QB365 Question Bank Software Study Materials

Transition and Inner Transition Elements Important 2 Marks Questions With Answers (Book Back and Creative)

12th Standard

Chemistry

Total Marks : 40

2 Marks

20 x 2 = 40

1) Explain the oxidation states of 4d series elements.

Answer : The oxidation states of 4d metals vary from +3 for Y to +8 for Ru and Os.

The highest oxidation state of 4d elements are found in their compounds with the higher electronegative elements like O, F & Cl.

Example: In RuO_4, OsO_4 & WCl_6

The oxidation state of Ru and Os is +8.

The oxidation state of W is +6.

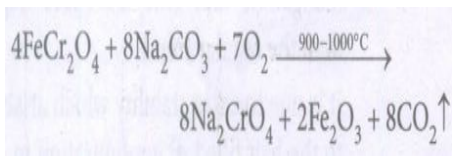
Generally in going down a group, a stability of higher oxidation state increases while that of lower oxidation state decreases.

4d series (5^{th} period) - Yttrium to Cadmium (10 elements)

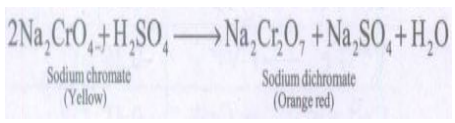
ELEMENTS	OXIDATION STATES
Y	+3
Zr	+3, +4
Nb	+2, +3, +4, +5
Mo	+2, +3, +4, +5, +6
Tc	+2, +4, +5, +7
Ru	+2, +3, +4, +5, +6, +7 +8
Rh	+2, +3, +4, +6
Pd	+2, +3, +4
Ag	+1, +2, +3
Cd	+2

2) Describe the preparation of potassium dichromate.

Answer : Potassium dichromate is prepared from chromate ore ($FeCr_2O_4$). The ore is concentrated by gravity separation. It is then mixed with excess sodium carbonate and lime and roasted in a reverbratory furnace.



The roasted mass is treated with water to separate soluble sodium chromate from insoluble iron oxide. The yellow solution of Sodium Chromate is treated with concentrated Sulphuric acid which converts Sodium Chromate into Sodium dichromate.



The saturated solution of sodium dichromate is mixed with KCl and filtered, the filtrate is cooled to obtain $K_2Cr_2O_7$ crystals.

$$\underset{\text{Sodium dichromatc (orange red)}}{Na_2Cr_2O_7} + 2KCl \rightarrow \underset{\text{Potassium dichromate (orange red)}}{K_2Cr_2O_7} + 2NaCl$$

3) Complete the following.

a. $3MnO_4^{2-} + 4H^+ \rightarrow ?$

b. $C_6H_5CH_3 \xrightarrow[KMnO_4]{acidified} ?$

c. $MnO_4^- + Fe^{2+} \rightarrow ?$

d. $KMnO_4 \xrightarrow[Red\ hot]{\triangle} ?$

e. $Cr_2O_7^{2-} + 6I^- + 14H^+ \rightarrow ?$

f. $Na_2Cr_2O_7 + 2KCl \rightarrow ?$

Answer : a. $3MnO_4^{2-} + 4H^+ \longrightarrow 2MnO_4^- + MnO_2 + 2H_2O$

(Manganate ion) (Permanganate ion) Manganese dioxide

b. $C_6H_5CH_3 \xrightarrow[KMnO_4]{acidified} C_6H_5COOH$

Toluene Benzoic Acid

c. $2MnO_4^- + 10Fe^{2+} + 16H^+ \xrightarrow{8H^+} 2Mn^{2+} + 10Fe^{3+} + 8H_2O$

d. $2KMnO_4 \xrightarrow[Red\ hot]{\triangle} K_2MnO_4 + MnO_2 + O_2$

(Potassium Permanganate) (Potassium Manganate)

e. $Cr_2O_7^{2-} + 6I^- + 14H^+ \xrightarrow{(O)} 2Cr^{3+} + 3I_2 + 7H_2O$

(Iodide ion) Iodine

f. $Na_2Cr_2O_7 + 2KCl \longrightarrow K_2Cr_2O_7 + 2NaCl$

(Sodium dichromate) (Potassium dichromate)

4) Calculate the number of unpaired electrons in Ti^{3+} , Mn^{2+} and calculate the spin only magnetic moment.

Answer : Electronic configuration of Ti = $3d^2 4s^2$

Electronic configuration of Ti^{3+} =$3d^1$

Hence number of unpaired electron = 1

Spin only magnetic moment $(\mu) = \sqrt{n(n+2)}$

= $\sqrt{1(1+2)}$

= $\sqrt{3}$

=1.732 BM

Electronic configuration of $Mn = 3\ d^5 4\ s^2$

Electronic configuration of $Mn^{2+} = 3\ d^5$

Hence number of unpaired electrons = 5

Spin only magnetic moment

$(\mu) = \sqrt{5(5+2)}$

= 5.92 BM

5) Write the electronic configuration of Ce^{4+} and Co^{2+}.

Answer : Electronic configuration of Ce^{4+} = [Xe] $4f^0 5d^0 6s^0$

Electronic configuration of Co^{2+} = [Ar]$3d^7$

6) Explain briefly how +2 states becomes more and more stable in the first half of the first row transition elements with increasing atomic number.

Answer : In 3d series as we move from Ti to Zn, the standard reduction potential $\left(E^0_{M^{2+}/M}\right)$ value is approaching towards less negative value and copper has a positive reduction potential. If the standard electrode potential E^0, of a metal is large and negative, the metal is a powerful reducing agent, because it loses electrons easily. Hence +2 states becomes more and more stable in the first half of the first row transition elements.

7) Why first ionization enthalpy of chromium is lower than that of zinc?

Answer : Chromium (24), the electronic configuration is $3d^5 4s^1$. It ready to lose its outer most electron ($4s^1$) to get exactly half-filled stable electronic configuration. The electronic configuration of Zinc is $3d^{10} 4s^2$.ie., It has completely filled stable configuration. From this configuration, the removal of $1e^-$ from 4s orbital is very difficult & it required more ionisation enthalpy. Due to this reason Zn has higher first lonisation enthalpy ($1.E_1$) than that of chronmium

8) Transition metals show high melting points. Why?

Answer : (i) Transition metals have number of unpaired electron. They are involved in metallic bonding. Hence they show high melting point.

(ii) As we move from left to right along the transition metal series melting point first increases reach a maximum value and then decreases as the d-electrons pairup and become less available for bonding.

9) Compare the stability of Ni^{4+} and Pt^{4+} from their ionisation enthalpy values.

IE	Ni	Pt
I	737	864
II	1753	1791

III	3395	2800
IV	5297	4150

Answer : 1. The value of the ionisation enthalpies can be used in estimating the relative stability of various transition metal compounds or ions.

2. The relative stability of Pt^{4+} & Ni^{4+} can be calculated as follows; Ni^{4+}:$I.E_1+1.E_2+ 1.E_3+ IE_4$ = 737 + 1753 + 3395 + 5297 = 11,182 $kJmol^{-1}$

Pt^{4+}:$I.E_1+I.E_2+ I.E_3+ IE_4$ = 864 + 1791 + 2800 + 4150 = 9,605 $kJmol^{-1}$

3. The calculated ionisation enthalpy / enerey values of Pt^{4+} (9,605 $kJmol^{-1}$) is smaller than Ni^{4+}(11,182 $kJmol^{-1}$).

4. Formation of Pt^{4+} requires lesser energy as compared to the formation of Ni^{4+}.

5. Therefore, Pt^{4+} compounds are more stable than Ni^{4+} compounds.

10) Why iron is more stable in +3 oxidation state than in +2 and the reverse is true for Manganese?

Answer : 1. Fe^{2+} the electronic configuration is $3d^6$.

2. Fe^{3+} the electronic configuration is $3d^5$.

3. So it has exactly half filled stable electronic configuration. Hence Fe^{3+} is more stable than Fe^{2+}.

4. For manganese Mn^{2+}. the electronic configuration is $3d^5$ and that of Mn^{3+} is $3d^4$. Here Mn^{2+} has exactly half-filled stable electronic configuration.

11) Which is the most common oxidation state of lanthanoides?

Answer : +3

12) Silver atom has completely filled d-orbitals ($4d^{10}$) in its ground state. How can you say that it is a transition element?

Answer : (i) Silver in its +1 oxidation state, exhibits $4d^{10}5s^0$configuration.

(ii) But in some compounds, it also shows +2 oxidation state, so the configuration becomes $4d^95s^0$

(iii) Here, d-orbital is not completely filled. Therefore silver is a transition element.

13) Complete the following equations.

(i) 2 CrO_4^{2-} + 2H+ ⟶

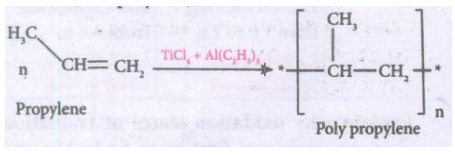
(ii) $KMnO_4$ ⟶

Answer : (i) 2 CrO_4^{2-} + 2H+ ⟶ $Cr_2O_7^{2-}$ + H_2O

(ii) $2KMnO_4 \xrightarrow[513k]{\triangle} K_2Mn_4O_4 + MnO_2 + O_2$

14) What is Zeigler - Natta catalyst?

Answer : A mixture of $TiCl_4$ and trialkyl aluminium is used for polymerization.



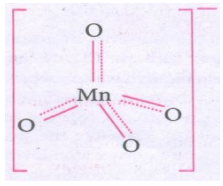
15) What are the conditions for alloy formation?

Answer : (i) According to Hume-Rothery rule to, form a substitute alloy the difference between the atomic radii of solvent and soluteis less than 15%.

(ii) Both the solvent and solute must have the same crystal structure and valence and their electro negativity difference must be close to zero.

16) Draw the structure of permanganate ion.

Answer : Permanganate ion has tetrahedral geometry in which the central Mn^{7+} is Sp^3 hybridised.



17) What are the properties of interstitial compound?

Answer : (i) They are hard and show electrical and thermal conductivity.

(ii) They have high melting points higher than those of pure metals.

(iii) Transition metal hydrides are used as powerful reducing agents

(iv) Metallic carbides are chemically inert.

18) A substance is found to have a magnetic moment of 3.9 BM. How many unpaired electrons does it contain?

Answer : $\mu = \sqrt{n(n+2)}$

$3.9 = \sqrt{n(n+2)}$

n = 3

Number of unpaired electrons = 3.

19) Write the uses of potassium dichromate.

Answer : (i) Potassium dichromate is used as a strong oxidizing agent.

(ii) It is used in dyeing and printing.

(iii) It is used in leather tanneries for chrome plating.

(iv) It is used in quantitative analysis for the estimation of iron compounds and iodides.

20) Why f-block elements are called as inner transition elements?

Answer : f-block elements are called as inner transition elements because they form a transition series with the transition elements.