

CHEMISTRY NOTES FOR CLASS 10TH (FOR SINDH)

CHAPTER

3

Nitrogen and Oxygen

You will learn in this chapter about:

- ✦ Nitrogen, its occurrence and preparation.
- ✦ Oxygen, its occurrence and preparation.
- ✦ Physical and chemical properties of nitrogen and oxygen.
- ✦ Oxides and their classification, normal oxides, peroxides, superoxides and suboxides.
- ✦ Hydrogen peroxides, its preparation, properties and uses.
- ✦ Oxidation, reduction reactions, oxidizing and reducing agents.
- ✦ Ozone, its preparations, properties and uses.
- ✦ Ammonia its industrial preparation by Haber's process, properties, uses and ammonia fountain.
- ✦ Nitric acid and its industrial preparation from NH_3 by Ostwald's method, properties and uses.
- ✦ Aqua regia and its importance as solvent.

Section - A

Multiple Choice Questions (M.C.Qs.)

Choose the correct answer for each from the given options:

1. When ammonium chloride is heated with a base, the gas liberated is :
(a) ammonia (b) oxygen (c) nitrogen (d) nitric oxide (NO).
2. The catalyst used for the catalytic oxidation of NH_3 in Ostwald's method is :
(a) nickel (b) chromium (c) platinum (d) vanadium penta oxide.
3. The metal that liberates H_2 gas when treated with dil. HNO_3 is :
(a) copper (b) aluminium (c) zinc (d) magnesium.
4. The boiling point of liquid oxygen is :
(a) -196°C (b) -183°C (c) -200°C (d) -187.5°C
5. Select the redox reaction from following reactions.
(a) $\text{Cl} + \text{Cl} \longrightarrow \text{Cl}_2(\text{g})$
(b) $\text{CaCO}_3(\text{s}) \longrightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$
(c) $2\text{FeCl}_3 + \text{H}_2\text{S}(\text{s}) \longrightarrow 2\text{FeCl}_2 + 2\text{HCl} + \text{S}$
(d) $\text{N}_2 \longrightarrow \text{N}^* + \text{N}^*$
6. The air we breathe in, usually contains a higher proportion of :
(a) nitrogen (b) oxygen (c) carbon dioxide (d) water vapours.

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7. Which one of the following is the easy way to distinguish ozone from oxygen?
(a) by comparing their solubilities. (b) by comparing their oxidizing properties.
(c) by comparing allotropic forms. (d) by comparing their odours.
8. The most abundant element found in nature is :
(a) oxygen (b) silicon (c) nitrogen (d) hydrogen
9. Urea is produced by heating carbon dioxide (CO_2) with,
(a) nitric acid (b) ammonia (c) hydrogen (d) potassium nitrate.
10. Nitrogen in 1772 was discovered by:
(a) John Dalton (b) Chaptal
(c) Daniel Rutherford (d) Antoine Lavoisier
11. The Number of electrons in the valence shell of Nitrogen are:
(a) 5 (b) 7 (c) 12 (d) 14
12. The atomic number of nitrogen is:
(a) 5 (b) 7 (c) 12 (d) 14
13. The atomic mass of nitrogen is:
(a) 5 (b) 7 (c) 12 (d) 14
14. Nitrogen is present by volume:
(a) 75% (b) 76% (c) 77% (d) 78%
15. Nitrogen is present _____ % by mass in the earth's atmosphere.
(a) 75 (b) 76 (c) 77 (d) 78
16. Scheele discovered oxygen in:
(a) 1771 (b) 1772 (c) 1773 (d) 1774
17. Priestly discovered oxygen in _____.
(a) 1771 (b) 1772 (c) 1773 (d) 1774
18. In Greek oxygen means _____ producer.
(a) acid (b) base (c) salt (d) alkali
19. The no. of electrons in the valence shell of oxygen is:
(a) 5 (b) 6 (c) 7 (d) 8
20. The atomic number of oxygen is:
(a) 6 (b) 8 (c) 12 (d) 16
21. The atomic mass of oxygen is:
(a) 6 (b) 8 (c) 12 (d) 16
22. Nitrogen is the first member of Group:
(a) VA (b) VIA (c) VIIA (d) VIIIA
23. Oxygen is present by volume in the air.
(a) 21% (b) 75% (c) 78% (d) 80%
24. The % of oxygen by mass in the earth's crust is:
(a) 40 (b) 50 (c) 60 (d) 70
25. Oxygen present by mass in water:
(a) 11.11% (b) 77.77% (c) 88.8% (d) 98.8%
26. Nitrogen is produced commercially by fractional distillation of:
(a) pure air (b) dry air (c) liquid air (d) solid air
27. The bond dissociation energy of nitrogen is:
(a) 641 KJ/mol (b) 741 KJ/mol (c) 841 KJ/mol (d) 941 KJ/mol

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28. Air liquefies at:
(a) -100°C (b) -150°C (c) -200°C (d) -250°C
29. Oxygen is stored in steel cylinders under a pressure of:
(a) 50ATM (b) 100 ATM (c) 150 ATM (d) 200 ATM
30. How many times oxygen is denser than air?
(a) 1.1 (b) 2.1 (c) 3.1 (d) 4.1
31. The binary compounds of oxygen with metals and nonmetals are called:
(a) hydrides (b) nitrides (c) oxides (d) carbides
32. The valence number or oxidation state of oxygen in normal oxides is:
(a) $-1/2$ (b) -1 (c) -2 (d) -3
33. The normal oxides of metals are called:
(a) acidic oxide (b) basic oxide (c) amphoteric oxide (d) neutral oxide
34. The normal oxides of nonmetals are called:
(a) acidic oxide (b) basic oxide (c) amphoteric oxide (d) neutral oxide
35. The oxides which can react with acids and alkalis are called:
(a) acidic oxide (b) basic oxide (c) amphoteric oxide (d) neutral oxide
36. The oxides which are neither acidic nor basic are:
(a) acidic oxide (b) basic oxide (c) amphoteric oxide (d) neutral oxide
37. Peroxides have an oxidation state for oxygen is:
(a) $-1/2$ (b) -1 (c) -2 (d) -3
38. Peroxides produce hydrogen peroxide with:
(a) acids (b) bases (c) salts (d) alkalis
39. Oxygen has an oxidation state in super oxides:
(a) $-1/2$ (b) -1 (c) -2 (d) -3
40. Superoxides are powerful:
(a) reducing agent (b) oxidizing agent
(c) catalytic agent (d) chemical agent
41. Suboxides are:
(a) stable (b) unstable (c) inert (d) reactive
42. Hydrogen peroxide first prepared by:
(a) Lavoisier (b) Scheele (c) Priestley (d) Thenard
43. The boiling point of hydrogen peroxide is:
(a) 150°C (b) 185°C (c) 190°C (d) 195°C
44. Hydrogen peroxide is a common:
(a) reducing agent (b) drying agent
(c) oxidizing agent (d) nitrating agent
45. Hydrogen peroxide in aqueous solution with 3% H_2O_2 can also behave as a/an:
(a) reducing agent (b) drying agent
(c) oxidizing agent (d) nitrating agent
46. Oxidation and reduction reactions go:
(a) separately (b) simultaneously (c) in stages (d) in steps
47. A reaction in which loss of electrons takes place is called a/an:
(a) oxidation (b) reduction (c) redox (d) none of them
48. A reaction in which gain of electrons takes place is called a/an:
(a) oxidation (b) reduction (c) redox (d) none of them
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49. An oxidizing agent is electron:
 (a) donor (b) remover (c) producer (d) destroyer
50. A reducing agent is electron:
 (a) donor (b) remover (c) producer (d) destroyer.
51. Ozone discovered in 1839 by:
 (a) Sorensen (b) Schonbein (c) Lavoiser (d) Scheele
52. Ozone exists above the earth in a layer about:
 (a) 10km (b) 15 km (c) 20 km (d) 25 km
53. The molecular formula of ozone is:
 (a) O_2 (b) O_3 (c) O_4 (d) O_5
54. Ozone is a very poisonous gas at a concentration of:
 (a) 10ppm (b) 50 ppm (c) 90 ppm (d) 100 ppm
55. Ozone acts as a strong:
 (a) oxidizing agent (b) reducing agent
 (c) neutralizing agent (d) desiccating agent
56. Ozone protects from:
 (a) infrared (b) ultra violet (c) magnetic (d) electromagnetic
57. Ammonia is produced commercially from:
 (a) Haber process (b) Ostwald process
 (c) Frasch process (d) Rault process
58. Ammonia acts as a/an:
 (a) acid (b) base (c) salt (d) reagent
59. Nitric acid is prepared industrially by:
 (a) Haber process (b) Ostwald process
 (c) Frasch process (d) Rault process
60. The boiling point of pure nitric acid is:
 (a) 80°C (b) 81°C (c) 82°C (d) 83°C
61. 65% nitric acid boils at:
 (a) 121°C (b) 131°C (c) 141°C (d) 151°C
62. Aqua regia means:
 (a) good water (b) bad water (c) royal water (d) soft water

Answers of M.C.Qs.

1. (a)	10. (c)	19. (b)	28. (c)	37. (b)	46. (b)	55. (a)
2. (c)	11. (a)	20. (b)	29. (b)	38. (a)	47. (a)	56. (b)
3. (b)	12. (b)	21. (d)	30. (a)	39. (a)	48. (b)	57. (a)
4. (a)	13. (d)	22. (a)	31. (c)	40. (b)	49. (b)	58. (b)
5. (c)	14. (d)	23. (a)	32. (c)	41. (b)	50. (a)	59. (b)
6. (a)	15. (a)	24. (b)	33. (b)	42. (d)	51. (b)	60. (d)
7. (c)	16. (b)	25. (c)	34. (a)	43. (a)	52. (c)	61. (a)
8. (a)	17. (d)	26. (c)	35. (c)	44. (c)	53. (b)	62. (c)
9. (b)	18. (a)	27. (d)	36. (d)	45. (a)	54. (d)	

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Section - B/C Short / Descriptive Answer Questions

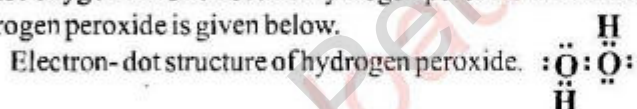
Q1. Give Introduction about Nitrogen, Oxygen, Hydrogen Peroxide, Ozone and Ammonia.

Ans. Nitrogen : Daniel Rutherford discovered nitrogen in 1772. Chaptal named the gas nitrogen because it was found in nitre (potassium nitrate). Nitrogen is the first member of group VA in the periodic table. The atomic number of nitrogen is 7 and its electronic configuration is 2,5. Nitrogen atom has five electrons in its valence shell. It normally forms triple covalent bonds with one or more atoms while there is a lone pair of electrons present on nitrogen atom. Nitrogen exists as a diatomic molecule.



Oxygen : Oxygen was discovered independently by Scheele in 1772 and Priestley in 1774. Lavoisier named the gas oxygen, which means acid producer, because he incorrectly believed that all acids contain this gas. Oxygen belongs to group VIA of the periodic table. It is the first member of this group. It has six electrons in its valence shell. The atomic number of oxygen is 8. Its electronic configuration is 2, 6. Oxygen is the most important gas because it is vital to all living things.

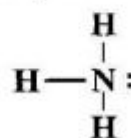
Hydrogen Peroxide : The prefix per indicates that this compound contains more than the usual oxygen. Its formula is H_2O_2 . Thenard called it oxygenated water because as compared to water it contains one more oxygen in its molecule. Hydrogen peroxide is found in traces in nature. The electron-dot formula of hydrogen peroxide is given below.



Ozone: Schonbein discovered ozone in 1839. J. Soret demonstrated in 1886 that ozone is an allotrope of oxygen. Its molecular formula is O_3 . Ozone is present in small amounts in the air. It is formed by a photochemical reaction between oxygen and sunlight. It collects as a protective layer around the earth about 20 km up and protects man from the harmful effects of too much ultraviolet radiation.

Ammonia: Ammonia is a hydride of nitrogen. It is a very important chemical in industry. Fritz Haber invented the process for manufacturing ammonia. Nowadays most of the ammonia produced from the Haber Process is used in the manufacture of fertilizers.

Molecular structure of ammonia



Q2. Write a note on the occurrence of nitrogen.

Ans. Occurrence of Nitrogen: In the free state, nitrogen gas is the major constituent of the air (78%). Despite the stability of atmospheric nitrogen, numerous nitrogen compounds are found in nature. Large deposits of sodium nitrate (Chile saltpeter) and potassium nitrate (saltpeter) exist, and soils may contain ammonia compounds. In addition, nitrogen is an essential component of many organic compounds found in both plants and animals. These organic compounds include amino acids, proteins, nucleic acids, urea, vitamin B compounds.

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Q3. Write a note on the occurrence of oxygen.

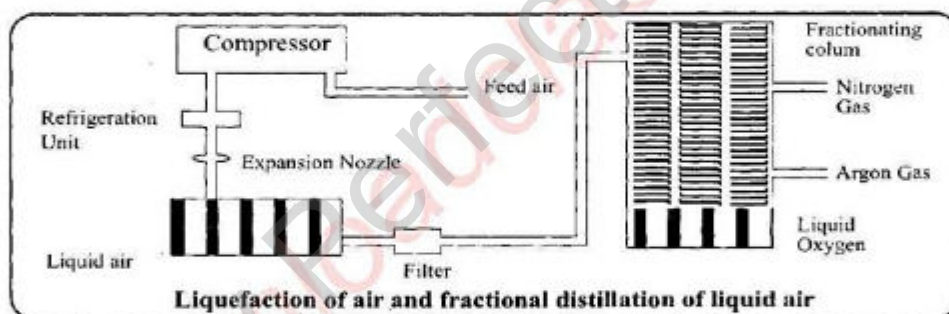
Ans. Occurrence of Oxygen: Of the elements that make up the earth's crust, oxygen is the most abundant. Its total mass is nearly equal to all of the other elements combined. Free oxygen exists as diatomic covalent molecules. Oxygen is 21% of the air, by volume. It constitute 88.8% by mass of water. Most of this oxygen is the product of photosynthesis. Most of the oxygen on earth, however, is in compounds that are the constituents of rocks and soils. Quartz and sand (SiO_2), limestone and marble (CaCO_3) and gypsum (CaSO_4) are common oxygen containing minerals. Clay has a complex composition of aluminium, silicon and oxygen. Water and the organic molecules that make up living tissues also contain oxygen.

Q4. How are nitrogen and oxygen produced industrially by fractional distillation of liquid air?

Ans. Preparation of Nitrogen and Oxygen by Fractional Distillation of Liquid Air:

Both nitrogen and oxygen are produced industrially by fractional distillation of liquid air. Fractional distillation relies on the fact that different liquids have different boiling points, those having the lower boiling points distilling over first. This process consists of two stages:

Liquefaction of Air: Air is first filtered to remove any dust. It is then passed through caustic soda (NaOH) to remove carbon dioxide gas and cooled to -25°C to freeze out the water vapour. Both CO_2

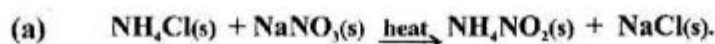


and H_2O would block the apparatus if they were not removed. Air is compressed to 200 atmospheres. The cooled, compressed air is allowed to expand rapidly through a nozzle. It does work as it expands and therefore loses energy. The loss of energy causes the temperature of the gas to fall. The process of compression, cooling, and then expansion to produce much greater cooling are continued and repeated until the air liquefies.

Fractional Distillation of Liquid Air : The liquid air enters a tower which contains many compartments one above the other and each at a slightly higher temperature than the one above it. The first gas to come out is nitrogen at -196°C (77K). When all the nitrogen has been given off, the temperature rises (87K) -186°C and argon gas comes out. Finally at -183°C (90K) oxygen gas comes out. The gases are stored under pressure in steel cylinders.

Q5. Write down the laboratory preparation of nitrogen gas, its physical and chemical properties and uses.

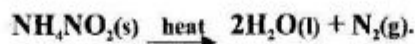
Ans. Laboratory Preparation of Nitrogen Gas: Ammonium chloride (NH_4Cl) and sodium nitrite (NaNO_2) are heated first in a round bottom flask which produces ammonium nitrite (NH_4NO_2).



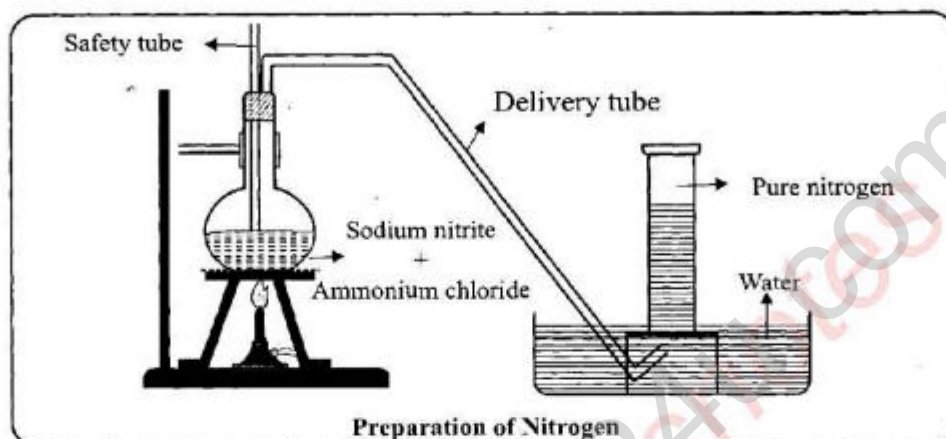
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Preparation of N_2 :

(b) Ammonium nitrite (NH_4NO_2) is then heated to give off nitrogen (N_2) gas.



Nitrogen gas is collected by the downward displacement of water.

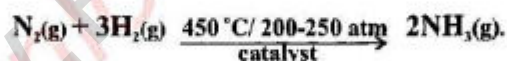


Physical Properties of Nitrogen:

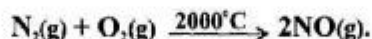
- (i) Nitrogen is a colourless, odourless, tasteless gas.
- (ii) The gas is only slightly soluble in water (less soluble than oxygen).
- (iii) Nitrogen is slightly lighter than air.
- (iv) The boiling point of nitrogen is $-196^\circ C$.

Chemical Properties of Nitrogen :

1. **Reaction with Hydrogen:** If a mixture of nitrogen and hydrogen is heated at $450^\circ C$ under 200-250 atmospheric pressure in the presence of finely divided iron as a catalyst, it is converted to ammonia.



2. **Reaction with Oxygen:** Nitrogen combines with oxygen at about $2000^\circ C$ to form nitric oxide (NO).



3. **Reaction with Ca, Mg and B :** Nitrogen when heated with calcium (Ca), magnesium (Mg) and boron (B) forms respective nitrides.



Uses of Nitrogen:

- (i) Nitrogen is used in the industrial preparation of ammonia and nitric acid.
- (ii) Light bulbs with tungsten filaments are often filled with nitrogen gas.
- (iii) Nitrogenous compounds are used in making fertilizers.
- (iv) Liquid nitrogen is used in hospitals to preserve donor's organs like kidneys.
- (v) Nitrogen gas is used in the storage of fruit like apples.

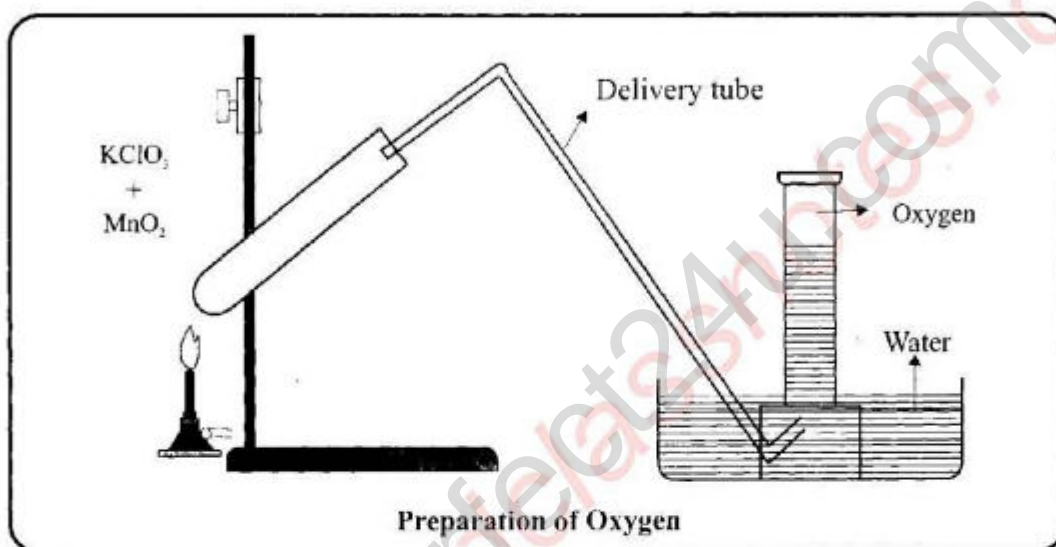
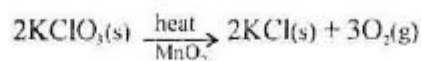
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Q6.

Write down the laboratory preparation of oxygen, its physical and chemical properties and uses.

Ans. Laboratory Preparation of Oxygen:

From Potassium Chlorate: Oxygen is evolved on heating a mixture of three parts potassium chlorate (KClO_3) with one part manganese dioxide (MnO_2). Manganese dioxide acts as a catalyst.



Physical Properties of Oxygen:

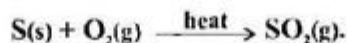
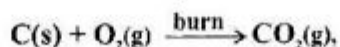
- (i) Oxygen is a colourless, odourless, tasteless gas.
- (ii) It is slightly soluble (2%) in water.
- (iii) Oxygen is found in the air as diatomic molecules, O_2 , with a double covalent bond.
- (iv) Its density is the same as that of the air. It is about 1.1 times denser than air.
- (v) Oxygen liquefies at -183°C and solidifies at -225°C .

Chemical Properties of Oxygen:

1. **Reaction with Metals :** Oxygen reacts with metals of Groups IA, IIA, IIIA to form basic oxides.

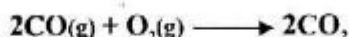
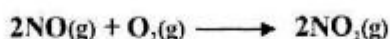


2. **Reaction with nonmetals of Groups IV A, V A and VI to form acidic Oxides:**



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3. Reaction with Compounds:



Uses of Oxygen:

- (i) Liquid oxygen (LOX) is used as a fuel for rockets.
- (ii) Oxyacetylene flame burns at about 3000°C which is used for welding metals.
- (iii) High altitude workers (climbers, pilots) and underwater workers (divers) need oxygen cylinders for respiration.
- (iv) Oxygen gas is blasted into molten iron to remove any impurities.
- (v) Oxygen is essential for life. Plants and animals can not live without it.

Q7. What are oxides? How are oxides classified?

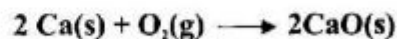
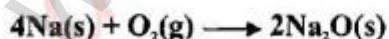
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Ans. Oxides: Oxygen combines readily with all other elements except the elements of Group VII A (halogens) and Group VIII A (noble gases). The binary compounds of oxygen with metals and nonmetals are called oxides, e.g. Li_2O , CaO , Al_2O_3 , CO_2 , P_2O_5 , SO_2 , etc.

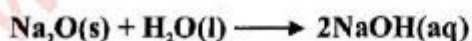
Classification of Oxides: Oxides are classified into several groups on the basis of valence number or oxidation state of oxygen.

1. Normal Oxides: The oxidation state or valence number of oxygen in normal oxides is -2. Normal oxides are further classified into four types:

(i) **Basic Oxides:** They are the oxides of metals.



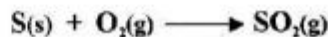
The basic oxides if soluble in water form alkalis.



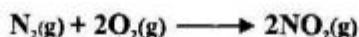
Basic oxides react with acids to form salts and water.



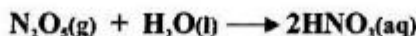
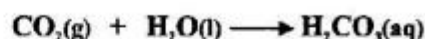
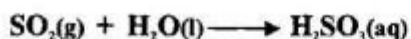
(ii) **Acidic Oxides:** The oxides of nonmetals are called acidic oxides.



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Acidic oxides react with water to form acids.



Acidic oxides react with alkalis to form salts and water.



(iii) **Amphoteric Oxides:** Metals like aluminum, zinc, tin, lead react with oxygen to form amphoteric oxides that possess dual characteristics of acids and bases.



(a) **Reaction of Amphoteric Oxides with Acids:** Amphoteric oxides behave as bases towards acids forming salts and water.



(b) **Reaction of Amphoteric Oxides with Bases:** Amphoteric oxides behave as acids towards bases forming salts and water.



(iv) **Neutral Oxides:** They are neither acidic nor basic. They are neutral to litmus paper.
e.g. H_2O , NO , CO etc.

2. **Peroxides:** They contain a higher proportion of oxygen than the normal oxides. They give hydrogen peroxide on reaction with dilute acids. The oxidation state or valence number of oxygen in peroxides is -1.



Examples: Sodium peroxide (Na_2O_2), barium peroxide (BaO_2) and hydrogen peroxide (H_2O_2).

3. **Super Oxides:** Elements of Group IA form superoxides. They contain more oxygen than peroxides. In these oxides, the oxidation state or valence number of oxygen is -1/2 or -0.5. They are strong oxidizing agents. They release oxygen on heating.

Examples: potassium superoxide (KO_2), rubidium superoxide (RbO_2), caesium superoxide (CsO_2).

4. **Sub Oxides:** They contain less quantity of oxygen than the normal oxides. They are unstable.

Example: Carbon Suboxide = C_3O_2

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Q8. Write down the laboratory preparations of hydrogenperoxide.

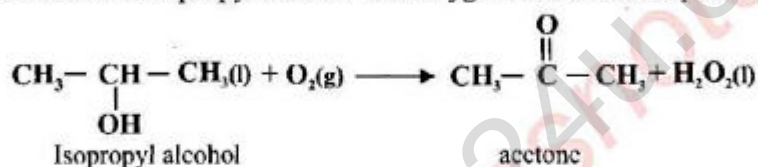
Ans. Laboratory Preparation of Hydrogen Peroxide: Hydrogen peroxide is prepared in the laboratory by the action of sulphuric acid on barium peroxide.



Barium sulphate (BaSO_4) is insoluble in water and can be removed by filtration and pure hydrogen peroxide (H_2O_2) is obtained.

Q9. Give industrial preparation of hydrogen Peroxide. write physical, chemical properties and uses of H_2O_2 .

Ans. Industrial Preparation of Hydrogen Peroxide: Hydrogen peroxide is manufactured industrially by the oxidation of isopropyl alcohol with oxygen under reduced pressure.



The solution of hydrogen peroxide is concentrated by distillation under reduced pressure. Hydrogen peroxide is stored in smooth dark glass bottles or in smooth aluminium containers because it is decomposed by light.

Physical Properties of Hydrogen Peroxide :

- (i) It is a pale blue syrupy liquid.
- (ii) Its freezing point is -0.9°C .
- (iii) It is miscible with water, ether and alcohol in all proportions.
- (iv) Its boiling point is 150°C , it decomposes at this temperature.
- (v) It mixes with water to give a slightly acidic solution.

Chemical Properties of Hydrogen Peroxide:

- Decomposition of hydrogen peroxide on exposure to air :** It decomposes into water and oxygen.

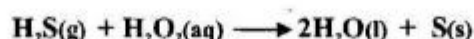


- Hydrogen Peroxide as an Oxidizing Agent:**

(i) **With Potassium Iodide :** Hydrogen peroxide reacts with potassium iodide solution acidified with sulphuric acid to liberate iodine.



(ii) **With Hydrogen Sulphide :** If hydrogen sulphide is bubbled through a solution of hydrogen peroxide, sulphur is formed due to the oxidation of H_2S along with water.



- Hydrogen Peroxide as a Reducing Agent:**

(i) Hydrogen peroxide reduces acidified potassium permanganate solution by changing the purple colour to pale pink.



CHEMISTRY NOTES FOR CLASS 10TH (FOR SINDH)

(ii) Hydrogen peroxide reduces chlorine to hydrochloric acid and liberates oxygen gas.



Uses of Hydrogen Peroxide :

- (i) Hydrogen peroxide is used as a bleaching agent for wool and hair.
- (ii) It is used as an antiseptic for cleaning wounds and as a mouth wash.
- (iii) It is used in preparing organic peroxides.
- (iv) It helps in retaining the colour of lead paints.
- (v) It is used as a deodorant in crowded places and in sewers.

Q10. Describe oxidation and reduction.

Ans. Oxidation : It is defined in the following ways:

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1. **Addition of Oxygen:** Oxidation takes place when oxygen combines with other elements or compounds to form oxides.

Examples :



2. **Removal of Hydrogen:** Oxidation also takes place when hydrogen is removed from a compound.

Examples :



3. **Loss of electrons or Increase in the Oxidation State:** As a result of loss of electrons, the oxidation number increases. Thus loss of electrons is also called oxidation.



Reduction: It is defined as under :

1. **Removal of Oxygen :** Here hydrogen is a reducing agent because it accepts oxygen from CuO and hydrogen is oxidized to water while CuO is an oxidizing agent because it donates oxygen and CuO is reduced to Cu.



2. **Addition of Hydrogen :** Here Cl₂ is an oxidizing agent because it removes H₂ from H₂S and thus Cl₂ is reduced. H₂S is a reducing agent because it supplies hydrogen and H₂S is oxidized.



3. **Gain of Electrons or Decrease in the Oxidation state :** Reduction occurs when there is a gain of electrons. As a result, the oxidation states also decreases.



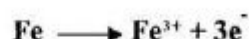
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Q11. Define the followings in terms of electrons transfer.

(i) oxidation (ii) reduction (iii) oxidizing agent (iv) reducing agent (v) redox reaction

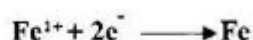
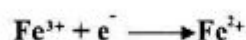
Ans. (i) Oxidation by Electron Transfer : Oxidation takes place when an atom, or ion, loses one or more. Electrons. The atom, or ion, is said to move to a higher oxidation state. Modern nomenclature for writing chemical names emphasises the oxidation state of a metal.

Examples :



(ii) **Reduction by Electron Transfer :** Reduction takes places when an atom, or ion, gains one or more electrons. The atom, or ion moves to a lower oxidation state.

Examples :



(iii) **Oxidizing Agent :** An oxidizing agent is a substance which removes electrons. It's an electron remover.

(iv) **Reducing Agent :** A reducing agent is a substance that donates electrons. It's an electron donor.

(v) **Redox Reactions :** Oxidation and reduction take place at the same time. The two reactions always go together, and hence are correctly termed as redox reaction.

Typical Redox Reactions :

1. Magnesium burns in oxygen to form magnesium oxide.



Magnesium is oxidized (it loses two electrons), oxygen is reduced (it gains two electrons).

2. Hydrogen reduces copper oxide.



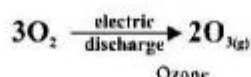
Copper is reduced, (it gains two electrons); Hydrogen is oxidized (it loses 1 electron per atom).

Q12. Write down the occurrence of ozone. Also write down its preparation, physical and chemical properties and uses.

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Ans. Occurrence of Ozone : Ozone occurs in small quantities in the upper layers of the earth's atmosphere. It exists as a layer at a height of 20 km above the earth. In nature ozone is formed from atmospheric oxygen by lightning flashes. It protects the earth's surface from excessive ultraviolet radiation which causes skin cancer and eye cataracts. Ozone also occurs around machinery using high voltage.

Preparation of Ozone : Ozone is prepared by passing ultraviolet radiation or silent electric discharge through oxygen gas. It is necessary to use silent electric discharge because sparking would generate heat energy which decomposes ozone produced. The apparatus used for converting oxygen into ozone is called ozonizer.



Physical Properties of Ozone :

- (i) Ozone is pale blue gas.
- (ii) Ozone has a characteristic irritating smell like chlorine.
- (iii) Pure ozone can be obtained as blue liquid by cooling ozonized oxygen to -112°C .
- (iv) Ozone is slightly soluble in water but dissolves in turpentine oil readily.
- (v) Ozone is a very poisonous gas at a concentration 100 parts per million.

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Chemical Properties of Ozone : Because of its higher energy content, ozone is more reactive chemically than oxygen.

1. Oxidizing Agent :

(i) **With lead Sulphide :** Ozone oxidizes lead sulphide to lead sulphate liberating oxygen gas.



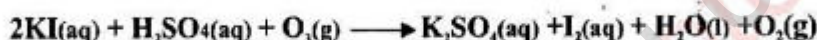
(ii) **With Hydrogen Sulphide :** Ozone oxidizes hydrogen sulphide to sulphuric acid liberating oxygen gas.



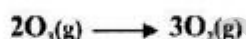
(iii) **With Sulphur Dioxide :** Ozone oxidizes sulphur dioxide to sulphur trioxide along with oxygen gas.



(iv) **With Potassium Iodide :** Ozone oxidizes potassium iodide to iodine.



2. **Decomposition of Ozone :** Ozone decomposes into oxygen on heating or even on standing.



Uses of Ozone :

- Ozone is sometimes used in treatment of domestic water instead of chlorine to kill bacteria.
- It is used as a bleaching agent.
- It is largely used in the preparation of pharmaceuticals, synthetic lubricants and other commercially useful organic compounds
- Ozone in very low concentration is used for ventilating places which get very little fresh air.

Q13. Write down the laboratory preparation of ammonia.

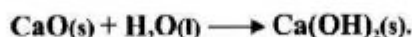
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Ans. Laboratory Preparation of Ammonia : Ammonia is usually prepared in the laboratory by heating ammonium chloride and calcium hydroxide (slaked lime).

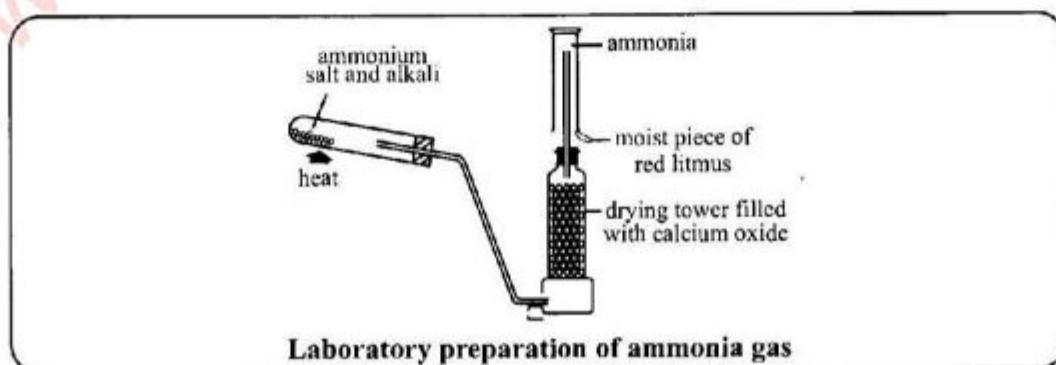


Ammonia

From the equation, water is also produced, So calcium oxide is used by passing the ammonia through a lime tower.



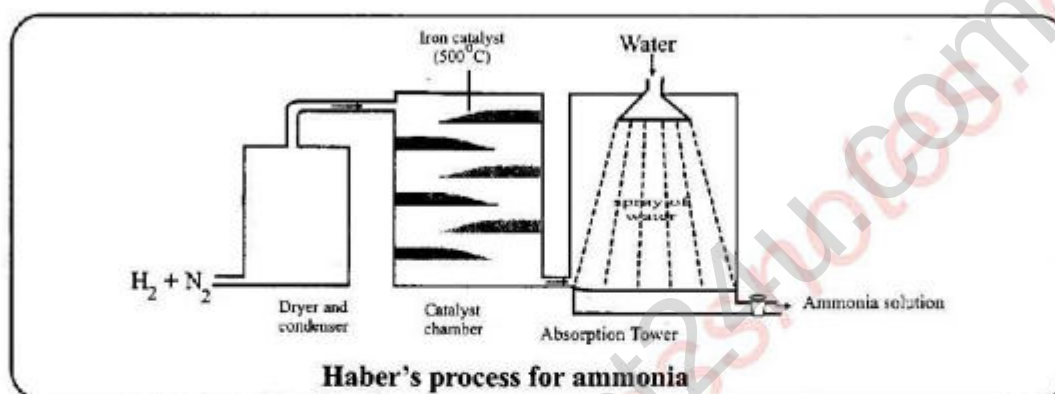
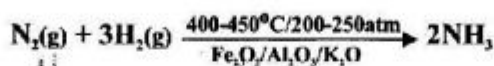
Ammonia gas is collected by the downward displacement of air, as it is a lighter gas than air.



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Q14. Write down the industrial preparation of Ammonia, Also give physical and chemical properties and uses.

Ans. Industrial Preparation of Ammonia (Haber Process): In this process, a mixture of nitrogen and hydrogen in the ratio of 1:3 is heated at 400-450°C in the presence of a catalyst Fe_2O_3 along with some Al_2O_3 , K_2O to produce ammonia gas.



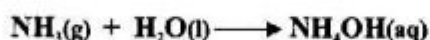
The ammonia is then liquefied by cooling, and the unused gases are recycled over the catalyst to prevent any wastage.

Physical Properties of Ammonia :

- (i) Ammonia is a colourless gas with a pungent smell.
- (ii) It is highly soluble in water (1300 ml dissolves in 1 ml water).
- (iii) Its solution is alkaline and turns red litmus paper blue.
- (iv) Ammonia is easily liquefied into a colourless liquid under compression.
- (v) Ammonia is poisonous in large quantities because of its effect on respiratory muscles.

Chemical Properties of Ammonia :

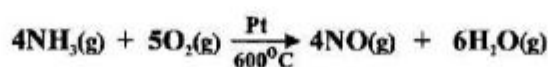
1. **Reaction with Water :** Ammonia gas dissolves in water to form an alkaline solution because of the hydroxide ions.



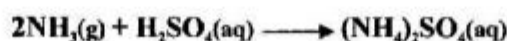
2. **Reaction with Oxygen :** Ammonia does not burn in air but burns readily in oxygen to form nitrogen gas and water vapours.



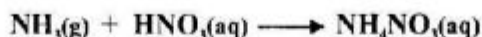
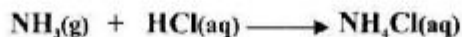
However, in the presence of a heated platinum catalyst ammonia reacts with excess of air (oxygen) to produce nitric oxide gas along with water vapours.



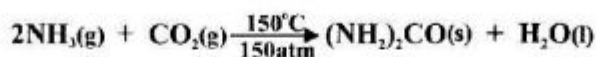
3. **Reaction with Acids (As a Base) :** Being a base, ammonia reacts with acids to form ammonium salts.



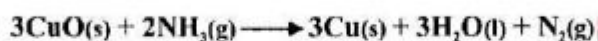
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4. **Reaction with Carbon Dioxide :** Ammonia reacts with carbon dioxide at a temperature of 150°C and at a pressure of 150 atmospheres to produce urea $(\text{NH}_2)_2\text{CO}$, an important organic fertilizer.



5. **Reducing Agent :** Ammonia is not a strong reducing agent. However, it reduces heated copper oxide to copper while it is itself oxidized to water and Nitrogen.



6. **Reaction with Chlorine :**

(i) With excess ammonia, hydrogen chloride and nitrogen are produced. Hydrogen chloride reacts with excess ammonia forming dense white fumes of ammonium chloride.



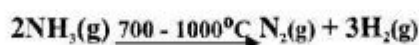
The overall reaction is as under:



(ii) With excess chlorine, ammonia forms nitrogen trichloride (NCl_3) (which is an oily liquid and highly explosive) alongwith hydrogen chloride.



7. **Thermal Decomposition of Ammonia :** Ammonia decomposes into nitrogen and hydrogen at high temperatures.

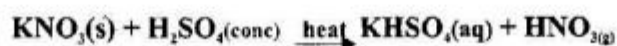


Uses of Ammonia :

- (i) Ammonia is widely used to make fertilizers.
- (ii) Ammonia is also used to make nitric acid.
- (iii) It is used in making solvents used in laundries to remove oil and grease stains from clothes.
- (iv) Liquid ammonia is used in refrigerators as a cooling agent.
- (v) It is also used in making nylon and other organic compounds.

Q15. Write down the laboratory and industrial preparation of nitric acid. Also write the physical properties of nitric acid.

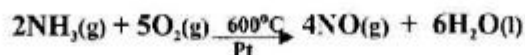
Ans. Laboratory Preparation of Nitric Acid : Nitric acid is prepared by heating potassium nitrate with concentrated sulphuric acid in the laboratory.



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Industrial Preparation of Nitric Acid : Industrially, nitric acid is made by the catalytic oxidation of ammonia over heated platinum. This method of preparation of nitric acid was developed by Ostwald. It has three steps.

- Initially catalytic oxidation of ammonia forms nitric oxide.



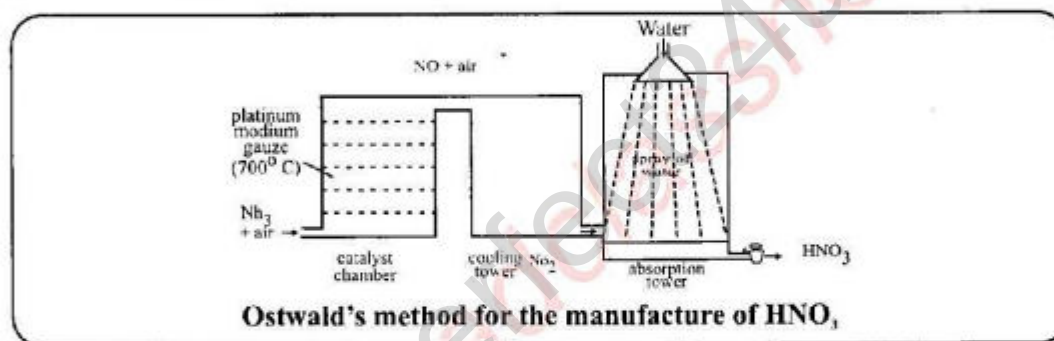
- Nitric oxide is rapidly cooled before combining with oxygen (from excess air) to form nitrogen dioxide.



- Nitrogen dioxide (nitrogen peroxide) is then allowed to react with water to form nitric acid.



Nitric acid obtained from this process is 68% concentrated which can be concentrated further by passing over concentrated sulphuric acid upto 98%.



Physical Properties of Nitric Acid :

- Nitric acid is colourless when pure with a pungent smell and sour taste.
- The boiling point of pure nitric acid is 83°C while its freezing point is -41.6°C .
- The density of pure nitric acid is 1.52g/cm^3 .
- It is miscible in water in all proportions.

Q16 Write down the chemical properties of nitric acid.

Ans. Chemical Properties of Nitric Acid :

1. As an Acid :

- It ionizes completely in an aqueous solution.



- Nitric acid neutralizes an alkali base forming a salt and water (neutralization reaction).



CHEMISTRY NOTES FOR CLASS 10TH (FOR SINDH)

(iii) Nitric acid reacts with metallic carbonates and bicarbonates producing carbon dioxide, water and respective salts.

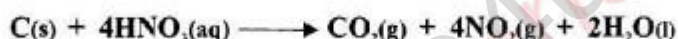


(iv) Metals do not react with nitric acid usually. However, very dilute nitric acid reacts with magnesium and manganese liberating hydrogen gas along with the nitrate.



2. **As an Oxidizing Agent :** Hot concentrated nitric acid reacts with many nonmetals and oxidizes them into their oxides or oxyacid and itself is reduced to nitrogen peroxide (NO_2).

(i) **Reaction with Carbon :** Carbon oxidizes to carbon dioxide on heating with concentrated nitric acid.



(ii) **Reaction with Silicon :** Silicon oxidizes to silica (SiO_2).



(iii) **Reaction with Sulphur :** Nitric acid oxidizes sulphur to sulphuric acid.



(iv) **Reaction with phosphorous :** Red phosphorous oxidizes to phosphoric acid on heating with concentrated nitric acid.

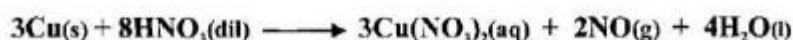
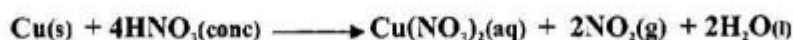


(v) **Reaction with Iodine :** Iodine is oxidized to hydroiodic acid (HIO_3) on heating with concentrated nitric acid.

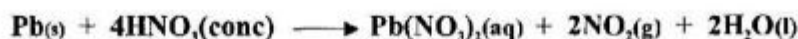


3. **Reaction with Metals:** Both concentrated and dilute nitric acid oxidize many metals. Concentrated nitric acid gives nitrogen dioxide (NO_2) gas while the reaction of dilute nitric acid depends on the nature of reducing agent.

(i) **Reaction with Copper:**

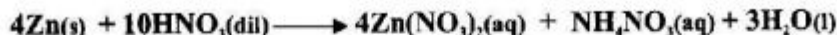


(ii) **Reaction with Lead :**



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(iii) Reaction with Zinc :



4. Reaction with Reducing Agents :

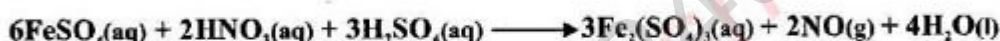
(i) **Reaction with Hydrogen Sulphide:** Concentrated nitric acid oxidizes hydrogen sulphide to sulphur and itself is reduced to nitrogen dioxide.



(ii) **Reaction with Sulphur Dioxide :** Hot concentrated nitric acid oxidizes sulphur dioxide to sulphuric acid.



(iii) **Reaction with Ferrous Sulphate :** Ferrous sulphate reacts with concentrated nitric acid and oxidizes to ferric sulphate in the presence of sulphuric acid while nitric acid is reduced to nitric oxide(g).



5. **Reaction with Benzene (C₆H₆) / Nitration Reaction (As a Nitrating Agent) :** Hot concentrated nitric acid reacts with organic compounds like benzene (C₆H₆) to replace hydrogen atom by the nitro (-NO₂) group to form substituted product, nitrobenzene (C₆H₅NO₂). The substitution of nitro group (-NO₂) in an organic compound is called nitration.



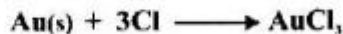
Q17. What is Aqua Regia? How does it dissolve gold?

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Ans. Aqua Regia : When one volume of concentrated nitric acid is mixed with three volumes of concentrated hydrochloric acid, aqua regia is formed. Aqua regia means royal water. It is used to dissolve gold and platinum. Aqua regia dissolves gold and platinum due to the liberation of nascent chlorine which forms soluble gold chloride and platinum chloride with it.



atomic chloride



gold chloride

Q18. Write down the uses of nitric acid.

Ans. Uses of Nitric Acid :

- (i) Nitric acid is mostly used in making fertilizers such as ammonium nitrate.
- (ii) It is used in making explosives like nitroglycerine and trinitrotoluene (TNT).
- (iii) It is also used in making dyes.
- (iv) It is used as a powerful oxidizing agent in the production of important polymers like nylon and terylene.
- (v) It is used as an important laboratory reagent.

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Q19. Differentiate between oxidation and reduction.

Ans.

Oxidation	Reduction
1. Gain of oxygen	1. Los of Oxygen
2. Loss of hydrogen	2. gain of hydrogen
3. Loss of electron	3. gain of electron
4. increase in oxidation state	4. decrease in oxidation state

Textbook Exercise

1. (a) Fill in the blanks :

- The yellow colour of nitric acid is due to dissolved NO_2 gas.
- When 1 mole of N_2 gas is mixed with 3 moles of H_2 gas, 2 moles of NH_3 gas are produced.
- Nitric acid on the large scale is produced by Ostwald's method from ammonia.
- Ammonia on the large scale is produced by Haber Bosch process.
- Ozone is an allotropic form of oxygen with molecular formula O_3 .
- The powerful ultra violet radiation of the sun are screened by ozone layer.
- The process which takes place by the loss of electrons is called oxidation.
- In peroxides the oxidation state of oxygen is -1.
- The oxides that show acidic and basic characters are known as amphoteric oxides.
- Nitrogen boils out from the liquid air at temperature -196 °C.

(b) Point out True or False the following statements :

- Oxygen is separated from the liquid air before nitrogen. (false)
- Air contains about 21% O_2 gas by volume. (true)
- Nitric acid acts as a powerful oxidizing agent. (true)
- Hydrogen peroxide decomposes to liberate O_2 gas on exposure. (true)
- Ammonia gas is insoluble in water. (false)
- Ozone exists at the height of about 20 kilometers above the earth. (true)
- The substance that accepts or gains electrons acts as reducing agent. (false)
- Haber's process is used for the production of nitric acid. (false)
- Nitrogen in HNO_3 is in its highest oxidation state of +5. (true)
- Nitrogen belongs to VIA group of the periodic table. (false)

(c) Pick up the correct answer from the following :

Ans: See MCQs 1 to 10.

2. (a) The first step in the manufacture of nitric acid from NH_3 involves the exothermic oxidation of NH_3 to nitric oxide (NO) and steam.

- Write the equation for the reaction of ammonia with O_2 to form NO.

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(ii) Predict the conditions of temperature for the maximum yield of NO in the equilibrium mixture. What is the percentage conversion of NH_3 into NO.

(iii) Describe with equations, how nitric oxide produced is changed into nitric acid.

Ans: See Q.14.

(b) What happens when nitric acid is reacted with .

- (i) CaCO_3 (ii) NaOH (iii) Mg (iv) C
(v) Zn (conc and dilute HNO_3) (vi) FeSO_4 (vii) H_2S
(viii) C_6H_6 (Benzene).

Ans: See Q.16.

3. (a) What is aqua regia? How does it dissolve gold?

Ans: See Q.17.

(b) What is the result, when potassium nitrate is heated with conc. sulphuric acid? Give the correct equation.

Ans: See Q.15.

(c) Give the industrial preparation of ammonia by Haber's process. With an example, show that ammonia acts as (i) a base (ii) a reducing agent.

Ans: See Q.14.

(d) Explain why ammonia is used in

- (i) refrigerators (ii) laundries (iii) fertilizers.

Ans: See Q.14.

4. (a) Nitrogen is one of the major components of air. How can you get nitrogen from the atmospheric air. Give two uses of nitrogen.

Ans: See Q.4 and 5.

(b) Describe the laboratory preparation of oxygen. How is oxygen industrially produced from liquid air.

Ans: See Q.6 and 4.

(c) Give the action of oxygen on the following :

- (i) carbon (ii) phosphorous (iii) carbon monoxide (CO)
(iv) Mg metal (v) nitric oxide (NO) and (vi) ammonia (NH_3).

Ans: See Q.06 (chemical properties of oxygen).

5. (a) What are oxides? How are they classified? Describe normal oxides in detail.

Ans: See Q.07.

(b) Give the preparation and properties of hydrogen peroxide and its uses.

Ans: See Q.09.

(c) Explain what happens when H_2O_2 is added to the followings :

- (i) hydrogen sulphide (H_2S) (ii) acidified potassium iodide (KI) (iii) chlorine (Cl_2)
(iv) potassium permanganate (KMnO_4) in the presence of H_2SO_4

Ans: See Q.09 (chemical properties of hydrogen proxide).

6. (a) Define the followings in terms of electron transfer :

- (i) oxidation (ii) reduction (iii) oxidizing agent
(iv) radox reaction (v) reducing agent.

Ans: See Q.11.

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(b) Classify the following normal oxides on the basis of their acidic, basic, amphoteric and neutral nature.

- | | | | |
|------------------|--------------------|-------------------------------|----------------------------|
| (i) CaO | (ii) CO_2 | (iii) Al_2O_3 | (iv) Na_2O |
| (v) NO | (vi) CO | (vii) ZnO | (viii) SO_2 |

Ans: See Q.07.

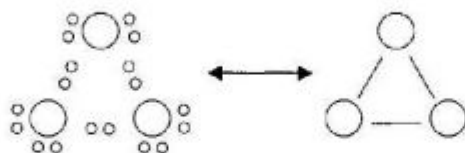
(c) Give the reactions of ZnO with HCl and NaOH .

Ans: See Q.07.

7. (a) What is ozone? How ozone is produced in the atmosphere? How can be obtained from oxygen? What is the structure of ozone?

Ans: See Q.12.

Structure of Ozone:



(b) Describe the reactions of ozone with:

- | | | |
|------------------|--------------------|------------------------------------|
| (i) PbS | (ii) SO_2 | (iii) KI in acidic medium |
|------------------|--------------------|------------------------------------|

Ans: See Q.12 (chemical properties of ozone).

(c) Why ozone is important in the upper atmosphere? What is its importance?

Ans: See Q.12 (occurrence of ozone).

8. Complete the following reactions. Give the balanced equations.

Balanced Equations:

- | | | | | | | | |
|--------|-------------------------------|---|----------------------------|--------|--|---|-----------------------------|
| (i) | $2\text{H}_2\text{S}_{(g)}$ | + | $3\text{O}_{2(g)}$ | —————> | $2\text{SO}_{2(g)}$ | + | $2\text{H}_2\text{O}_{(g)}$ |
| (ii) | $2\text{NH}_{3(g)}$ | + | $3\text{Cl}_{2(g)}$ | —————> | $\text{NCl}_{3(l)}$ | + | $3\text{HCl}_{(g)}$ |
| (iii) | $2\text{NH}_{3(g)}$ | + | $3\text{CO}_{2(g)}$ | —————> | $(\text{NH})_2\text{CO}_{(s)}$ | + | $\text{H}_2\text{O}_{(g)}$ |
| (iv) | $4\text{NH}_{3(g)}$ | + | $5\text{O}_{2(g)}$ | —————> | $4\text{NO}_{(g)}$ | + | $6\text{H}_2\text{O}_{(g)}$ |
| (v) | $3\text{NO}_{2(g)}$ | + | $\text{H}_2\text{O}_{(l)}$ | —————> | $2\text{HNO}_{3(aq)}$ | + | $\text{NO}_{(g)}$ |
| (vi) | $\text{PbO}_{(s)}$ | + | $\text{HNO}_{3(aq)}$ | —————> | $\text{Pb}(\text{NO}_3)_{2(aq)}$ | + | $\text{H}_2\text{O}_{(l)}$ |
| (vii) | $\text{C}_6\text{H}_{6(l)}$ | + | $\text{HNO}_{3(aq)}$ | —————> | $\text{C}_6\text{H}_5\text{NO}_{2(l)}$ | + | $\text{H}_2\text{O}_{(l)}$ |
| (viii) | $\text{NH}_4\text{NO}_{3(s)}$ | | | —————> | $\text{N}_{2(g)}$ | + | $2\text{H}_2\text{O}_{(g)}$ |
| (ix) | $\text{HNO}_{3(aq)}$ | + | $3\text{HCl}_{(aq)}$ | —————> | $\text{NOCl}_{(g)}$ | + | $2\text{H}_2\text{O}_{(l)}$ |
| (x) | $\text{CO}_{2(g)}$ | + | $2\text{NaOH}_{(aq)}$ | —————> | $\text{Na}_2\text{CO}_{3(aq)}$ | + | $\text{H}_2\text{O}_{(l)}$ |

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