1 On what ground can you say that scandium (Z = 21) is a transition element but zinc (Z = 30) is not? 1

ANS: It is because Sc (21) has incompletely filled d-orbital, that is why it is transition element, whereas Zn(30) does not have incompletely filled d-orbitals, therefore, it is not regarded as transition element.

2 Why do transition metals show variable oxidation states? 1

ANS: It is because electrons from both 's' and d-orbitals can take part in bond formation.

3 Lanthanoids form primarily +3 ions, while the actinoids usually have higher oxidation states in their compounds, +4 or even +6 being typical. Give reason. 1

ANS: In Actinoids, 5f, 6d and 7s orbitals have comparable energies and electrons from these orbitals can take part to show higher oxidation states.

4 Among lanthanoids, Ln(III) compounds are predominant. However, occasionally in solutions or in solid compounds, +2 and +4 ions are also obtained. Give reason. 1

ANS: Lanthanoids show +3 oxidation state mostly as 2 electrons from outer 6s orbital and one electron from 5d orbital take part in bond formation. Some show +2 and +4 oxidation states due to stability of half filled and completely filled 4f orbitals.

5 Out of Cu_2Cl_2 and $CuCl_2$, which is more stable and why? 1

ANS: $CuCl_2$ is more stable due to more hydration energy.

6 Although Zr belongs to 4d and Hf belongs to 5d transition series but it is quite difficult to separate them. Why? 1

ANS: It is due to almost same size (Zr = 160 pm, Hf = 159 pm) which is due to lanthanoid contraction.

7 E° of Cu is +0.34 V while that of Zn is –0.76 V. Explain. 1

ANS: It is because Cu(s) is more stable than Cu^{2+} due to high ionisation enthalpy which is not overcome by its hydration energy.
In the case of Zn, after removal of 2 electrons from 4s orbtital, stable $3d^{10}$ configuration is acquired.

8 Why do the transition metals have higher enthalpy of atomisation? In 3d series (Sc to Zn), which element has lowest enthalpy of atomisation and why? 2

ANS: It is due to the involvement of greater number of unpaired electrons from (n – 1)d as well as ns orbitals in the strong inter-atomic metallic bonding. Zinc has lowest enthalpy of atomisation due to larger size and in the absence of unpaired electrons, it forms weak metallic bond.

9 For the first row transition metals, the E° values are given below: 2

E°	V	Cr	Mn	Fe	Co	Ni	Cu
(M^{2+}/M)	−1.18	−0.91	−1.18	−0.44	−0.28	−0.25	+0.34

Explain the irregularity in the above values.

ANS: It is due to irregular variation of sublimation enthalpies and ionisation enthalpies of elements of 3d transition series.

10 How would you account for the following? 2
(i) Cr^{2+} is reducing in nature while with the same d-orbital configuration (d^4), Mn^{3+} is an oxidising agent.
(ii) In a transition series of metals, the metal which exhibits the greatest number of oxidation states occurs in the middle of the series. or N ame the element showing maximum number of oxidation states among the first series of transition metal Sc (21) to Zn (30).

ANS: (i) It is because Cr^{2+} loses electron to become Cr^{3+} which is more stable due to half filled t_{2g} orbitals, whereas Mn^{3+} will gain electron to become Mn2+ which is more stable due to half filled

d-orbitals.
(ii) Manganese. It is due to large number of unpaired electrons in d-orbitals in middle of the series. Mn (25) $4s^2 3d^5$.

11 Explain the following observations giving an appropriate reason for each.
(i) There occurs much more frequent metal-metal bonding in compounds of heavy transition metals (i.e. 3rd series).
(ii) Mn^{2+} is much more resistant than Fe^{2+} towards oxidation. 2

ANS: (i) Due to lanthanoid contraction, effective nuclear charge remains almost same therefore, metallic radii are nearly same, therefore, metal-metal bonding is more.
(ii) Mn^{2+} ($3d^5$) has stable electronic configuration, therefore, it does not get oxidised. Fe^{2+} ($3d^6$) gets oxidised to form Fe^{3+}($3d^5$) which is more stable.

12 State reasons for the following:
(i) Actinoids exhibit greater range of oxidation states than lanthanoids.
(ii) Unlike Cr^{3+}, Mn^{2+}, Fe^{3+} and the subsequent other M^{2+} ions of the 3d series of elements, the 4d and the 5d series metals generally do not form stable cationic species. 2

ANS: (i) It is due to poor shielding effects of 4f and 5f electrons, more number of electrons take part in bond formation in actinoids.
(ii) It is because energy required to remove electron is more due to greater effective nuclear charge which is due to lanthanoid contraction.

13 Assign reasons for each of the following:
(i) T ransition metals generally form coloured compounds.
(ii) Manganese exhibits the highest oxidation state of + 7 among the 3d series of transition elements. 2

ANS: (i) It is because transtion metals have unpaired electron in d-orbitals and undergo d-d-transitions by absorbing light from visible region and rediate complementary colour.
(ii) Mn has electronic configuration (Ar)$4s^2$ $3d^5$ and all the electrons in 's' as well as 'd' orbitals can take part in bond formation, therefore, it shows +7 (highest) oxidation state.

14 Explain the following observations:
(i) Generally there is an increase in density of elements from titanium (Z = 22) to copper (Z = 29) in the first series of transition elements.
(ii) T ransition elements and their compounds are generally found to be good catalysts in chemical reactions. 2

ANS: (i) It is because atomic mass increases more than atomic volume, therefore, density increases from titanium (Z = 22) to copper (Z = 29).
(ii) It is because they show variable oxidation states and have vacant d-orbitals forming unstable intermediates which readily change into products.

15 Explain the following observations:
(i) Transition elements generally form coloured compounds.
(ii) Zinc is not regarded as a transition element. 2

ANS: (i) It is due to presence of unpaired electrons in d-orbitals, therefore, they undergo d-d transitions by absorbing light from visible region and radiate complementary colour.
(ii) It is because neither Zn nor Zn^{2+} ion has incompletely filled d-orbital.

16 Complete the following equations: $(i)\ 2MnO_4^- + 5SO_3^{2-} + 6H^+ \longrightarrow$ $(ii)\ 2CrO_4^{2-} + 2H^+ \longrightarrow$ 2

ANS: $(i)\ 2MnO_4^- + 5SO_3^{2-} + 6H^+ \longrightarrow 2Mn^{2+} + 5SO_4^{2-} + 3H_2O$
$(ii)\ 2CrO_4^{2-} + 2H^+ \longrightarrow Cr_2O_7^{2-} + H_2O$

17 Complete the following equations: $(i)\ 2MnO_4^- + 5NO_2^- + 6H^+ \longrightarrow$ $(ii)\ Cr_2O_7^{2-} + 14\ H^+ + 6\ e^- \longrightarrow$ 2

ANS: (i) $2MnO_4^- + 5NO_2^- + 6H^+ \longrightarrow 2Mn^{2+} + 5NO_3^- + 3H_2O$

(ii) $Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$

18 Complete the following chemical equations: 2

(i) $MnO_4^-(aq) + C_2O_4^{2-}(aq) + H^+(aq) \longrightarrow$

(ii) $Cr_2O_7^{2-}(aq) + Fe^{2+}(aq) + H^+(aq) \longrightarrow$

ANS: (i) $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow 2Mn^{2+} + 10CO2 + 8H_2O$

(ii) $Cr_2O_7^{2-}(aq) + 6Fe^{2+}(aq) + 14H^+(aq) \longrightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$

19 Name the oxometal anions of the first series of the transition metals in which the metal exhibits the oxidation state equal to its group number. 2

ANS: In MnO_4^-, oxidation state of Mn is +7 which is equal to its group number.
In CrO_4^{2-}, oxidation state of Cr is +6 which is equal to its group number.

20 Write complete chemical equations for:
(i) Oxidation of Fe^{2+} by $Cr_2O_7^{2-}$ in acid medium. 2
(ii) Oxidation of $S_2O_3^{2-}$ by MnO_4^- in neutral aqueous medium.

ANS: (i) $6Fe^{2+} + Cr_2O_7^{2-} + 14H^+ \longrightarrow 6Fe^{3+} + 2Cr^{3+} + 7H_2O$

(ii) $8MnO_4^- + 3S_2O_3^{2-} + H_2O \longrightarrow 8MnO_2 + 6SO_4^{2-} + 2OH^-$

21 Write one similarity and one difference between the chemistry of lanthanoids and that of actinoids. 2

ANS: Similarity
Lanthanoids show lanthanoid contraction like actinoids contraction.
Dissimilarity
Lanthanoids show mostly +3 oxidation state. Few show +2 and +4, whereas Actinoids show +3, +4, +5, +6 and +7 oxidation states.

22 Give reasons for the following observations:
(i) Mn(II) ion shows maximum paramagnetic character amongst the bivalent ions of first transition series. 2
(ii) Scandium (At. no. 21) salts are white.

ANS: (i) It is due to presence of five unpaired electrons.
(ii) Sc^{3+} does not have unpaired electrons, therefore, cannot undergo d-d transition by absorbing light from visible region. Therefore, its salts are white.

23 State reasons for the following observations:
(i) The enthalpies of atomisation of transition elements are quite high.
(ii) There is a greater horizontal similarity in the properties of the transition elements than of the main group elements. 2

ANS: (i) It is due to smaller size of transition metals and strong metallic bonds due to the presence of large number of unpaired electrons.
(ii) It is due to similarity in atomic and ionic size, there is more horizontal similarity. Secondly, in transition elements incoming electron goes to inner shell (d-orbitals), whereas in main group elements, the incoming electron goes to outermost shell.

24 Assign suitable reasons for the following:
(a) The Mn^{2+} compounds are more stable than Fe^{2+} towards oxidation to their +3 state.
(b) In the 3d series from Sc (Z = 21) to Zn (Z = 30), the enthalpy of atomization of Zn is the lowest. 3
(c) Sc^{3+} is colourless in aqueous solution, whereas Ti^{3+} is coloured.

ANS: (a) Mn^{2+} has $3d^5$ (stable electronic configuration), therefore, it does not get oxidised to Mn^{3+}, whereas Fe^{2+} has $3d^6$ which readily changes to Fe^{3+} ($3d^5$) which has stable electronic configuration.
(b) Zinc does not have unpaired electrons and larger in size, therefore, has weak metallic bonds. That is why it has least enthalpy of atomisation.
(c) Sc^{3+} is colourless as it does not have unpaired electron and cannot undergo d-d transition,

whereas Ti^{3+} is coloured due to presence of unpaired electrons, and undergoes d-d transition by absorbing light from visible region and radiate complementary colour.

25 How would you account for the following?
(i) The atomic radii of the metals of the third (5d) series of transition elements are virtually the same as those of the corresponding members of the second (4d) series.
(ii) The E° value for the Mn^{3+}/Mn^{2+} couple is much more positive than that for Cr^{3+}/Cr^{2+} couple or Fe^{3+}/Fe^{2+} couple. 3
(iii) The highest oxidation state of a metal is exhibited in its oxide or fluoride.

ANS: (i) It is due to lanthanoid contraction which is due to poor shielding effect of f-electrons.
(ii) It is because Mn^{2+} is more stable than Mn^{3+} due to stable half filled 3d5 configuration, whereas $Cr^{3+}(t_{2g}^3)$ and $Fe^{3+}(3d^5)$ are more stable than Cr^{2+} and Fe^{2+} respectively.
(iii) It is because oxygen and fluorine are strong oxidising agents, highly electronegative, small size and can provide energy for formation of transition metal ion in higher oxidation state.

26 Give reasons for each of the following:
(i) Size of trivalent lanthanoid cations decreases with increase in the atomic number.
(ii) T ransition metal fluorides are ionic in nature, whereas bromides and chlorides are usually covalent in nature. 3
(iii) Chemistry of all the lanthanoids is quite similar.

ANS: (i) It is due to poor shielding effect of f-electrons, effective nuclear charge increases, so, ionic size decreases.
(ii) F is more electronegative than Cl and Br, therefore, fluorides are ionic; whereas chlorides and bromides are covalent.
(iii) It is due to similar ionic size which is due to lanthanoid contraction, they resemble in their properties.

27 A solution of $KMnO_4$ on reduction yields either a colourless solution or a brown precipitate or a green solution depending on pH of the solution. 3
What different stages of the reduction do these represent and how are they carried out?

ANS: Oxidising behaviour of $KMnO_4$ depends upon pH of solution. Different compounds with different colours are formed at different pH.

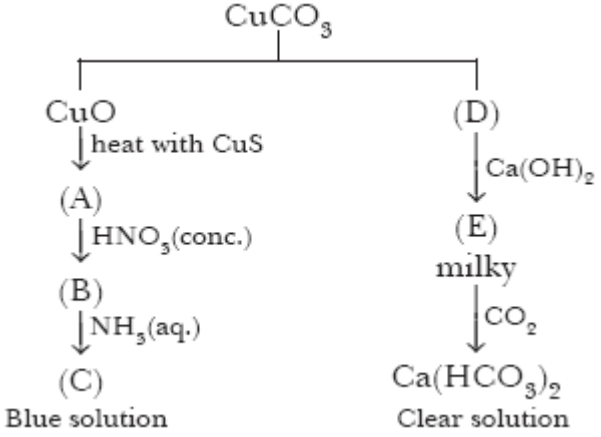
$$MnO_4^- + 8H^+ + 5e^- \longrightarrow \underset{\text{Colourless}}{Mn^{2+}} + 4H_2O \text{ (in acidic medium, pH} < 7)$$

$$MnO_4^- + e^- \longrightarrow \underset{\text{Green}}{MnO_4^{2-}} \text{ (in basic medium, pH} > 7)$$

In neutral medium

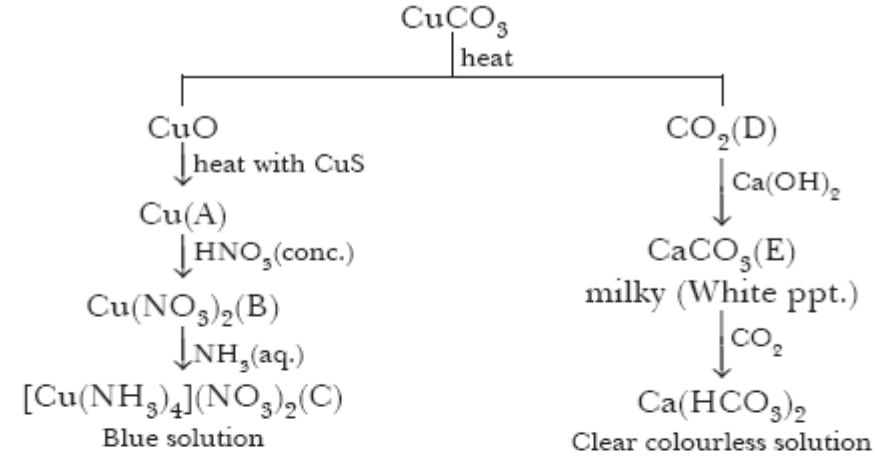
$$MnO_4^- + 2H_2O + 3e^- \longrightarrow \underset{\text{Brown ppt.}}{MnO_2} + 4OH^- \text{ (pH} = 7)$$

28 Identify A to E and also explain the reactions involved.



3

ANS:



'A' is Cu, 'B' is $Cu(NO_3)_2$; 'C' is $[Cu(NH_3)_4](NO_3)_2$; 'D' is CO_2 and 'E' is $CaCO_3$.

$$CuCO_3(s) \xrightarrow{\text{heat}} \underset{\text{'A'}}{CuO(s)} + \underset{\text{'D'}}{CO_2(g)}$$

$$2CuO + CuS \longrightarrow \underset{\text{'A'}}{3Cu} + SO_2$$

$$Cu + 4HNO_3(\text{conc.}) \longrightarrow \underset{\text{'B'}}{Cu(NO_3)_2} + 2NO + 2H_2O$$

$$Cu(NO_3)_2 + 4NH_3 \longrightarrow \underset{\text{'C'}}{[Cu(NH_3)_4][NO_3]_2}$$

$$\underset{\text{'D'}}{Ca(OH)_2 + CO_2(g)} \longrightarrow \underset{\text{'E'}}{CaCO_3(s)} + H_2O(l)$$

$$\underset{\text{'E'}}{CaCO_3} + CO_2 + H_2O \longrightarrow \underset{\text{soluble}}{Ca(HCO_3)_2}$$

29 When a chromite ore(A) is fused with sodium carbonate in free excess of air and the product is dissolved in water, a yellow solution of compound (B) is obtained. After treatment of this yellow solution with sulphuric acid, compound (C) can be crystallised from the solution. When compound (C) is treated with KCl, orange crystals of compound (D) crystallise out. Identify A to D and also explain the reactions. 3

ANS:

'A' is iron chromite ($FeCr_2O_4$), 'B' is sodium chromate (Na_2CrO_4), 'C' is sodium dichromate ($Na_2Cr_2O_7$) and 'D' is potassium dichromate ($K_2Cr_2O_7$).

$$\underset{\substack{\text{'A'}\\\text{(Chromite ore)}}}{4FeCr_2O_4} + 8Na_2CO_3 + 7O_2 \longrightarrow \underset{\substack{\text{'B'}\\\text{(Yellow solution)}}}{8Na_2CrO_4} + 2Fe_2O_3 + 8CO_2(g)$$

$$2Na_2CrO_4 + H_2SO_4 \longrightarrow \underset{\text{'C'}}{Na_2Cr_2O_7} + Na_2SO_4 + H_2O$$

$$\underset{\text{'C'}}{Na_2Cr_2O_7} + 2KCl \longrightarrow 2NaCl + \underset{\text{'D'}}{K_2Cr_2O_7}$$

30 When an oxide of manganese (A) is fused with KOH in the presence of an oxidising agent and dissolved in water, it gives a dark green solution of compound (B). Compound (B) disproportionates in neutral or acidic solution to give purple compound (C). An alkaline solution of compound (C) oxidises potassium iodide solution to a compound (D) and compound (A) is also formed. Identify compounds A to D and also explain the reactions involved. 3

ANS:

'A' is manganese dioxide (MnO_2), 'B' is potassium manganate (K_2MnO_4), 'C' is potassium permanganate ($KMnO_4$) and 'D' is potassium iodate (KIO_3).

$$\underset{\text{'A'}}{MnO_2} + 4KOH + O_2 \longrightarrow \underset{\text{'B'}}{2K_2MnO_4} + 2H_2O$$

(Dark green solution)

K_2MnO_4 gives MnO_4^{2-} ions which undergoes oxidation as well as reduction (disproportionation) into MnO_4^- and MnO_2.

$$3MnO_4^{2-} + 4H^+ \longrightarrow \underset{\substack{\text{Purple}\\ \text{'C'}}}{3MnO_4^-} + MnO_2 + 2H_2O$$

Purple coloured $KMnO_4$ 'C' gives MnO_4^- ions which convert KI to KIO_3 in basic medium and 'A' (MnO_2) is also formed.

$$\underset{\text{'C'}}{2MnO_4^-} + H_2O + KI \longrightarrow \underset{\text{'A'}}{2MnO_2} + 2OH^- + \underset{\substack{\text{Potassium iodate}\\ \text{'D'}}}{KIO_3}$$

31 A violet compound of manganese (A) decomposes on heating to liberate oxygen and compounds (B) and (C) of manganese are formed. Compound (C) reacts with KOH in the presence of potassium nitrate to give compound (B). On heating compound (C) with conc. H_2SO_4 and NaCl, chlorine gas is liberated and a compound (D) of manganese along with other products is formed. Identify compound A to D and also explain the reactions involved. 3

ANS:

$$\underset{\text{'A'}}{2KMnO_4} \xrightarrow{\text{heat}} \underset{\text{'B'}}{K_2MnO_4} + \underset{\text{'C'}}{MnO_2} + O_2$$

Potassium nitrate is an oxidising agent. It provides O_2 which oxidises MnO_2 in presence of KOH to form K_2MnO_4(B).

$$2MnO_2 + 4KOH + O_2 \longrightarrow \underset{\text{'B'}}{2K_2MnO_4} + 2H_2O$$

$$\underset{\text{'C'}}{MnO_2} + 4NaCl + 4H_2SO_4 \longrightarrow \underset{\text{'D'}}{MnCl_2} + 2NaHSO_4 + 2H_2O + \underset{\text{Chlorine gas}}{Cl_2}$$

'A' is potassium permanganate, 'B' potassium manganate, 'C' is manganese dioxide and 'D' is manganese chloride.

32 (a) How would you account for the following:
(i) Actinoid contraction is greater than lanthanoid contraction.
(ii) T ransition metals form coloured compounds. 3
(b) Complete the following equation:
$2MnO_4^- + 6H+ + 5NO_2^- \rightarrow$

ANS: (a) (i) It is due to more poor shielding effect of 5f electrons in actinoids than 4f electrons in lanthanoids.
(ii) It is due to the presence of unpaired electrons, they undergo d-d transitions by absorbing light from visible region and radiate complementary colour.

(b) $2MnO_4^- + 6H^+ + 5NO_2^- \longrightarrow 2Mn^{2+} + 3H_2O + 5NO_3^-$

33 (a) How would you account for the following:
(i) Highest fluoride of Mn is MnF_4 whereas the highest oxide is Mn_2O_7.

Or Mn shows highest oxidation state of +7 with oxygen but with fluorine it shows the highest oxidation state +4. 3

(ii) T ransition metals and their compounds show catalytic properties.
(b) Complete the following equation:
$3MnO_4^{2-} + 4H^+ \rightarrow$

ANS: (a) (i) Oxygen can form double bond, therefore, it can form Mn_2O_7 , whereas 'F' cannot form double bonds, so, it can form MnF_4.
(ii) Transition metals show variable oxidation states, therefore, they and their compounds act as catalyst.
(b) $3MnO_4^{2-} + 4H^+ \rightarrow MnO_2 + 2MnO_4^- + 2H_2O$

34 (a) How would you account for the following:
(i) The chemistry of actinoids is more complicated as compared to lanthanoids.
(ii) Transition metals form complex compounds. 3
(b) Complete the following equation: $2MnO_4^- + 6H^+ + 5SO_3^{2-} \longrightarrow$

ANS: (a) (i) It is because they are radioactive and some of them have very short half life.
(ii) It is due to small size, high charge and availability of d-orbitals of suitable energy. (b)
$2MnO_4^- + 6H^+ + 5SO_3^{2-} \longrightarrow 2Mn^{2+} + 5SO_4^{2-} + 3H_2O$

35 Explain the following:
(i) The transition elements have great tendency for complex formation.
(ii) There is a gradual decrease in the atomic sizes of transition elements in a series with increasing atomic numbers. 3
(iii) Lanthanum and Lutetium do not show colouration in solutions.
(At. No.: La = 57, Lu = 71)

ANS: (i) It is due to presence of vacant d-orbitals of suitable energy, smaller size of cations and higher charge.
(ii) It is due to increase in effective nuclear charge gradually because unpaired electrons increases in the beginning with no repulsion. There is repulsion between paired electrons after middle of series, therefore, effective nuclear charge increases a little.
(iii) It is due to absence of unpaired electrons, they do not absorb light from visible region and cannot undergo f-f transition. and do not radiate colour.

36 (a) Complete the following chemical equations for reactions in aqueous media :
(i) $Cr_2O_7^{2-} + H^+ + Fe^{2+} \rightarrow$
(ii) $MnO_4^- + I^- + H^+ \rightarrow$ 3
(b) How many unpaired electrons are present in Mn^{2+} ion (At. no. of Mn = 25)? How does it influence magnetic behaviour of Mn^{2+} ions?

$$(i)\ Cr_2O_7^{2-} + 14\ H^+ + 6Fe^{2+} \longrightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$$

ANS: (a) $(ii)\ 2\ MnO_4^- + 10\ I^- + 16\ H^+ \longrightarrow 2Mn^{2+} + 8H_2O + 5I_2$ (b) Mn^{2+}: $3d^5 4s^0$ has 5 unpaired electrons. It is highly paramagnetic and attracted by magnet.

37 When a brown compound of manganese (A) is treated with HCl it gives a gas (B). The gas taken in excess, reacts with NH_3 to give an explosive compound (C). Identify compounds A, B and C. 3

ANS: 'A' is MnO_2 which is brownish black.

$$MnO_2(s) + 4HCl(conc.) \longrightarrow MnCl_2(aq) + Cl_2(g) + 2H_2O(l)$$

Gas 'B' is Cl_2. $\quad NH_3 + \underset{(excess)}{3Cl_2} \longrightarrow \underset{\text{'C'}}{NCl_3} + 3HCl$

(explosive compound)

38 (a) What are the different oxidation states exhibited by the lanthanoids?
(b) Write two characteristics of the transition elements. 3
(c) Which of the 3d-block elements may not be regarded as the transition elements and why?

ANS: (a) Lanthanoids, mostly show +3 oxidation state but some of them show +2 and +4 oxidation states also due to the stability of electronic configuration ($4f^0$, $4f^7$ and $4f^{14}$).
(b) (i) They show variable oxidation states.
(ii) They form coloured ions.
(c) Zn may not be regarded as transition metal because neither Zn nor Zn^{2+} have incompletely filled d-orbital.

39 (a) Transition metals can act as catalysts, why? How does Fe(III) catalyse the reaction between iodide ion and persulphate ions? 3
(b) Mention any three processes where transition metals act as catalysts.

ANS: (a) Transition metals act as catalyst because they show variable oxidation states as explained below:
Reaction between iodide and persulphate ions is

$$2I^- + S_2O_8^{2-} \xrightarrow{Fe^{3+}} I_2 + 2SO_4^{2-}$$

Role of Fe^{3+} ions (It acts as catalyst)

$$2Fe^{3+} + 2I^- \longrightarrow 2Fe^{2+} + I_2$$

$$2Fe^{2+} + S_2O_8^{2-} \longrightarrow 2Fe^{3+} + 2SO_4^{2-}$$

(b)

$$(i)\ 2SO_2(g) + O_2(g) \xrightarrow{V_2O_5} 2SO_3(g)\ \text{(Contact Process)}$$

$$(ii)\ N_2(g) + 3H_2(g) \xrightarrow{Fe} 2NH_3(g)\ \text{(Haber's Process)}$$

$$(iii)\ 4NH_3 + 5O_2 \xrightarrow[\text{heat}]{Pt} 4NO + 6H_2O\ \text{(Ostwald process)}$$

40 (a) Complete the following equations:
(i) $Cr_2O_7^{2-} + 2OH^- \rightarrow$
(ii) $MnO_4^- + 4H^+ + 3\ e^- \rightarrow$
(b) Account for the following: 5
(i) Zn is not considered a transition element.
(ii) T ransition metals form a large number of complexes.
(iii) T he E° value for the Mn^{3+}/Mn^{2+} couple is much more positive than that for Cr^{3+}/Cr^{2+} couple.

ANS: (a)

$$(i)\ Cr_2O_7^{2-} + 2OH^- \longrightarrow 2CrO_4^{2-} + H_2O$$

$$(ii)\ MnO_4^- + 4H^+ + 3e^- \longrightarrow MnO_2 + 2H_2O$$

(b) (i) It is because neither Zn nor Zn^{2+} has incompletely filled d-orbital.
(ii) It is due to small size, higher charge and presence of vacant d-orbitals of suitable energy.
(iii) It is because Mn^{2+} is more stable than Mn^{3+} due to half filled ($3d^5$) d-orbitals, whereas Cr^{3+} is more stable than Cr^{2+} due to half filled (t_{2g}^3) orbitals.

41 (i) With reference to structural variability and chemical reactivity, write the differences between lanthanoids and actinoids.
(ii) N ame a member of the lanthanoid series which is well known to exhibit +4 oxidation state. 5
(iii) Complete the following equation:
$MnO_4^- + 8H^+ + 5\ e^- \rightarrow$
(iv) Out of Mn^{3+} and Cr^{3+}, which is more paramagnetic and why? (Atomic nos.: Mn = 25, Cr = 24)

ANS: (i)

Lanthanoids	Actinoids
(i) They show +3 oxidation state mostly along with +2 and +4 by few elements.	(i) They show +3, +4, +5, +6 and +7 oxidation states.
(ii) They are less reactive due to high I.E.	(ii) They are more reactive due to low I.E.

(ii) Ce shows +4 oxidation state.
(iii) $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$
(iv) Mn^{3+} ($3d^4$) has 4 unpaired electrons, therefore, it is more paramagnetic than Cr^{3+} ($3d^3$) which has three unpaired electrons.

42 (a) Complete the following chemical equations: 5

(i) $Cr_2O_7^{2-}(aq) + H_2S(g) + H^+(aq) \longrightarrow$

(ii) $Cu^{2+}(aq) + I^-(aq) \longrightarrow$

(b) How would you account for the following?

(i) The oxidising power of oxoanions are in the order

$VO_2^+ < Cr_2O_7^{2-} < MnO_4^-$.

(ii) The third ionization enthalpy of manganese (Z = 25) is exceptionally high.

(iii) Cr^{2+} is a stronger reducing agent than Fe^{2+}.

ANS:

(a) (i) $Cr_2O_7^{2-}(aq) + 3H_2S(g) + 8H^+(aq) \longrightarrow 2Cr^{3+} + 3S + 7H_2O$

(ii) $2Cu^{2+}(aq) + 2I^-(aq) \longrightarrow 2Cu^+(aq) + I_2(s)$

(b) (i) It is because V in lower oxidation state is less stable than Cr which is less stable than Mn. That is why MnO_4^- is best oxidising agent and VO_2^+ is least.

(ii) Mn (25) has electronic configuration $[Ar]4s^23d^5$, electronic configuration of Mn^{2+} is $[Ar]4s^03d^5$. After losing 2 electrons, it has half filled *d*-orbital, which is more stable that is why Mn^{2+} has exceptionally high third ionization energy, i.e. the energy required to remove third electron is very high.

(iii) It is because in Cr^{3+}, d^3 (half filled t_{2g} orbitals) is more stable in aqueous solution than Fe^{3+} ($3d^5$), i.e. Cr^{3+} is more stable than Fe^{3+}. Cr^{3+} has 3 electrons in lower energy t_{2g}^3 orbitals, whereas Fe^{3+} has t_{2g}^3 (lower energy) and e_g^2 (higher energy).

43 In which of the following pairs, both the ions are coloured in aqueous solutions? 1

(a) Sc^{3+}, Ti **(b) Sc^{3+}, Co^{2+}**

(c) Ni^{2+}, Cu^+ **(d) Ni^{2+}, Ti^{3+}** [Atomic no of Sc = 21, Ti = 22, Ni = 28, Co = 27, Cu = 29]

ANS: (d) Ni^{2+}, Ti^{3+} are coloured due to presence of unpaired electrons.

44 Which of the following is most stable in aqueous solution? 1

(a) Mn^{2+} (b) Cr^{3+} (c) V^{3+} (d) Ti^{3+}

ANS: (b) Cr^{3+} ∵ t_2g^3 (half filled p-orbitals) are more stable.

45 The number of moles of $KMnO_4$ that will be needed to react with one mole of SO_3^{2-} in acidic solution. (a) 1 (b) 3/5 1

(c) 4/5 (d) 2/5

(d) $2\,MnO_4^- + 5SO_3^{2} + 16H^+ \longrightarrow 2Mn^{2+} + 5SO_4^{2-} + 8H_2O$

5 moles of SO_3^{2-} needs 2 moles of $KMnO_4$

ANS: 1 mole of SO_3^{2-} needs 2/5 moles of $KMnO_4$

46 The correct order of decreasing second ionisation enthalpy of Ti(22), V(23), Cr(24) Mn(25) 1

(a) V > Mn > Cr > Ti (b) Mn > Cr > Ti > V

(c) Ti > V > Cr > Mn (d) Cr > Mn > V > Ti

ANS: (d) ∵ Cr^+ ($4s^03d^5$), Mn^+ $4s^13d^5$, V^+($4s^13d^3$), Ti^+ $4s^13d^2$

47 Which of the following pairs has the same ionic size? (a) Zr^{4+}, Hf^{4+} (b) Zn^{2+}, Hf^{4+} (c) Fe^{2+}, Ni^{2+} (d) Zr^{4+}, Ti^{4+} 1

ANS: (a) Zr^{4+}, Hf^{4+} have similar size due t o lanthanoid contraction.

48 Acidified $K_2Cr_2O_7$ solution turns green when SO_2 gas is passed through it due to formation of
(a) $Cr_2(SO_4)_3$ (b) CrO_4^{2-}
(c) $Cr_2(SO_3)_3$ (d) $CrSO_4$ 1

ANS: (a) It is due to formation of chromium sulphate.

49 The stability of Mn^{2+}, Fe^{2+}, Cr^{2+}, Co^{2+} is in order of
(At No. of Mn = 25, Fe = 26, Cr = 24, Co = 27)
(a) $Mn^{2+} > Fe^{2+} > Cr^{2+} > Co^{2+}$
(b) $Fe^{2+} > Mn^{2+} > Co^{2+} > Cr^{2+}$
(c) $Co^{2+} > Mn^{2+} > Fe^{2+} > Cr^{2+}$
(d) $Cr^{2+} > Mn^{2+} > Co^{2+} > Fe^{2+}$ 1

ANS: (a) Mn^{2+} ($3d^5$) is most stable, Fe^{2+} ($3d^6$), Cr^{2+}($3d^4$), Co^{2+}($3d^7$)

50 Which of the following does not give O_2 on heating?
(a) $K_2Cr_2O_7$ (b) $(NH_4)_2 Cr_2O_7$
(c) $KClO_3$ (d) $Zn(ClO_3)_2$ 1

ANS: (b) $(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2 + Cr_2O_3 + 4H_2O$

51 Which of the following lanthanoid ion is diamagnetic?
(At No. of Ce = 58, Sm = 62, Eu = 63 Yb = 70)
(a) Eu^{2+} (b) Yb^{2+}
(c) Ce^{2+} (d) Sm^{2+} 1

ANS: (b) Yb^{2+} ($4f^{14}$) does not have unpaired election, therefore, diamagnetic.

52 The reaction of acidified $KMnO_4$ and H_2O_2 gives
(a) Mn^{4+} and O_2 (b) Mn^{2+} and O_2
(c) Mn^{2+} and O_3 (d) Mn^{4+} and MnO_2 1

ANS: (b) $2MnO_4 + 6H^+ + 5H_2O_2 \rightarrow 2Mn^{2+} + 8H_2O + 5O_2$

53 Magnetic moment of 2.83 BM is given by which of the following ion?
(a) Ti^{3+} (b) Ni^{2+}
(c) Cr^{3+} (d) Mn^{2+} 1

ANS: (b) Ni^{2+} has 2 unpaired electrons. $\mu = \sqrt{n(n+2} = \sqrt{2 \times 4} = \sqrt{8} = 2.83$ BM

54 The colour of $KmnO_4$ is due to
(a) L → M charge transfer transition
(b) σ → σ* transition
(c) M → L charge transfer transition
(d) d → d transition. 1

ANS: (a) It is due to L → M charge transfer transition by absorbing light from visible region and radiates purple colour.

55 $KMnO_4$ is not acidified by HCl instead of H_2SO_4 because
(a) H_2SO_4 is stronger acid than HCl
(b) HCl is oxidised to Cl_2 by $KMnO_4$
(c) H_2SO_4 is dibasic acid
(d) rate is faster in presence of H_2SO_4 1

ANS: (b) $2KMnO_4 + 16\ HCl \rightarrow 2KCl + 2MnCl_2 + 5Cl_2 + 2H_2O$

56 Out of Mn_2O_7, V_2O_3, V_2O_5, CrO, Cr_2O_3, the basic oxides are
(a) Mn_2O_7, V_2O_3 (b) V_2O_3, V_2O_5
(c) V_2O_5, CrO (d) V_2O_3 and CrO
1

ANS: (d) V_2O_3 and CrO are basic oxides due to lower, oxidation states.

57 The oxidation state of Cr in final product formed by reaction of KI and acidified dichromate solution is
(a) +4 (b) +6
(c) +2 (d) +3
1

ANS: (d) Cr^{3+} is formed.

58 $KMnO_4$ gets reduced to
(a) K_2MnO_4 in neutral medium
(b) MnO_2 in acidic medium
(c) Mn^{2+} in alkaline medium
(d) MnO_2 in neutral medium
1

ANS: $(a)\ 2KMnO_4 \xrightarrow{\Delta} K_2MnO_4 + MnO_2 + O_2$

59 The electronic configuration of Cu(II) is $3d^9$ whereas that of Cu(I) is $3d^{10}$. Which of the following is correct? [NCERT Exemplar Problem]
(a) Cu(II) is more stable
(b) Cu(II) is less stable
(c) Cu(I) and Cu(II) are equally stable
(d) Stability of Cu(I) and Cu(II) depends on nature of copper salts
1

ANS: (a) Cu(II) is more stable due to higher hydration energy.

60 Metallic radii of some transition elements are given below. Which of these elements will have highest density? [NCERT Exemplar Problem]

Element	Fe	Co	Ni	Cu
Metallic radii/pm	126	125	125	128

(a) Fe (b) Ni
(c) Co (d) Cu
1

ANS: (d) Cu has highest density due to greater atomic mass.

61 Generally transition elements form coloured salts due to the presence of unpaired electrons. Which of the following compounds will be coloured in solid state?
(a) Ag_2SO_4 (b) CuF_2
(c) ZnF_2 (d) Cu_2Cl_2
1

ANS: (b) CuF_2 is coloured due top resence of unpaired electron in d-orbital

62 On addition of small amount of $KMnO_4$ to concentrated H_2SO_4, a green oily compound is obtained which is highly explosive in nature. Identify the compound from the following. [NCERT Exemplar Problem]
(a) Mn_2O_7 (b) MnO_2
(c) $MnSO_4$ (c) Mn_2O_3
1

ANS: (a) It is due to formation of Mn_2O_7.

63 Which of the following reactions are disproportionation reactions?
(i) $Cu^+ \rightarrow Cu^{2+} + Cu$
1

(ii) $3MnO_4^- + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$
(iii) $2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$
(iv) $2MnO_4^- + 3Mn^{2+} + 2H_2O \rightarrow 5MnO_2 + 4H+$
(a) (i), (ii) (b) (i), (ii), (iii)
(c) (ii), (iii), (iv) (d) (i), (iv)

ANS: (b) (i), (ii), (iii) are disproportionation because same substance is oxidised as well as reduced.

64 When $KMnO_4$ solution is added to oxalic acid solution, the decolourisation is slow in the beginning but becomes instantaneous after some time because
(a) CO_2 is formed as the product.
(b) Reaction is exothermic.
(c) MnO_4^- catalyses the reaction.
(d) Mn^{2+} acts as autocatalyst. 1

ANS: (d) Mn^{2+} acts as autocatalyst.

65 In the form of dichromate, Cr (VI) is a strong oxidising agent in acidic medium but Mo (VI) in MoO_3 and W (VI) in WO_3 are not because _____. [NCERT Exemplar Problem]
(a) Cr (VI) is more stable than Mo(VI) and W(VI).
(b) Mo(VI) and W(VI) are more stable than Cr(VI). 1
(c) Higher oxidation states of heavier members of group-6 of transition series are more stable.
(d) Lower oxidation states of heavier members of group-6 of transition series are more stable.

ANS: (b) and (c) higher oxidation states are more stable.

66 Which of the following actinoids show oxidation states upto +7? [NCERT Exemplar Problem]
(a) Am (b) Pu
(c) U (d) Np 1

ANS: (a) and (d) Pu and Np show oxidation state upto +7.

67 General electronic configuration of actionoids is $(n - 2)f^{1-14}\ (n - 1)d^{0-2}\ ns^2$.Which of the following actinoids have one electron in 6d orbital?
[NCERT Exemplar Problem] 1
(a) U (Atomic no. 92) (b) Np (Atomic no. 93)
(c) Pu (Atomic no. 94) (d) Am (Atomic no. 95)

ANS: (a) and (b) U and Np, U ($5f^36d^17s^2$), Np ($5f^46d^17s^2$)

68 Which of the following lanthanoids show +2 oxidation state besides the characteristic oxidation state +3 of lanthanoids? [NCERT Exemplar Problem]
(a) Ce (b) Eu
(c) Yb (d) Ho 1

ANS: (b) and (c) Eu^{2+} ($4f^7$) and Yb^{2+} ($4f^{14}$) are more stable.

69 Match the catalysts given in Column I with the processes given in Column II.

Column I (Catalyst)	Column II (Process)
(a) Ni in the presence of hydrogen	(i) Zieglar Natta catalyst
(b) Cu_2Cl_2	(ii) Contact process
(c) V_2O_5	(iii) Vegetable oil to ghee
(d) Finely divided iron	(iv) Sandmeyer reaction
(d) $TiCl_4 + Al(CH_3)_3$	(v) Haber's Process
	(vi) Decomposition of $KClO_3$

1

ANS: (a) (iii) (b) (iv) (c) (ii) (d) (v) (e) (i)

70 Match the compounds/elements given in Column I with uses given in Column II.

Column I (Compound/element)	Column II (Use)
(a) Lanthanoid oxide	(i) Production of iron alloy
(b) Lanthanoid	(ii) Television screen
(c) Misch metal	(iii) Petroleum cracking
(d) Magnesium based alloy is constituent of	(iv) Lanthanoid metal + iron
(e) Mixed oxides of lanthanoids are employed	(v) Bullets
	(vi) In X-ray screen

1

ANS: (a) (ii) (b) (i) (c) (iv) (d) (v) (e) (iii)

71 Match the properties given in Column I with the metals given in Column II.

Column I (Property)	Column II (Metal)
(a) An element which can show +8 oxidation state	(i) Mn
(b) 3d block element that can show upto +7 oxidation state	(ii) Cr
(c) 3d block element with highest melting point	(iii) Os
	(iv) Fe

1

ANS: (a) (iii) (b) (i)
(c) (ii) Cr due to maximum number of unpaired electrons.

72 Match the statements given in Column I with the oxidation states given in Column II.

Column I	Column II
(a) Oxidation state of Mn in MnO_2 is	(i) +2
(b) Most stable oxidation state of Mn is	(ii) +3
(c) Most stable oxidation state of Mn in oxides is	(iii) +4
(d) Characteristic oxidation state of lanthanoids is	(iv) +5
	(v) + 7

1

ANS: (a) (iii) (b) (i) (c) (v) (d) (ii)

73 In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.
(a) Both assertion and reason are true, and reason is the correct explanation of the assertion.
(b) Both assertion and reason are true but reason is not the correct explanation of assertion.
(c) Assertion is not true but reason is true.
(d) Both assertion and reason are false.
Assertion: Cu^{2+} iodide is not known.
Reason: Cu^{2+} oxidises I^- to iodine.

1

ANS: (a) Both assertion and reason are true, and reason is the correct explanation of the assertion.
$Cu^{2+}\ 2I^- \rightarrow 2Cu^+ + I_2$

74 $2MnO_4^- + 16H^+ + 5\,\begin{matrix}COO^-\\|\\COO^-\end{matrix} \longrightarrow 2Mn^{2+} + \_\_\_\_ + 8H_2O$ 1

ANS: 10 CO_2

75 $Cr_2O_7^{2-} + 14H^+ + 6I^- \longrightarrow 2Cr^{3+} + \_\_\_\_ + 7H_2O$ 1

ANS: $3I_2$

76 $Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \longrightarrow 2Cr^{3+} + \_\_\_\_ + 7H_2O$ 1

ANS: 6 Fe^{3+}

77 Cu^{2+} is reduced by CN^- to Cu^+ which forms the complex $[Cu(CN)_4]^{3-}$. [True/False] 1

ANS: True.

78 The number of moles of Mohr's salt required per mole of dichromate ion are 6. [True/False] 1

ANS: True

79 The colour of light absorbed by an aqueous solution of $CuSO_4$ is orange red. [True/False] 1

ANS: True

80 The electronic configuration of Gd (64) is
(a) [Xe] $4f^7\ 5d^1 6s^2$ (b) [Xe] $4f^6\ 5d^2 6s^2$ 1
(c) [Xe] $4f^8\ 6s^2$ (d) [Xe] $4f^9 5s^1$

ANS: (a) because half-filled f-orbitals are more stable.

81 Which of the following statements related to lanthanoids is incorrect?
(a) Eu shows +2 oxidation state
(b) $Pr(OH)_3$ to $Lu(OH)_3$, basicity decreases 1
(c) All lanthanoids more reactive than Al
(d) Ce^{4+} is used as oxidising agent

ANS: (c) All are not more reactive than Al.

82 Name the gas that can readily decolourised by acidified $KMnO_4$ solution.
(a) SO_2 (b) NO_2 1
(c) P_2O_5 (d) CO_2

ANS: (a) SO_2 because it is good reducing agent.

83 The reason for greater range of oxidation state of actinoids is due to
(a) actinoid contraction
(b) 5f, 6d, 7s levels have comparable energies 1
(c) 4f and 5d levels are close in energies
(d) the radioactive nature of actinoids

ANS: (b) It is due to comparable energies of 5f, 6d, 7s, electron from these orbitals take part in bond formation.

84 The correct order of ionic radii Y^{3+}, La^{3+}, Eu^{3+} and Lu^{3+} is
(a) $Y^{3+} < La^{3+} < Eu^{3+} < Lu^{3+}$ 1
(b) $Lu^{3+} < Eu^{3+} < La^{3+} < Y^{3+}$

(c) $La^{3+} < Eu^{3+} < Lu^{3+} < Y^{3+}$
(d) $Y^{3+} < Lu^{3+} < Eu^{3+} < La^{3+}$

ANS: (d) $Y^{3+} < Lu^{3+} < Eu^{3+} < La^{3+}$ due to lanthanoid contraction.

85 In the following reactions, ZnO is respectively acting as a/an
(i) $ZnO + Na_2O \longrightarrow Na_2ZnO_2$
(ii) $ZnO + CO_2 \longrightarrow ZnCO3$ 1
(a) acid and acid (b) acid and base
(c) base and acid (d) base and base

ANS: (b) ZnO acts as acidic in (i) and basic in (ii).

86 Interstitial compounds are formed when small atoms are trapped inside the crystal lattice of metals. Which of the following is not the characteristic property of interstitial compounds? [NCERT Exemplar Problem]
(a) They have high melting points in comparison to pure metals. 1
(b) They are very hard.
(c) They retain metallic conductivity.
(d) They are chemically very reactive.

ANS: (d) They are chemically very reactive.

87 $KMnO_4$ acts as an oxidising agent in alkaline medium. When alkaline $KMnO_4$ is treated with KI, iodide ion is oxidised to _____. (a) I_2 (b) IO^- (c) IO_3^- (d) IO_4^- 1

ANS: (c) I^- is oxidised to IO_3^- in basic medium.

88 Which of the following statements is not correct? [NCERT Exemplar Problem]
(a) Copper liberates hydrogen from acids.
(b) In its higher oxidation states, manganese forms stable compounds with oxygen and fluorine. 1
(c) Mn^{3+} and Co^{3+} are oxidising agents in aqueous solution.
(d) Ti^{2+} and Cr^{2+} are reducing agents in aqueous solution.

ANS: (a) It is because copper is less reactive than H_2.

89 When acidified $K_2Cr_2O_7$ solution is added to Sn^{2+} salts then Sn^{2+} changes to [NCERT Exemplar Problem]
(a) Sn (b) Sn^{3+} 1
(c) Sn^{4+} (d) Sn^+

ANS: (c) Sn^{2+} gets oxidised to Sn^{4+} (more stable)

90 Highest oxidation state of manganese in fluoride is +4 (MnF4) but highest oxidation state in oxides is +7 (Mn_2O_7) because _____. [NCERT Exemplar Problem]
(a) fluorine is more electronegative than oxygen. 1
(b) fluorine does not possess d-orbitals.
(c) fluorine stabilises lower oxidation state.
(d) in covalent compounds fluorine can form single bond only while oxygen forms double bond.

ANS: (d) Oxygen can form multiple bonds due to presence of 2 unpaired electrons.

91 Which of the following ions show higher spin only magnetic moment value? [NCERT Exemplar Problem]
(a) Ti^{3+} (b) Mn^{2+} 1
(c) Fe^{2+} (d) Co^{3+}

(*b*) and (*c*).

$Mn^{2+}(3d^5)$, $\mu = \sqrt{n(n+2)} = \sqrt{5 \times 7}$

$= \sqrt{35} = 5.92$ BM

ANS: and Fe^{2+}, $\mu = \sqrt{4 \times 6} = 4.92$ BM.

92 Transition elements form binary compounds with halogens. Which of the following elements will form MF_3 type compounds? [NCERT Exemplar Problem] 1

(a) Cr (b) Co

(c) Cu (d) Ni

ANS: (a) and (b) CrF_3, CoF_3 are easily formed ∵ Cr^{3+} and Co^{3+} are stable.

93 Which of the following will not act as oxidising agents? [NCERT Exemplar Problem] 1

(a) CrO_3 (b) MoO_3

(c) WO_3 (d) CrO_4^{2-}

ANS: (b) MoO_3 and (c) WO_3 because their +6 oxidation states are more stable.

94 Although +3 is the characteristic oxidation state for lanthanoids but cerium also shows +4 oxidation state because _____. [NCERT Exemplar Problem] 1

(a) it has variable ionisation enthalpy

(b) it has a tendency to attain noble gas configuration

(c) it has a tendency to attain f^0 configuration

(d) it resembles Pb^{4+}

ANS: (b) and (c) It has stable electronic configuration.

95 Match the solutions given in Column I and the colours given in Column II. 1

Column I (Aqueous solution of salt)	Column II (Colour)
(a) $FeSO_4.7H_2O$	(i) Green
(b) $NiCl_2.4H_2O$	(ii) Light pink
(c) $MnCl_2.4H_2O$	(iii) Blue
(d) $CoCl_2.6H_2O$	(iv) Pale green
(e) Cu_2Cl_2	(v) Pink
	(vi) Colourless

ANS: (a) (iv) (b) (i) (c) (ii) (d) (v) (e) (vi)

96 Match the property given in Column I with the element given in Column II. 1

Column I (Property)	Column II (Element)
(a) Lanthanoid which shows +4 oxidation state	(i) Pm
(b) Lanthanoid which can show +2 oxidation state	(ii) Ce
(c) Radioactive lanthanoid	(iii) Lu
(d) Lanthanoid which has $4f^7$ electronic configuration in +3 oxidation state	(iv) Eu
(e) Lanthanoid which has $4f^{14}$ electronic configuration in +3 oxidation state	(v) Gd
	(vi) Dy

ANS: (a) (ii) (b) (iv) (c) (i) (d) (v) (e) Lu^{3+}(iii)

97 Match the properties given in Column I with the metals given in Column II.

Column I (Property)	Column II (Metal)
(a) Element with highest second ionisation enthalpy	(i) Co
(b) Element with highest third ionisation enthalpy	(ii) Cr
(c) M in M $(CO)_6$ is	(iii) Cu
(d) Element with highest heat of atomisation	(iv) Zn
	(v) Ni

1

ANS: (a) (iii) (b) (iv) (c) (ii) (d) (i)

98 In the following question a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.
(a) Both assertion and reason are true, and reason is the correct explanation of the assertion.
(b) Both assertion and reason are true but reason is not the correct explanation of assertion.
(c) Assertion is not true but reason is true.
(d) Both assertion and reason are false.
Assertion: Actinoids form relatively less stable complexes as compared to lanthanoids.
Reason: Actinoids can utilise t heir 5f orbitals along with 6d orbitals in bonding but lanthanoids do not use their 4f orbital for bonding. 1

ANS: (c) Assertion is not true but reason is true.

99 Cr^{3+} is _____ stable than Mn^{2+}. 1

ANS: more

100 The general molecular formula of compounds formed by heating lanthanoids with sulphur is _____ . 1

ANS: Ln_2S_3

101 Cr in CrO_4^{2-} is sp^3 hybridised and tetrahedral shape. [True/False] 1

ANS: True

102 MnO_4^- and MnO_4^{2-} have tetrahedral structure. [True/False] 1

ANS: True