Solved Question Paper
2016
Class – XII
Subject – Chemistry (Theory)
All India: Set – II

Time allowed: 3 hours **Maximum Marks: 70**

General Instructions:

(i) All questions are compulsory.

(ii) Questions number 1to 5 are very short answer questions and carry 1 mark each.

(iii) Questions number 6 to 10 are very short answer question and carry 2 marks each.

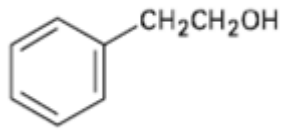
(iv) Questions number 11 to 22 are also short answer question and carry 3 marks each.

(v) Question number 23 is a value based question and carry 4 amrks.

(vi) Questions number 24 to 26 are long answer question and carry 5 marks each.

(vii) Use log tables, if necessary. Use of calculators is not allowed.

Question1. Write the IUPAC name of given compound.

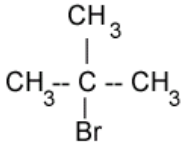


Sol.

2- phenylethanol

Question2. Write the structure of an isomer of compound C_4H_9Br which is most reactive towards S_N1 reaction.

Sol.



Tertiary alkyl halide (2- methyl, 2-bromopropane)

Question3. Write the main reason for the stability for colloidal sols.

Sol.

Electrostatic stabilization and salvation.

Colloidal sols posses a definite type of electrical charge on the colloidal particles and the dispersion medium has an equal but opposite charge. Thus, the charge on colloidal particles is balanced with the equal and opposite charge of dispersion medium which makes the colloidal solution electrically neutral and stable.

Question4. Give an example of each of molecular solid and ionic solid.

Sol.

Molecular solid: sucrose/table sugar; Ionic solid: sodium chloride (NaCl).

Question5. $Pb(NO_3)_2$ on heating gives a brown gas which undergoes dimerization on cooling. Identify the gas.

Sol.

$2\ Pb(NO_3)_2 \rightarrow 2\ PbO + 4\ NO_2\uparrow + O_2\uparrow$

$2\ NO_2 \rightarrow N_2O_4$

So, Gas is NO_2 (nitrogen dioxide).

Question6. For a reaction:

$$H_2 + Cl_2 \xrightarrow{hv} 2HCl$$

Rate = k

(i) Write the order and molecularity of this reaction.

(ii) Write the unit of k.

Sol.

(i) It is a photochemical reaction that proceeds via chain mechanism and lack any rate determining step. Hence, rate of the reaction is constant and not dependent upon concentration of reactants; it is a zero order reaction. Molecularity of a reaction refers to sum total of stoichiometric coefficients of reactants. Since one **molecule of hydrogen**

and one of chlorine are undergoing the chemical change; the molecularity of the reaction is 2.

(ii) Unit of k for zero order reaction is mol $L^{-1}Sec^{-1}$.

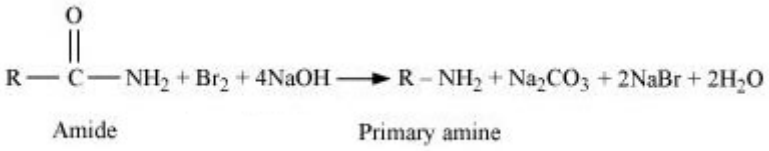
Question7. Write chemical equations involved in following reaction:

(i) Hoffmann-bromamide degradation reaction

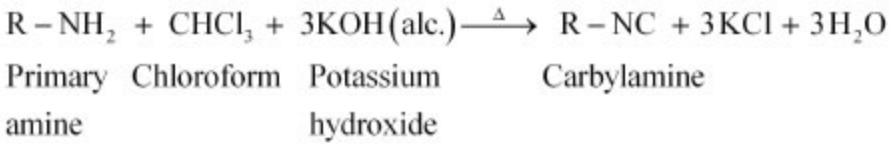
(ii) Carbylamine reaction

Sol.

(i) Hoffmann-bromamide degradation reaction: Reaction of an amide with bromine in an aqueous or ethanolic solution of sodium hydroxide results in formation of a primary amine with one carbon atom less than the original amide. This degradation reaction is known as Hoffmann bromamide reaction.



(ii) Carbylamine reaction: Heating of aliphatic and aromatic primary amines with chloroform and ethanolic potassium hydroxide produces carbylamines (with unpleasant odour).



Question8. (I) Gas (A) is more soluble in water than gas (B) at the same temperature. Which one of these two gases have higher value of K_H (Henry's constant) and why?

(II) In a non ideal solution, what type of deviation shows the formation of maximum boiling azeotropes?

Sol.

(I) According to Henry's law; C = kP

Here C= concentration of gas in solution

K_H =Henry constant

P= Pressure

Hence as value of k increases, C; solubility of gas in solution increases. Therefore K_H will be higher for A

(II) Negative deviation from Raoult's Law.

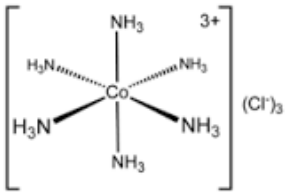
Question9. When a coordination compound $CoCl_3.6NH_3$ is mixed with $AgNO_3$, 3 moles of AgCl are precipitated per mole of compound. Write

(i) Structural formula of the complex

(ii) IUPAC name of the complex

Sol.

(i) Structural formula of the complex - $[Co(NH_3)_6]^{3+} 3Cl^-$



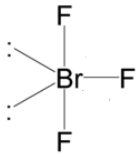
(ii) IUPAC name of the complex- Hexamminecobalt(III) chloride

Question10. Write the structures of following:

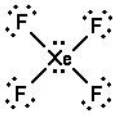
(I) BrF_3 (II) XeF_4

Sol.

(I) BrF_3 is T-shaped molecule with sp^3d hybridization.



(II) XeF_4 has square planer geometry with sp^3d^2 hybridization.



OR

What happens when?

(I) SO_2 gas is passed through an aqueous solution Fe^{3+} salt?

(II) XeF_4 reacts with SbF_5?

Sol.

(I) When SO_2 gas is passed through an aqueous solution Fe^{3+} salt, SO_2 serves as reducing agent and red color of Fe (III) solution is turned into green color Fe (II).

$SO_2 + 2\ Fe^{3+} + 2\ H_2O \rightarrow 2\ Fe^{2+} + SO_4^{2-} + 4\ H^+$

(II) The xenon fluorides react with strong Lewis acids to form complexes.

$XeF_4 + SbF_5 \longrightarrow [XeF_3]^+ [SbF_6]^-$

Question11. Write the final product (s) in each of following reactions:

(a) $CH_3-C(CH_3)(CH_3)-O-CH_3 + HI \longrightarrow$

(b) $CH_3-CH_2-CH(OH)-CH_3 \xrightarrow{Cu/573K}$

(c) $C_6H_5-OH \xrightarrow[(ii)\ H^+]{(i)\ CHCl_3 + aq.NaOH}$

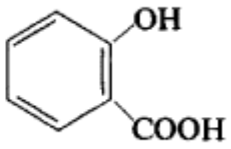
Sol.

(a) $CH_3-C(CH_3)(CH_3)-O-CH_3 + HI \longrightarrow CH_3OH + CH_3-C(CH_3)(CH_3)-I$

Methanol 2- methyl, 2-iodopropane

(b) $CH_3-CH_2-CH(OH)-CH_3 \xrightarrow{Cu/573K} CH_3CH_2COCH_3 + H_2$

Butane-2-one

(c) $C_6H_5-OH \xrightarrow[(ii)\ H^+]{(i)\ CHCl_3 + aq.NaOH}$ 

2-hydroxybenzoic acid

Question12. How would you convert:

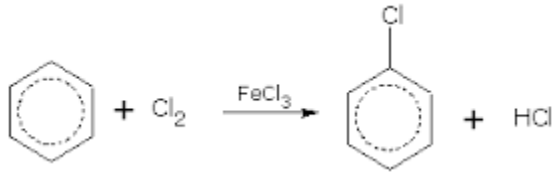
(I) Chlorobenzene to biphenyl

(II) Propene to 1-iodopropane

(III) 2-bromobutane to but-2-ene

Sol.

(I) Wurtz reaction: When benzene reacts with chlorine in presence of $AlCl_3$, it forms chlorobenzene



Reaction of Chlorobenzene with sodium metal in dry ether produces biphenyl.

$$C_6H_5\text{-}Cl + 2Na + Cl\text{-}C_6H_5 \xrightarrow{\text{dryether}} C_6H_5\text{-}C_6H_5 + 2NaCl$$

(II) Hydroboration oxidation of propene gives 1-propanol. Reaction of 1-propanol with hydrogen iodide (HI) gives 1-iodopropane.

$$CH_2=CH-CH_3 + BH_3 \longrightarrow CH_3CH_2CH_2OH + HI$$

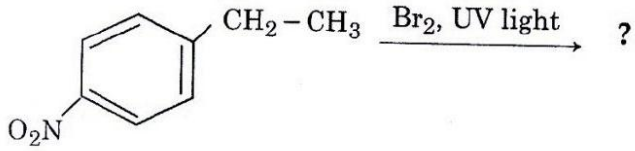
$$CH_3CH_2CH_2OH + HI \longrightarrow CH_3CH_2CH_2I + H_2O$$

(III) Elimination reaction of 2-bromobutane in presence of alcoholic KOH gives mixture of but-1-ene and but-2-ene.

$$CH_3C(Br)HCH_2CH_3 \xrightarrow{\text{alc KOH}} \underset{\text{but}-1-\text{ene}}{CH_2=CHCH_2CH_3} + \underset{\text{but}-2-\text{ene}}{CH_3CH=CHCH_3}$$

OR

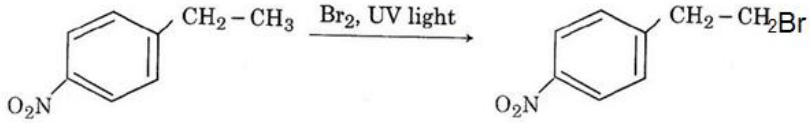
Write the major product (s) in the following:

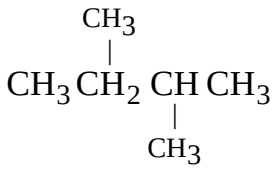
(i) 

(ii) $2CH_3-\underset{\underset{Cl}{|}}{CH}-CH_3 \xrightarrow[\text{dry ether}]{Na}$

(iii) $CH_3-CH_2-Br \xrightarrow{AgCN}$?

Sol.

(i) 

(ii) 

2,3–dimethylbutane

(III) CH_3CH_2NC

Question13. (I) Write the structural difference between starch and cellulose.

(II) What type of linkage is present in nucleic acids?

(III) Give an example of each fibrous protein and globular protein.

Sol.

(I) Starch is branched homopolysaccharide of D-glucose and contains two types of glucose polymer, amylase and amylopectin. The long, unbranched chains of D-**glucose** residues connected by alpha1, 4 linkages are termed as amylase. The branched polymer of glucose wherein alpha 1, 4 glycosidic linkages join successive glucose with branch points having alpha 1, 6 linkages. Cellulose is linear unbranched polymer of glucose residues linked together by beta 1, 4 linkage.

(II) Phosphodiester linkage in which the 5'-phosphate group of one nucleotide unit is joined to the 3'-hydroxyl group of the next nucleotide (a covalent bond).

(III) Fibrous protein: silk; globular protein: egg albumin.

Question14. (i) Name the method of refining of nickel.

(ii) What is the role of cryolite in the extraction of aluminium?

(iii) What is the role of limestone in extraction of iron from its oxides?

Sol.

(i) Mond's process

$$Ni + 4CO \longrightarrow Ni(CO)_4 \xrightarrow{\Delta} Ni + 4CO$$

(ii) Hall's process: for increasing the conductivity of metal solution cryolite is used

(iii) $CaCO_3$ (limestone) flux is used to remove the acidic impurities.

Question15. (i) SO_2 is reducing while TeO_2 is an oxidizing agent.

(ii) Nitrogen does not form pentahalide.

(iii) ICl is more reactive than I_2.

Sol.

(i) Because of inert pair effect.

(ii) Because of lack of d orbital, N cannot form 5 covalent bonds.

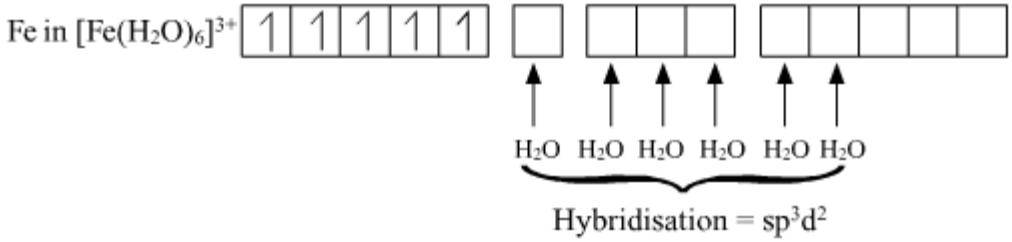
(iii) ICl is interhallogen compound in which I atom is partially electropositive and chlorine is electronegative. In other words, we can say that ICl consists of ionic characters whereas I_2 is pure covalent compound.

Question16. (a) For the complex $[Fe(H_2O)_6]^{3+}$, write the hybridization, magnetic character and spin of complex. (At. Number : Fe= 26)

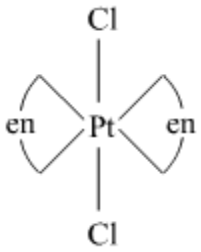
(b) Draw one of the geometrical isomers of the complex $[Pt(en)_2Cl_2]^{2+}$, which is optically inactive.

Sol.

(i) $[Fe(H_2O)_6]^{3+}$ = sp^3d^2 hybridisation, paramagnetic nature, high spin complex



(ii) $[Pt(en)2Cl2]^{2+}$: the cis isomer is optically active and trans isomer is optically inactive.



Trans isomer

Question17. An element crystallizes in a *b.c.c.* lattice with cell edge of 500pm. The density of the element is 7.5g cm^{-3}. How many atoms are present in 300 g of the element?

Sol.

According to the question:

a = 500 pm or 500 x 10^{-10} cm

m= 300g and z=2

We know that $m=M/N_A$; here, M= molar mass

Since, d (density) = $zM/a^3 N_A$

Putting the given values on above equation to calculate M

$M= 7.5 \times (500)^3 \times 10^{-30} \times 6.02 \times 10^{23} / 2= 282.1$ g/mol

As we know that Molar mass (M) = mass of compound× (N_A / Number of atoms)

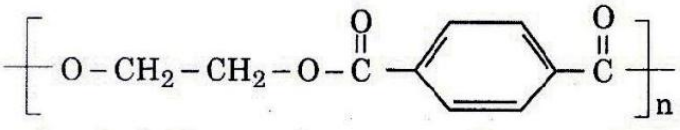
Putting all the values to calculate number of atoms

$282.1 = 300 \times 6.02 \times 10^{23}$ / Number of atoms

Or Number of atoms = $300 \times 6.02 \times 10^{23} / 282.1 = 6.4 \times 10^{23}$

Question18. **(i) What is the role of Sulphur in the vulcanization of rubber?**

(ii) Identify the monomer in the following polymer:



(iii) Arrange the following polymers in the increasing order of their intermolecular forces: Terylene, Polythene, Neoprene

Sol.

(i) Rubber is made up of hydrocarbon chains, basically carbon and hydrogen. Sulphur is used bind the side chains through disulphide (or similar) bonds.

(ii) Polyethylene terephthalate (terephthalic acid (benzene 1,4 carboxylic acid) and ethylene glycol (ethane 1,.2 –diol)

(iii) Neoprene < polythene < Terylene

Question19. **For the first order thermal decomposition reaction, the following data were obtained:**

$C_2H_5Cl_{(g)} \rightarrow C_2H_{4(g)} + HCl_{(g)}$

Time/second	**Total pressure/atm**
0	**0.30**
300	**0.50**

Calculate the log constant.

(Given log 2= 0.301, log 3=0.4771, log 4=0.6021)

Sol.

K= (2.303/t) × log [a/a-x]

Here:

- K = Rate constant for first order reaction
- t= time
- a= Initial pressure
- (a–x)= pressure after time t

K = (2.303 /300) log [0.30 / 0.30 -0.20]

K = (2.303 × 0.4771) / 300 or K= 0.00366 sec^{-1}

Question20. Give reasons for the following:

(i) Aniline does not undergo Friedel-Crafts reaction.

(ii) $(CH_3)_2NH$ is more basic than $(CH_3)_3N$ in an aqueous solution.

(iii) Primary amines have higher boiling point than tertiary amines.

Sol.

(i) Due to basic nature of aniline, it forms anelinium ion in acidic medium of Friedal-craft reaction. Therefore, the benzene ring of aniline can't undergo electrophilic substation reaction.

(ii) $(NH_3)_3N$ cannot release its lone pair due to steric hindrance of 3 methyl groups around nitrogen atom.

(iii) Primary amines form intermolecular hydrogen bond which requires more energy to boil the solution. Tertiary amines do not have any hydrogen atoms for formation of hydrogen bonds.

Question21. Define the following terms:

(i) Lycophilic colloid

(ii) Zeta potential

(iii) Associated colloids

Sol.

(i) Lyophilic colloids: They are liquid loving colloids therefore w**hen they are mixed with the suitable liquid; there will be very strong force of attraction exists between colloidal particles and liquid.**

(ii) Zeta potential: It is measurement of the magnitude of the electrostatic between charged particles such as in colloidal solutions. Therefore it is one of the fundamental parameters known to affect stability.

(iii) Associated colloids: They are also called as micelle. They are strong electrolytes at low concentration and show colloidal properties at high concentration. That is because of aggregation of particles. These aggregated particles are called as associated colloids or micelles such as Sodium stearate ($C_{17}H_{35}COONa$).

Question22. Calculate the boiling point of solution when 4 g of $MgSO_4$ (M=120 g mol^{-1}) was dissolved in 100 g of water, assuming $MgSO_4$undergoes complete ionization.
(K_b for water = 0.52 K kg mol^{-1})

Sol.

According to the question:

K_b =0.52 K kg/mol, Molar mass of solute $MgSO_4$ = 120.366 g/mol, Mass of $MgSO_4$ = 4g, mass of water (solvent)= 100g

Hence, Moles of $MgSO_4$ = 4 / 120.4 = 0.033 moles

And Molarity of $MgSO_4$= 0.033 × 1000/100 = 0.33 mol/L

Since $MgSO_4$ undergoes complete ionization, one mole of $MgSO_4$ obtains 2 mols of constituent ions; hence i=2

$\Delta T = iK_b m$

2 × 0.52 × 0.33 = 0.343 K

Hence boiling point would be = 0.343 K

Question23. Due to hectic and busy schedule, Mr Singh stared taking junk food in the lunch break and slowly became habitual of eating food irregularly to excel in his field. One day during meeting he felt severe chest pain and fell down. Mr Khanna, a close friend of Mr Singh, took him to doctor immediately. The doctor diagnosed that Mr Singh was suffering from acidity and prescribed some medicines. Mr Khanna advised him to eat homemade food and change his lifestyle by doing yoga, meditation and some physical exercise. Mr Singh followed his friend's advice and after few days he started feeling better.

After reading the above passage, answer the following:

(i) What are the values (at least two) displayed by Mr Khanna?

(ii) What are antacids? Give one example.

(iii) Would it be advisable to take antacids for a long period of time? Give reason.

Sol.

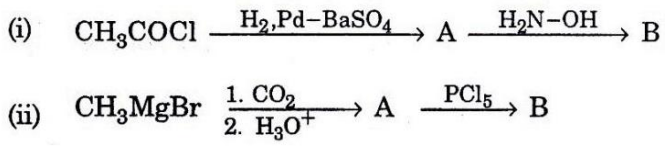
(i) Concern for his friend and knowledge

(ii) Antacids are type of medicines which mainly consist of some mild basic compounds. These alkaline compounds neutralize the effect of stomach acid and reduce the

symptoms of heartburn, relieve pain. For example aluminium hydroxide, magnesium carbonate, magnesium trisilicate.

(iii) No, we should not take antacids in excess as it may cause reduction in stomach pH resulting in digestion related problems.

Question24. Write structures of A and B in following reactions:



(b) Distinguish between:

(i) C_6H_5-$COCH_3$ and C_6H_5-CHO

(ii) CH_3COOH and HCOOH

(c) Arrange the following in increasing order of their boiling points:

CH_3CHO, CH_3COOH, CH_3CH_2OH

Sol.

(a)(i) A = CH_3CHO; B = CH_3CH=N-OH; (ii) A = CH_3COOH B= CH_3COCl

(b) (i)Acetophenone being a methyl ketone responds to Iodoform test and gives yellow precipitate of iodoform with sodium hypoiodite (NaOI) whereas banzaldehyde does not perform this test.

(ii) The Formic acid instantly decolorizes pink color of $KMnO_4$, while acetic acid does not.

(c) $CH_3CHO < CH_3CH_2OH < CH_3COOH$

OR

(a) Write the chemical reaction involved in Wolff-Kishner reduction.

(b) Arrange the following in the increasing order of their reactivity towards nucleophilic addition reaction:

C_6H_5-$COCH_3$, CH_3 –CHO, CH_3COCH_3

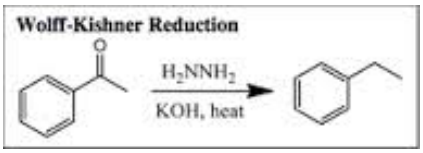
(c) Why carboxylic acid does not give reactions of carbonyl group?

(d) Write the product in following reaction

(e) A and B are two functional isomers of compound C_3H_6O. On heating with NaOH and I_2, isomer B forms yellow precipitate of iodoform whereas isomer A does not form any precipitate. Write the formulae for A and B.

Sol.

(a) $RCOR + NH_2NH_2 \rightarrow RCH_2R$ (reaction occurs in the presence of base)



(b) $C_6H_5\text{-}COCH_3 < CH_3COCH_3 < CH_3CHO$

(c) In carboxylic acids, the carbonyl group involves in resonance with –OH group therefore the lone pair of >C=O group are not free to give nucleophilic addition reactions of carbonyl compounds.

(d) $CH_3CH_2CH=CHCH_2CHO$

(e) A= CH_3CH_2CHO and B= CH_3COCH_3

Question25. (a) Calculate E^o_{cell} for the following reaction at 298 K:

$$2Al(s) + 3Cu^{2+}(0.01M) \rightarrow 2Al^{3+}(0.01M) + 3Cu(s)$$

Given: E^o_{cell} = 1.98 V

(b) Using the E^o values of A and B, predict which is better for coating the surface of iron [E^o (Fe^{2+}/Fe)=-0.44V] to prevent corrosion and why?

Sol.

(a) $E_{cell} = E°_{cell} - 2.303\ RT \log Q / nF$

$E°_{cell} = E_{cell} + 2.303\ RT \log Q / nF$

$E°_{cell} = 1.98 + (0.0591 / 6) = 1.99\ V$

Here:

- $E°_{cell}$ = Standard electrode potential
- E_{cell} = Electrode potential
- R = Gas constant
- T = temperature = 298 K
- n= Number of electron change
- F = Faraday constant
- Q = Reaction coefficient which is one here due to same concentrations of ions.

(b) For electroplating, we need cathode couple which gives +ve $E°_{cell}$

Since $E°_{cell} = E°_{cathode} - E°_{anode}$

$E°_{cell} = E° (A^{2+} / A) = (-2.37 + 0.44) = -1.93$ V

Or $E°_{cell} = E° (B^{2+} / B) = (-0.14 + 0.44) = 0.3$ v

Since $E°_{cell}$ of Fe^{2+} is +ve, hence it is a good choice for coating the surface of iron.

OR

(a) The conductivity of 0.001 mol L^{-1} solution of CH_3COOH is 3.095×10^{-5} S cm^{-1}. Calculate its molar conductivity and degree of dissociation (α).

(b) Define electrochemical cell. What happens if external potential applied becomes greater than $E°_{cell}$ of electrochemical cell?

Sol.

(a) Molar conductance = Measured conductivity × 1000/ Electrolyte concentration= 39.05 s cm^2 mol^{-1}

Degree of dissociation = molar conductance / molar conductance at infinite dilution = 39.05 / 39.05 = 0.1

(b) A device which can generate electrical energy from chemical reactions is called as electrochemical cell. If the external potential is higher compare to $E_{cell,}$ the flow of current is reversed and recharging of cell takes place.

Question26. (A) Account for the following:

(I) Mn shows the highest oxidation state of +7 with oxygen but with fluorine it shows the highest oxidation state of +4.

(II) Cr^{2+} is a strong reducing agent.

(III) Cu^{2+} salts are coloured while Zn^{2+} salts are white.

(B) Complete the following reactions:

(i) $2MnO_2 + 4KOH + O_2 \xrightarrow{\Delta}$

(ii) $Cr_2O_7^{2-} + 14H^+ + 6I^- \rightarrow$

Sol.

(A)

(I) Fluorine can form only single bond in a covalent compound while oxygen forms double bond causing Mn to exhibit higher oxidation states as compared to fluorides.

(II) Cr2+ is a stronger reducing agent because while acting as reducing agent it loses one of its electrons and become oxidized to Cr^{3+} which is more stable because its t2g level of d-orbital is half filled and eg level is empty.

(III) Zn has electronic configuration as $3d^{10}4s^2$ and that of Zn^{2+} is $3d^{10}$. The full filled d orbital of Zn^{2+} does not allow d-d transition which makes salts colourless. The electronic configuration of Cu is $3d^5 4s^1$ and that of Cu^{2+} is $3d^4$; the unaired electron allow d-d transition of electrons that emit light in visible region of spectrum and make the salts colored.

(B)

(I) $2MnO_2 + 4KOH + O_2 \longrightarrow 2K_2MnO_4 + 2H_2O$

(II) $Cr_2O_7^{2-} + 6I^- + 14H^+ \rightleftharpoons 2Cr^{3+} + 3I_2 + 7H_2O$

OR

The elements of 3d transition series are given as

Sc Ti V Cr Mn Fe Co Ni Cu Zn

Answer the following:

(I) Write the element which shows maximum number of oxidation states. Give reason.

(II) Which element has the highest melting point?

(III) Which element shows only +3 oxidation state?

(IV) Which element is a strong oxidizing agent in +3 oxidation state and why?

Sol.

(I) Mn shows +2 to +7 oxidation states due to presence of maximum number of unpaired electrons. The valence shell electronic configuration of $3d^5 4s^2$ allows it to lose all seven valence electrons.

(II) Due to presence of maximum unpaired electrons Cr forms strong metallic bonds and has the highest m.p.

(III) Scandium Sc, (Z=21, $1s^2 2s^2 2p^6 3s^2 3p^6 3d^1 4s^2$) exhibits only +3 oxidation state as its valence shell electronic configuration is $3d^1 4s^2$

(IV) Mn^{+3} is strongest oxidizing agent based on their value of electrode potential and the $3d^5$ valence shell configuration of +3 oxidation state is highly stable.