

ANSWERS TO THE SHORT QUESTIONS

GENERAL FEATURES OF TRANSITION ELEMENTS

Q.1 What are the d-block elements? Why are they called so?

Ans: Those elements of periodic table whose outermost sub-shell is d- and it is in the process of completion are called d-block elements. There are four series of d-block elements i.e., 3d, 4d, 5d and 6d in period number 4, 5, 6 and 7 respectively.

Q.2 What are f-block elements? Why are they called so? (Faisalabad 2008)

Ans: Those elements of the periodic table whose outermost sub-shell is f- and that is in the process of completion are called f-block elements. There are two series of f-block elements i.e. 4f and 5f. They lie in sixth and seventh periods of the periodic table.

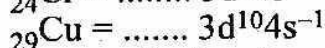
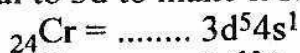
Q.3 Why d- and f-block elements are called transition elements?

(Faisalabad 2008, D.G. Khan 2013)

Ans: In the periodic table, d- and f-block elements lie in between s and p-block elements. So, their properties lie in between s and p. That is why, they are called transition elements.

Q.4 Why the electronic distribution of chromium and copper are different from the rest of the elements of 3d series? (Lahore 2010)

Ans: In case of $_{24}\text{Cr}$, 3d-sub-shell has four electrons normally. It promotes one electron from 4s-orbital and makes five electrons in 3d to make it half filled and get extra stability. Similarly, copper promotes one electron from 4s-orbital to 3d to make it fulfilled and make it stable.



Q.5 What are typical and non-typical transition elements and why are they called so? (Lahore 2008, D.G.K 2009, Faisalabad 2010)

Ans: The elements of group II-B (Zn, Cd, Hg) and III-B (Sc, Y, La) are non-typical transition elements. They are at the boundaries of the series, and their properties are not exactly identical to other d-block elements. The other d-block elements are typical transition elements.

Q.6 How do you distinguish between outer transition and inner transition elements?

Ans: The transition elements of d-series are outer transition elements. There are four series of this category. The elements of f-block i.e. lanthanides and actinides are inner transition elements.

Q.7 What is lanthanide contraction? (D.G. Khan 2011, Faisalabad 2011)

Ans: No doubt, there is a increasing number of electrons from one d-series to the next but the excessive increase of nuclear charge does not allow the sizes of the elements to increase that much. This is called lanthanide contraction.

PROPERTIES OF TRANSITION ELEMENTS

Q.8 How the atomic radii of d-block elements vary from left to the right in a period?

Ans: The atomic radii decrease from left to the right in all d-series. This is due to the increasing nuclear charges and same shielding effects. Anyhow, Zn, Cd and Hg show the abnormal behaviour due to their completely filled sub-shells.

Q.9 How the ionization energy values change from left to the right in d-block elements?

Ans: Due to decreasing sizes from left to the right, the ionization energy values should increase from left to the right but some of the elements like Cr and Ni in 3d-series show the abnormal behaviour.

Q.10 Justify the variation of binding energies in d-block elements from left to right:

Ans: The binding energies depend upon the number of unpaired electrons in the outermost sub-shell. They are maximum in the middle of the series. So binding energies increase from left to right upto the middle and then they decrease.

Q.11 Why the melting and boiling points are maximum somewhere in the middle of the series of d-block elements?

Ans: The melting and boiling points depend upon the binding energies which are the results of number of unpaired electrons. Since the number of unpaired electrons in the middle of the d-block series are greater. So melting and boiling points in the middle are greater.

Q.12 What is paramagnetism? What are its units?

Ans: Those substances which when placed between magnetic poles allow the magnetic lines of forces pass through them are called paramagnetic. It is measured in Bohr magneton (B.M). It is measured by Gouy's balance.

Q.13 How the property of paramagnetism is developed in the substances?

Ans: The unpaired electrons in the outermost orbitals of substances create the magnetic moment. This is due to the orbital motion and spin motion. This magnetic moment is influenced by the external magnetic field.

Q.14 Why the maximum paramagnetic strength is associated with the middle elements of d-block series?

Ans: The elements in the middle of the series have greater number of unpaired electrons in their outermost orbitals. This will create greater values of magnetic moments. Hence they show greater paramagnetic strength.

Q.15 What is the reason for the variations of oxidation states of transition elements?

Ans: This is due to the greater number of unpaired electrons in the outermost orbitals. These electrons can change the orbital due to small energy differences and so the oxidation states can vary.

Q.16 What is the reason for the development of the colours in the compounds of transition elements? or What is d-d transition?

(Sargodha 2008, Mirpur 2009, Faisalabad 2010, Faisalabad 2011)

Ans: Colours are developed due to the jumping of electrons from low energy levels to the higher ones and vice versa. d-orbitals are split up into t_{2g} and e_g orbitals. Electrons are promoted from lower d-orbitals to higher d-orbitals and photons of light are absorbed. The colour of the rest of the compounds depends upon the complementary colour which is absorbed. This is called d-d transition.

Q.17 What are complementary colours? Give examples:

Ans: When a particular wavelength is absorbed by a certain substance from the white light, the rest of the light has a different colour from that one which is absorbed. So, that colour is called the complementary colour of the absorbed one.

Q.18 Why the catalytic properties are associated with the transition elements?

Ans: The substances having unpaired electrons mostly act as catalysts. Actually, they give the electrons to other species and make them activated and increase the rates of reactions.

Q.19 What are interstitial compounds? Give their examples. (D.G. Khan 2013)

Ans: Those compounds in which the interstices of the transition metals in their crystal structures are filled by small sized atoms like H, C, B, etc. are called interstitial compounds.

Q.20 Give examples of alloys and give their properties: (Rwp. 2011)

Ans: Alloys are mixtures of two or more than two metals. For example, brass, bronze and coinage alloys are the best alloys. They are usually harder than pure metals. They have high melting points and more resistant to corrosion.

TRANSITION METAL COMPLEXES

Q.21 How many types of various groups are present in the transition metal complex?

Ans: Transition metal complexes consist of cations and anions with a few exceptions. One of the ion is complex which has central transition metal atom or ion and a few ligands are attached with that.

Q.22 Give the nature of the ions which are produced in water when $K_4[Fe(CN)_6]$ and $[Cu(NH_3)_4] SO_4$ are dissolved in water:

Ans: $K_4[Fe(CN)_6]$ gives $4K^+$ and $[Fe(CN)_6]^{-4}$.

$[Cu(NH_3)_4] SO_4$ gives $[Cu(NH_3)_4]^{+2}$ and SO_4^{-2} .

Q.23 Indicate the central metal atom or ion along with its oxidation number in the complexes:

(i) $K_4[Fe(CN)_6]$ (ii) $K_3[Fe(CN)_6]$ (iii) $[Ag(NH_3)_2] Cl$

Ans: In (i) iron is in +2 oxidation state

In (ii) iron is in +3 oxidation state

In (iii) silver is in +1 oxidation state

Q.24 Give three examples of each:

(i) Monodentate neutral ligands

(ii) Bidentate ligands.

Ans: (i) $H_2\ddot{O}$, $\ddot{N}H_3$, $\ddot{P}H_3$

(ii) $\ddot{N}H_2$, $\ddot{N}H_2$, SO_4^{2-} , $|$ COO^-

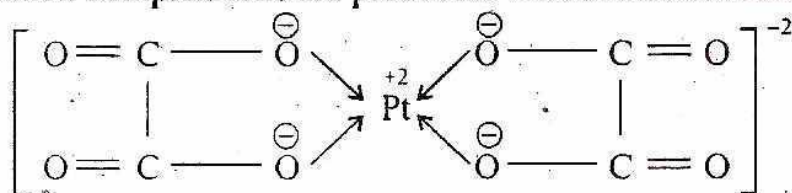
Q.25 What is co-ordination number and co-ordination sphere of a complex compounds? (Gujranwala 2006)

Ans: The number of ligands which surround the central metal atom or ion is called co-ordination number. The collection of central metal atom with all the ligands is called co-ordination sphere.

Q.26 What are chelates?

(Lahore Board 2007, Multan 2009, Guj. 2010, Multan 2012, Lahore 2012)

Ans: When a polydentate ligand surrounds the central metal atom or ion, cyclic co-ordination complex ions are produced. These are called chelates.



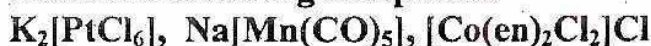
Dioxalato platinate (II) ion

Q.27 While naming the complex compounds, how do you end with negatively charged ligands, positively charged ligands and neutral ligands?

Ans: Negatively charged ligands end in 'o', positively charged ligands end in 'ium', and neutral ligands are called as such.

Q.28 Name the following complexes.

(Sarg. 2010)



Ans: Potassium hexachloroplatinate (IV); Sodium pentacarbonyl managanese (-I) Dichlorobisethylene diamine cobalt (III) chloride. Potasium tetracyano cuprate (II), Pentacarbonyl iron (0).

Q.29 Indicate the shapes of the transition metal ions in which the central metal atom or ion has sp^3 , dsp^2 and dsp^3 hybridization:

Ans: For sp^3 hybridization, the structure is tetrahedral. For dsp^2 hybridization the structure is square planar. For dsp^3 hybridization triangular bipyramid structure is produced.

IRON AND ITS VARIOUS FORMS

Q.30 Give the names and formulas for important ores of iron:

Ans: The important ores of iron are as follows:

Magnetite	Fe_3O_4
Haematite	Fe_2O_3
Limonite	$\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$
Copper iron pyrite	CuFeS_2

Q.31 How do you compare the cast iron, wrought iron and steel with respect to the percentage of carbon? (Rawalpindi 2010)

Ans: Cast iron , carbon = 2.5 – 4.5 %
Wrought iron , carbon = 0.1 – 0.25 %
Steel , carbon = 0.25 – 2.5 %

Q.32 What are the uses of wrought iron?

Ans: It is extremely tough and used for the manufacture of those articles which

Q.33 How do you compare the wrought iron and steel with respect to carbon, sulphur, manganese and phosphorus?

Ans:	Wrought iron	Steel
% age of carbon	0.12 – 0.25	0.1 – 1.5
% age of sulphur	0.2 – 0.15	0.1 – 4.0
% age of manganese	upto 0.25	0.02 – 0.2
% age of phosphorus	0.04 – 0.2	0.04 – 0.07

STEEL

Q.34 How do you compare mild steel, medium carbon steel and high carbon steel with respect to their carbon contents and their properties?

Ans:	% age of carbon
Mild steel	0.1 – 0.2
Medium carbon steel	0.2 – 0.7
High carbon steel	0.7 – 1.5

Q.35 What is the role of acidic and basic lining in the open hearth process for the manufacture of steel?

Ans: Basic lining of dolomite is a mixture of CaO and MgO . It removes the acidic impurity like sulphur and phosphorus. Acidic lining is of SiO_2 and it removes manganese and silicon.

Q.36 Discuss the general shape of Bessemer's converter:

Ans: It is a pear-shaped vessel made up of steel plates. There are holes at the bottom. It is held on a central axis and can be tilted.

Q.37 How do you remove the entrapped gases from the steel?

(Lahore 2008, Gujranwala 2010)

Ans: A little aluminium or ferrosilicon is added. Aluminium combine with nitrogen to give aluminium nitride. Entrapped bubbles of gases are called blow holes.

Q.38 How do you compare the cast iron, steel, and wrought iron keeping in view their hardness, malleability and melting points?

Ans:	Cast iron	Steel	Wrought iron
Carbon	2.5 – 4.5 %	0.25 – 2.5 %	0.12 – 0.25 %
Hardness	hard	medium	soft
Malleability	brittle	malleable and brittle	malleable

CORROSION OF IRON

Q.39 Why the corrosion of metals is more rapid in the presence of water?

Ans: In the presence of water, the layer of oxides, sulphides or carbonates is dissolved in water. So the corrosion penetrates into the metal.

Q.40 How does electrochemical theory explain the corrosion of aluminium in the presence of copper? (Faisalabad 2008, Sarg. 2010)

Ans: In the mixture of copper and aluminium, aluminium corrodes because it loses the electrons, makes the Al^{+3} and give $\text{Al}(\text{OH})_3$.

Q.41 How does the metallic coating prevent the corrosion? (Bahawalpur 2011)

Ans: When the surface of iron is covered with a layer of metal which is more active than iron, iron will be protected. For examples, Zn, Sn, Al and Cr coatings can help to stop corrosion of iron,

Q.42 What do you mean by cathode coating?

Ans: If the sheets of iron are dipped in molten tin and then passed to the hot pairs of rollers, the process is called galvanizing. This is also called cathode coating.

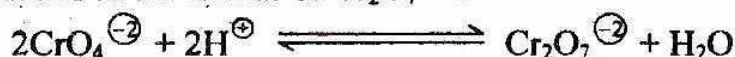
CHROMATES AND DICHROMATES

Q.43 What are chromates and dichromates?

Ans: Chromates are the salt of H_2CrO_4 and dichromates are the salts of $\text{H}_2\text{Cr}_2\text{O}_7$ and these are two acids of chromium.

Q.44 How the acidic medium develops an equilibrium between chromate and dichromate ion? (F. Abad 2013, Multan 2013)

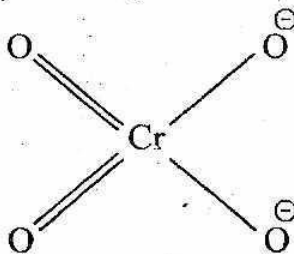
Ans: When the medium is acidic, then CrO_4^{2-} ion changes to $\text{Cr}_2\text{O}_7^{2-}$ ion and equilibrium lies in the favour of $\text{Cr}_2\text{O}_7^{2-}$.



In basic medium the equilibrium is shifted to the backward direction.

Q.45 Give the uses of potassium chromate and its structure?

Ans: K_2CrO_4 is used for the manufacture of pigments, as a corrosion inhibitor, in dyeing and tanning of leather and as an indicator in AgNO_3 titrations. The structure of K_2CrO_4 is that of CrO_4^{2-} ion which is tetrahedral in shape



Q.46 How does $\text{K}_2\text{Cr}_2\text{O}_7$ act as an oxidizing agent in the presence of H_2SO_4 ?

(Faisalabad 2012, Guj. 2013)

Ans: $\text{K}_2\text{Cr}_2\text{O}_7$ reacts with H_2SO_4 to give atomic oxygen which can oxidize other substances:



Q.47 How the mixture of $\text{K}_2\text{Cr}_2\text{O}_7$ and H_2SO_4 oxidizes H_2S gas and FeSO_4 separately?

Ans: The atomic oxygen released by acidified $\text{K}_2\text{Cr}_2\text{O}_7$ oxidizes H_2S to S and FeSO_4 to $\text{Fe}_2(\text{SO}_4)_3$:



Q.48 What is chromyl chloride test?

(Rawalpindi 2010, Lahore 2010, Multan 2011, Sarg. 2011, Lahore 2013)

Ans: When mixture of $K_2Cr_2O_7$ and a soluble chloride say $NaCl$ is heated with conc. H_2SO_4 then a deep red coloured liquid appears in the form of fumes having the formula CrO_2Cl_2 . This is called chromyl chloride.



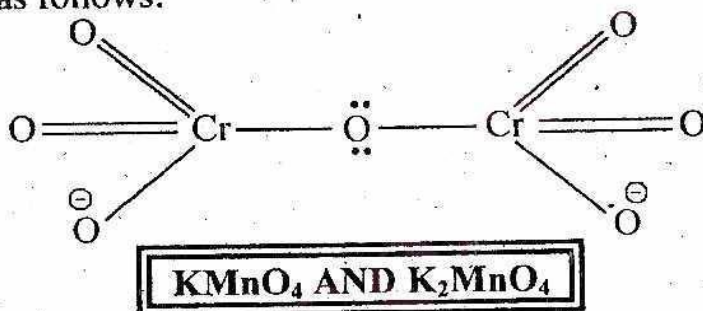
This test is used to check the presence of Cl^- radical.

Q.49 Give the uses of $K_2Cr_2O_7$:

Ans: It is used for the dyeing of many substances and in leather industry for chrome tanning. It acts as an oxidizing agent. It is used in calcoprinting and used in volumetric analysis of redox titration.

Q.50 Give the structure of dichromate ion:

Ans: Structure is as follows:



Q.51 How do you compare $KMnO_4$ and K_2MnO_4 ?

Ans: These two compounds differ from each other in the oxidation number of manganese which is +6 and +7 in K_2MnO_4 and $KMnO_4$ respectively.

Q.52 How $KMnO_4$ and H_2SO_4 act as oxidizing agents?

Ans: They react with each other to release atomic oxygen which can oxidize other substances.



Q.53 How $KMnO_4$ oxidizes SO_2 to H_2SO_4 ?

Ans: The reaction is as follows:



Q.54 How $KMnO_4$ can be prepared by electrolytic method? (Lahore 2010)

Ans: By the electrolytic oxidation K_2MnO_4 , we get $KMnO_4$. When electrical current is passed, water decomposes. Hydrogen is collected at the cathode and oxygen at the anode. The oxygen liberated at the anode oxidizes MnO_4^{2-} ion to MnO_4^- ion. The oxidation number of the manganese increases from +6 to +7



$KMnO_4$ is obtained in the form of purple solution.

Q.55 Write down the structure of MnO_4^- ion:

Ans: The structure is tetrahedral and negative charge of oxygen resonates on the whole ion.

