

A) 100,000
B) 100,0000
C)10,000
D) 1000

Q.19 Chlorofluorocarbon cause depletion of ozone layer in the stratosphere since they can produce

A) Atomic oxygen on reaction with ozone
B) Strongly oxidizing fluorine gas
C) Chlorine free radical by fission of C–Cl bond
D) Fluoride ion by C–F by bond breakage

Q.20 The yellowish brown color in photochemical smog is due to the presence of

A) SO_2 (sulphur dioxide)
B) CO (carbon monoxide)
C) CO_2 (carbon dioxide)
D) NO_2 (nitrogen dioxide)

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ANSWER KEY

1	C	11	D	21	A	31	D	41	D
2	D	12	B	22	C	32	A	42	C
3	B	13	D	23	D	33	C	43	C
4	A	14	B	24	A	34	A	44	B
5	D	15	B	25	B	35	D	45	A
6	B	16	B	26	A	36	B	46	A
7	B	17	A	27	C	37	A	47	D
8	D	18	A	28	C	38	C	48	A
9	C	19	B	29	C	39	C	49	C
10	B	20	D	30	D	40	B	50	B

PAST PAPERS QUESTIONS

1	B	6	B	11	C	16	D
2	B	7	B	12	D	17	A
3	A	8	B	13	C	18	A
4	C	9	D	14	B	19	C
5	A	10	C	15	D	20	D

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EXPLANATORY NOTES

Q.1 Because it produced by reaction of two primary pollutants i.e. NOx and VOCs.

Q.2 Coal is formed by carbonization of wood which contain sulphur.

Q.3 Greater the residence time more adverse the pollutant i.e. residence time of NO_2 is 3 days.

Q.4 CO_2 is one of the component of air. It is not harmful to human upto normal concentration and used by the plants for photosynthesis.

Q.5 Coal and oil are fossil fuels formed by the decomposition of plants and animals which contain nitrogen as essential constituent.

Q.7 Paddy fields contain large amount of water due to which anaerobic decomposition of organic matter take place.

$$2CH_2O \xrightarrow{\text{Bacteria}} CO_2 + CH_4$$

Q.9 Fossil fuels are major source of hydrocarbon fuel.

Q.10 It is colourless and odourless gas.

Q.11 It binds hemoglobin in the blood and reduce the oxygen required for normal respiration.

Q.12 It restore the hemoglobin ability to carry oxygen.

Q.14 Natural source of CH_4 is the anaerobic decomposition of organic matter required bacteria.

Q.15 $NO_2 + H_2O \longrightarrow HNO_3$

$SO_3 + H_2O \longrightarrow H_2SO_4$

Q.18 PAN is a secondary pollutant.

Q.19 Incomplete combustion of fossil fuel produce CO.

Q.20 $SO_2 + \frac{1}{2}O_2 + H_2O \longrightarrow H_2SO_4$

Q.22 Marble contain $CaCO_3$ which react with acid rain.

$H_2SO_4 + CaCO_3 \longrightarrow CaSO_4 + CO_2 + H_2O$

Q.23 $2HNO_3 + CaCO_3 \longrightarrow Ca(NO_3)_2 + CO_2 + H_2O$

Q.24 Oxides of non-metals are acidic in nature i.e. CO_2, SO_2, NO_2.

Q.25 Formed in air $H_2O + CO_2 \longrightarrow H_2CO_3$

Q.26 Because air contain H_2O vapours and CO_2 which react to form H_2CO_3.

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Q.31 Due to formation of H_2SO_4, HNO_3 and H_2CO_3.

Q.33 By the reaction with rain water.

Q.34 SO_2 formed H_2SO_4 not SO_2.

Q.36 CFCs produce $\dot{C}l$ free radical in UV radiation which react with ozone and deplete it.

Q.38 Otherwise these rays cause various heath problem i.e. damages eyes, decreases elasticity of lungs etc.

Q.39 As we move away from earth density of O_2 decrease which form O_3 in stratosphere.

Q.40
$$CFCs \xrightarrow{h\nu} \dot{C}FCl_2 + \dot{C}l$$

$$\dot{C}l + O_3 \longrightarrow Cl\dot{O} + O_2$$

$$\dot{C}lO + O_3 \longrightarrow \dot{C}l + 2O_2$$

Q.42 Normal amount of O_3 in stratosphere 350DU.

Q.43 25 to 28km O_3 layer is thick.

Q.44 It allows harmful UV rays enter in the earth and cause heath problems like sink cancer in humans and animals.

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