

MARKING SCHEME

PRACTICE PAPER - 06

1. (i) (d) Some metallic oxides exhibit a dual behaviour. They show characteristics of both acidic as well as basic oxides. Such oxides are known as amphoteric oxides. Al_2O_3 is such an example. There are some oxides which are neither acidic nor basic. (1)

(ii) (d) Ozone (O_3) is an allotrope form of oxygen. It is two reactive to remain for long in the atmosphere at sea level. It is formed from atmospheric oxygen in the presence of sunlight at a height of about 20 km. (1)

(iii) (d) Pure ozone has pale blue, dark blue and violet black. These phases are gas, liquid and solid. (1)

Or

(b) Starch paper moistened with solution of KI turns blue in ozone because iodine is liberated. (1)

(iv) (c) Angular shape of ozone molecule consists of one sigma and two π -bonds. (1)

2. (i) (b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

Greater the molecular mass, stronger the van der Waals' forces of attraction and hence higher is the melting point/boiling point. (1)

(ii) (c) Assertion is correct but Reason is incorrect.

Due to symmetrical nature and more close packing, *p*-dichlorobenzene has high melting point. (1)

(iii) (c) Assertion is correct but Reason is incorrect.

Alkyl iodides in general turn brown due to liberation of I_2 on their decomposition by the action of air and light. (1)

Or (c) Assertion is correct but Reason is not correct.

Even though haloalkanes are polar molecules, still they are insoluble in water. This is due to the fact that haloalkanes can neither form hydrogen bonds with water nor they can break the hydrogen bonds already existing between water molecules. (1)

(iv) (a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion. For a given halogen the boiling point rises with increasing atomic mass of the halogen, so that fluoride has the lowest boiling point and iodide has the highest boiling point. (1)

3. (b) Oxygen and sulphur exist as diatomic and polyatomic molecule respectively. Oxygen generally exist as O_2 whereas sulphur. (1)

Or

(b) All the hydrides except one possess reducing property and this character increases from H_2S to H_2Te . The hydride is H_2O . (1)

4. (c) Fructose is a monosaccharide. It is a simple carbohydrate which are composed of single unit of saccharide and cannot be hydrolysed further to give simpler unit of polyhydroxy aldehyde or ketone. (1)

5. (a) Isotonic solutions have same molar concentration of solute particles in solution. Molar concentration of solute particles in solution are 0.1 M in glucose, 2×0.05 M in NaCl, 3×0.05 in BaCl_2 and 4×0.1 in AlCl_3 . Therefore, 0.1 M glucose (A) and 0.05 M NaCl (B) solutions are isotonic. (1)

6. (c) Among the C—X bond (where, X = Cl, Br and I), the correct decreasing order of bond energy is



Or

(c) Bond length is maximum in HI because size of I is more than F^- , Cl^- , Br^- . As size of atom increases, bond length also increases. (1)

7. (b) Smaller the value of $\text{p}K_b$, stronger is the base. Since the value of $\text{p}K_b$ for N, N-dimethylaniline is the highest among the given compounds, it is the weakest base. (1)

8. (b) Since, 3-pentanone does not contain $\left(\text{CH}_3 - \overset{\text{O}}{\parallel}{\text{C}} - \right)$ group, it does not give iodoform test. (1)

9. (b) The number of ligands attached to the central metal ion is called the coordination number. So, coordination number of Fe in $[\text{Fe}(\text{CN})_6]^{4-}$ and $[\text{Fe}(\text{CN})_6]^{3-}$ are 6 and 6 respectively. (1)

Or

(b) The IUPAC name of the given compound is tetraammine diaquacobalt (III) chloride. (1)

10. (b) Rate = $k[A]^1[B]^1$

$$k = \frac{\text{Rate}}{[\text{A}][\text{B}]} = \frac{\text{mol L}^{-1} \text{s}^{-1}}{[\text{mol L}^{-1}]^2} \Rightarrow \text{mol}^{-1} \text{L s}^{-1}$$
 (1)

11. (b) Rate = $k[A]^x[B]^y$

$$\text{Order} = x + y$$

$$\therefore \text{Order is } \left(\frac{3}{2}\right) + (-1) = 1/2, \text{ i.e. half-order.}$$
 (1)

Or

(a) The units of rate constant of n th order is $\text{mol}^{1-n} \text{L}^{n-1} \text{s}^{-1}$. (1)

12. (a) We know that, $\Delta G = \Delta H - T\Delta S$

Since, adsorption is exothermic, so $\Delta H = -ve$.

Further, it occurs with decrease in randomness, so

$$\Delta S = -ve$$

$$\Delta G = -ve - T(-ve) = -ve + T$$

So, at low temperature $\Delta G = -ve$.

Thus, Both Assertion and Reason are correct and Reason is the correct explanation of Assertion. (1)

13. (c) Phenol is less acidic than p -nitrophenol because $-\text{NO}_2$ is strongly electron withdrawing p -nitrophenolate ion is more stable than phenolate ion. Hence, Assertion is correct but Reason is incorrect. (1)

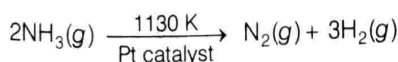
14. (a) Order of the following reaction,

$2\text{NO}(g) + 2\text{H}_2(g) \longrightarrow 2\text{H}_2\text{O}(g) + \text{N}_2(g)$ is 3. As we know that, order of the reaction with respect to given reactant is the power of the reactants concentration in the rate equation.

Thus, both Assertion and Reason are correct and Reason is the correct explanation of Assertion. (1)

Or

(a) It is a zero order reaction at high pressure.



$$\text{Rate} = k[\text{NH}_3]^0 = k$$

In this reaction, Pt acts as a catalyst the metal surface gets saturated with gas molecules at high pressure.

Thus, a further change in reaction conditions does not alter the amount of ammonia on the surface of the catalyst making rate of the reaction independent of its concentration. (1)

15. (b) Ethane-1, 2-diamine is a neutral molecule as it carries no charge. Oxidation number of Co in the complex ion is +3.

Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion. (1)

16. (a) Ethanol molecules shows hydrogen bonding. On adding acetone, its molecules get in between the host molecule and break some of hydrogen bonds between them. Due to weakening of interaction, the mixture of ethanol and acetone shows the positive deviation from Raoult's law.

Thus, Both Assertion and Reason are correct and Reason is the correct explanation of Assertion. (1)

17. Addition of non-volatile solute (NaCl) to water decreases the vapour pressure and ultimately increases the boiling point of water. Addition of methyl alcohol into water increases the vapour pressure of solution.

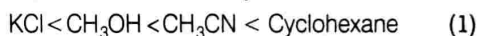
Therefore, the boiling point of water decreases. (2)

18. (i) **Cyclohexane** As cyclohexane and n -octane both are non-polar. Hence, they will mix completely in all proportions.

KCl is an ionic compound, while n -octane is non-polar. Hence, KCl will not dissolve in n -octane.

CH₃OH and **CH₃CN** Both are polar but CH₃CN is less polar than CH₃OH. As the solvent (n -octane) is non-polar, CH₃CN will dissolve more than CH₃OH in n -octane.

Therefore, the order of solubility will be :



(ii) **Saturated solution** A solution in which no more solute can be dissolved at the same temperature and pressure is known as saturated solution. (1)

Or The osmotic pressure method has the advantage over other methods because

- pressure measurement is around the room temperature and the molarity of the solution is used instead of molality. (1)
- its magnitude is large as compared to other colligative properties even for very dilute solutions. (1)

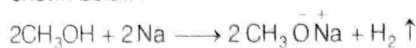
19. Amino acids which are synthesised by the body are called non-essential amino acid, e.g. glycine, alanine. The amino acids which cannot be synthesised in the body and must be obtained from diet are known as essential amino acids. e.g. lysine, valine etc. (2)

Or

Although, glucose in its open chain structure contains a free aldehydic group yet it does not give 2, 4-DNP test, a characteristic reaction of aldehydes, i.e.

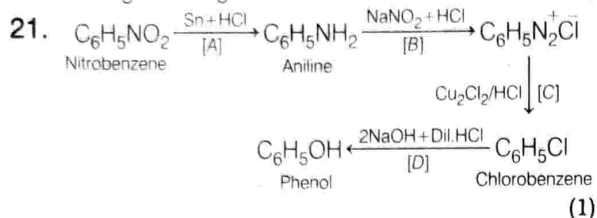
—CHO groups. This is because glucose actually exists in the cyclic hemiacetal form with only a small amount of the open chain form in equilibrium. Since, the concentration of the open chain form is very low and its reactions with 2, 4-DNP are reversible, thus its 2, 4-DNP adduct is generally not observed. (2)

20. (i) It can be distinguished by the reaction with Na as shown below :

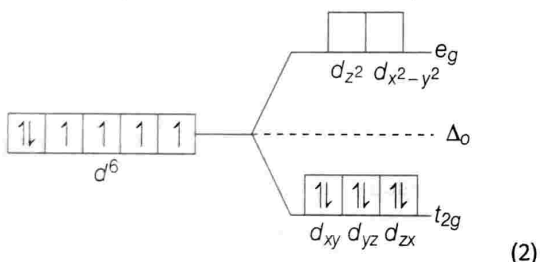


Methanol reacts with sodium to liberate hydrogen gas and dimethyl ether does not react with sodium. (1)

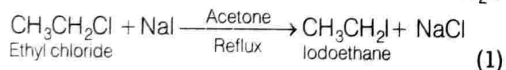
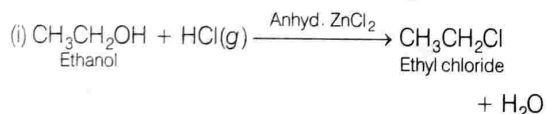
- (ii) Dimethyl ether being aprotic is unreactive towards Grignard reagent. (1)



22. With strong field ligands Δ_o > P, so pairing occur. Thus, the electronic configuration will be t_{2g}⁶ e_g⁰. It has no unpaired electrons and is diamagnetic.



23. Iodoethane is prepared from ethanol as given below :



- (ii) The correct order is :
 Methyl halide < 1° halide < 2° halide < 3° halide (1)

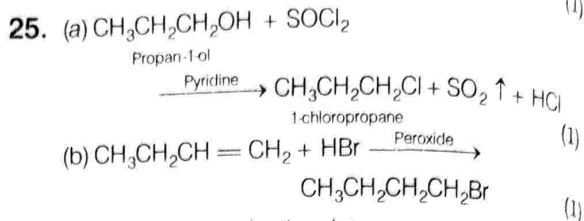
24. (i)
$$\text{N}_2(g) + 3\text{H}_2(g) \longrightarrow 2\text{NH}_3(g)$$

$$\begin{aligned} \text{Rate of reaction} &= -\frac{\Delta[\text{N}_2]}{\Delta t} = -\frac{1}{3} \frac{\Delta[\text{H}_2]}{\Delta t} \\ &= +\frac{1}{2} \frac{\Delta[\text{NH}_3]}{\Delta t} \end{aligned}$$

$$\begin{aligned} \therefore -\frac{1}{3} \frac{\Delta[\text{H}_2]}{\Delta t} &= +\frac{1}{2} \frac{\Delta[\text{NH}_3]}{\Delta t} \\ -\frac{\Delta[\text{H}_2]}{\Delta t} &= \frac{3}{2} \times 4 \times 10^{-8} \\ &= 6 \times 10^{-8} \text{ mol L}^{-1} \text{ s}^{-1} \end{aligned}$$

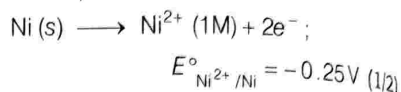
- (ii) (a) The given plot shows the first order reaction. (1)

(b) Unit of $k = (\text{mol L}^{-1})^{1-n} \text{ s}^{-1}$
 $= (\text{mol L}^{-1})^{1-1} \text{ s}^{-1} = \text{s}^{-1}$ (1)

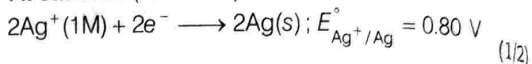


26. Half-cell reactions for the given case are as follows :

At anode (oxidation)



At cathode (reduction)



Thus, the overall reaction is



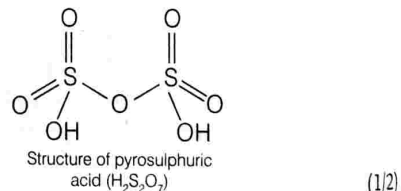
$$\begin{aligned} E^\circ_{\text{cell}} &= E^\circ_{\text{cathode}} - E^\circ_{\text{anode}} \\ &= E^\circ_{\text{Ag}^+/\text{Ag}} - E^\circ_{\text{Ni}^{2+}/\text{Ni}} \end{aligned}$$

$$\therefore E^\circ_{\text{cell}} = 0.80 - (-0.25) = 1.05\text{V}$$

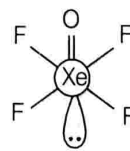
$$E_{\text{cell}} = E^\circ_{\text{cell}} - \frac{0.059}{n} \log \frac{[\text{Ni}^{2+}]}{[\text{Ag}^+]^2} \quad [\because n=2]$$

$$\begin{aligned} E_{\text{cell}} &= 1.05 - \frac{0.059}{2} \log(1) \\ &= 1.05 - \frac{0.059}{2} \times 0 = 1.05\text{V} \end{aligned} \quad (2)$$

27. (i) (a)



- (b)



Square pyramidal : XeOF₄ (1/2)

- (ii) (a)
$$\text{SO}_3 + \text{H}_2\text{SO}_4 \longrightarrow \text{H}_2\text{S}_2\text{O}_7$$
 (1)



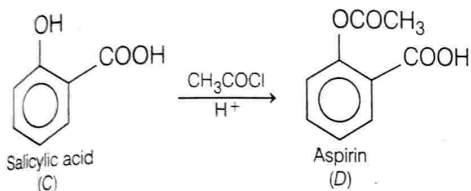
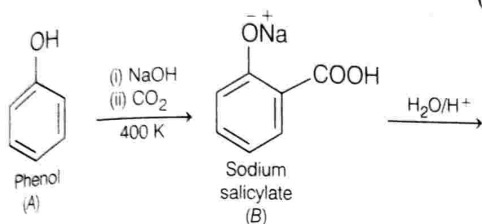
Or

(i) NeF_2 does not exist due to very high ionisation enthalpy (2080 kJ mol^{-1}) of neon. Ionisation enthalpy of xenon is low (1170 kJ mol^{-1}). So, its compounds XeOF_4 , XeF_2 and XeF_6 exist.

(ii) F does not have d -orbitals and it cannot show higher oxidation state. Hence, it does not play the role of a central atom in interhalogen compounds.

(iii) Noble gases being monoatomic have no interatomic forces except weak dispersion forces and, therefore they are liquefied at very low temperature. Hence, they have low boiling points.

28.



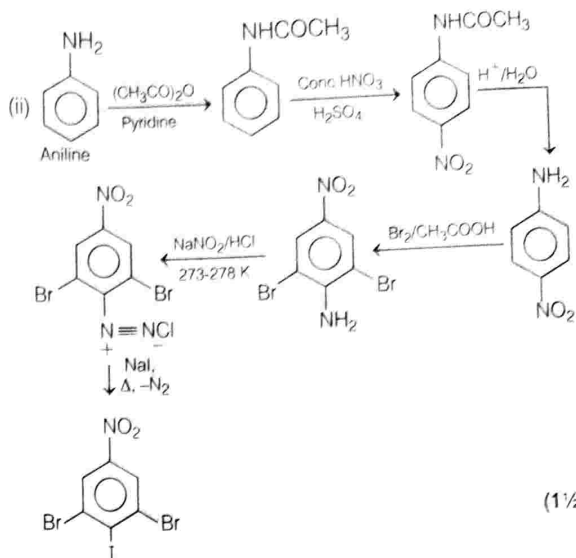
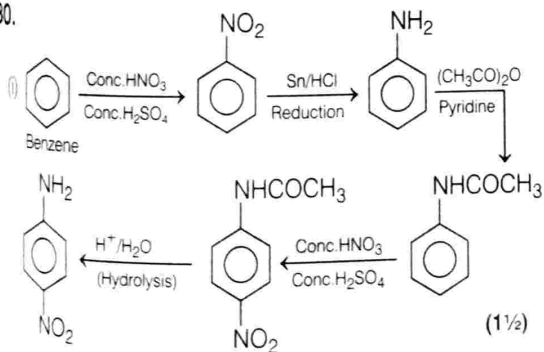
29. (i) Cubic closed packing is same as fcc.

For fcc, $a = 2\sqrt{2} \times r$
 $= 353.5 \approx 354 \text{ pm}$

(ii) Volume of unit cell, $a^3 = (353.5 \times 10^{-10} \text{ cm})^3$
 $= 4.42 \times 10^{-23} \text{ cm}^3$

Number of unit cells = $\frac{1 \text{ cm}^3}{4.42 \times 10^{-23} \text{ cm}^3}$
 $= 2.26 \times 10^{22} \text{ unit cell.}$

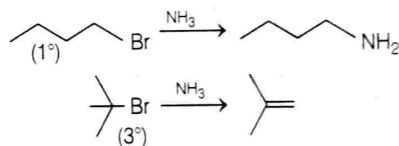
30.



Or

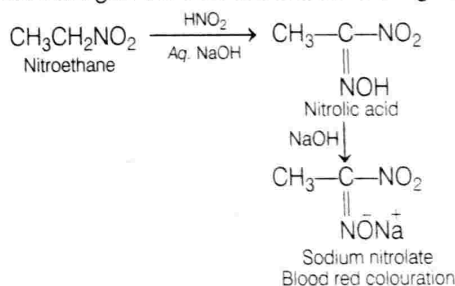
(i) (a) Gabriel phthalimide method is not useful for the preparation of aromatic primary amines because aryl halides do not undergo nucleophilic substitution with the anion formed by phthalimide. (1)

(b) Ammonolysis (action of NH_3) gives the highest yield with 1° halides where substitution predominates because 1° halides behave as nucleophile while in case of 3° halide elimination predominates where 3° halide acts as base. Therefore, *tert*-butylamine cannot be prepared by the action of NH_3 on *tert*-butyl bromide.



(ii) Ethyl nitrile ($\text{C}_2\text{H}_5\text{CN}$) and nitroethane ($\text{C}_2\text{H}_5\text{NO}_2$).

Nitroethane gives a blood red colouration when treated first with nitrous acid and then with aqueous NaOH solution. Ethyl nitrile, however, does not give this test. The reactions are given below:



31. (i) Mass of protein, $w = 100 \text{ mg} = 0.1 \text{ g}$
 Volume of solution, $V = 10 \text{ mL} = 0.01 \text{ L}$
 Osmotic pressure, $\pi = 13.3 \text{ mm Hg} = \frac{13.3}{760} \text{ atm}$
 $= 0.0175 \text{ atm}$
 $R = 0.0821 \text{ L atm mol}^{-1} \text{ K}^{-1}$
 $T = 25^\circ \text{C} = (25 + 273) \text{ K} = 298 \text{ K}$
 Using the formula,
 Molar mass of protein, $M = \frac{wRT}{\pi V}$
 $= \frac{0.1 \text{ g} \times 0.0821 \text{ L atm mol}^{-1} \text{ K}^{-1} \times 298 \text{ K}}{0.0175 \text{ atm} \times 0.01 \text{ L}}$
 $= 13980.5 \text{ g mol}^{-1}$ (3)

(ii) Molarity (M) = $\frac{\text{Mass of solute} \times 1000}{\text{Molecular mass} \times \text{volume}}$
 $V = \frac{M}{D} = \frac{100}{1.84}$
 $M = \frac{98 \times 1000 \times 1.84}{98 \times 100} = 18.4 \text{ M}$ (2)
 Or

- (i) (a) The osmotic pressure of a solution is the excess pressure that must be applied to a solution to prevent osmosis, i.e. to stop the passage of solvent molecules through a semipermeable membrane into the solution. It is a colligative property as it depends upon the number of solute molecules and not on their nature. (1)
 (b) It is defined as the elevation in boiling point for 1 molal solution. It is denoted as K_b . (1)

(ii) (a) According to Raoult's law,
 For toluene, $p_1 = p_1^\circ \times \chi_1$
 $p_1^\circ = 0.0925 \text{ bar}$ and $\chi_1 = 0.6$
 Then, $p_1 = 0.0925 \times 0.6 = 0.0555 \text{ bar}$ (1/2)
 For benzene, $p_2 = p_2^\circ \times \chi_2$
 Mole fraction of benzene,
 $\chi_2 = 1 - \chi_1 = 1 - 0.6 = 0.4$
 and $p_2^\circ = 0.256 \text{ bar}$
 Then, $p_2 = 0.256 \times 0.4 = 0.1024 \text{ bar}$ (1/2)
 Total vapour pressure of solution

$$p_{\text{total}} = p_1 + p_2$$

$$= 0.0555 + 0.1024 = 0.158 \text{ bar} \quad (1)$$

(b) Mole fraction of toluene in vapour phase

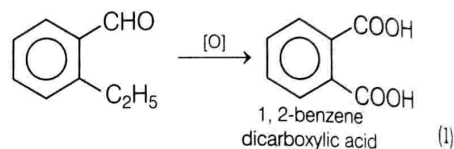
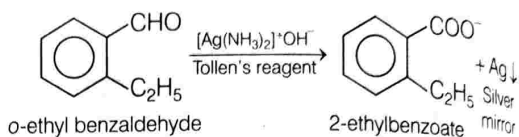
$$y_1 = \frac{p_1}{p_{\text{total}}} = \frac{0.0555}{0.158} = 0.351 \quad (1/2)$$

Mole fraction of benzene in vapour phase

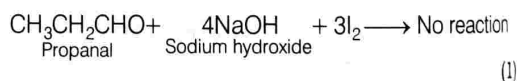
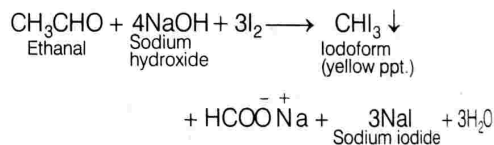
$$y_2 = \frac{p_2}{p_{\text{total}}} = \frac{0.1024}{0.158} = 0.648 \quad (1/2)$$

32. (i) (a) As the given compound with molecular formula $\text{C}_9\text{H}_{10}\text{O}$ forms a 2,4-DNP derivative and reduces Tollen's reagent, thus it must be an aldehyde. (1/2)
 (b) As it undergoes Cannizzaro reaction, hence $-\text{CHO}$ group is directly attached to the benzene ring. (1/2)
 (c) On vigorous oxidation, it gives 1,2-benzene dicarboxylic acid. Therefore, it must be an *ortho*-substituted benzaldehyde. And the only *o*-substituted aromatic aldehyde which have $\text{C}_9\text{H}_{10}\text{O}$ molecular formula is *o*-ethyl benzaldehyde. (1)

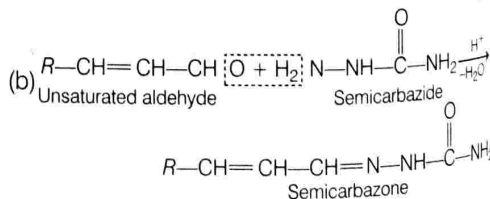
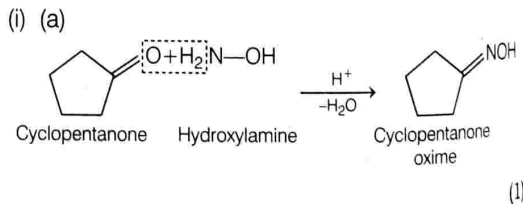
Reactions involved

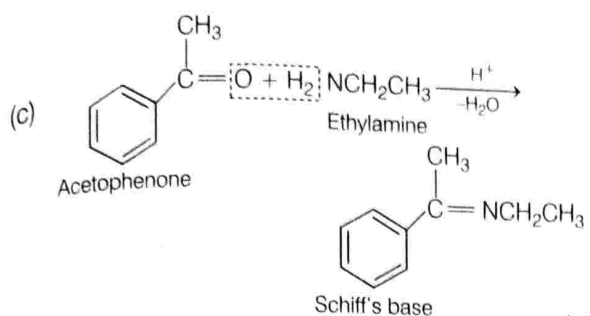


- (ii) **Distinguish test between ethanal and propanal**
 Ethanal because of the presence of CH_3CO skeleton gives iodoform test, whereas propanal due to the absence of such a skeleton does not. (1)



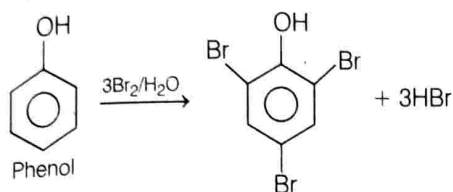
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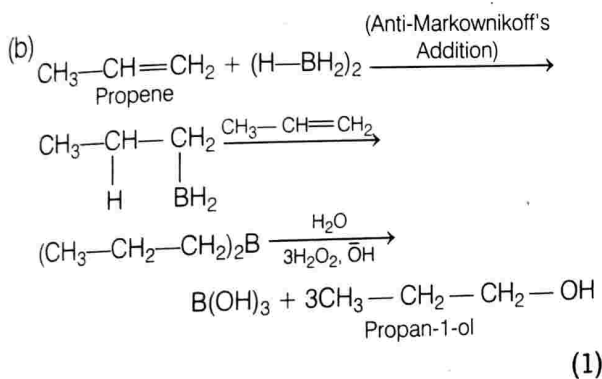


(1)

- (ii) (a) When phenol is treated with bromine water, 2,4,6-tribromophenol is formed as white precipitate.



(1)



(1)

33. (i) (a) Cr^{3+} ($Z = 24$) = $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3$

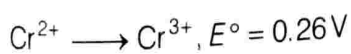
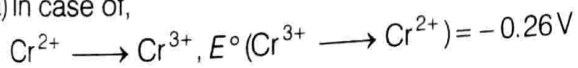
Here, $1s^2 2s^2 2p^6 3s^2 3p^6$ refer to the electronic configuration of $[\text{Ar}]^{18}$, thus electronic configuration of Cr^{3+} can be written as:
 $\text{Cr}^{3+} = [\text{Ar}] 3d^3$

(b) Cu^+ ($Z = 29$) = $[\text{Ar}]^{18} 3d^{10}$

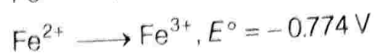
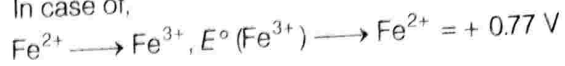
(c) Co^{2+} ($Z = 27$) = $[\text{Ar}]^{18} 3d^7$

(d) Mn^{2+} ($Z = 25$) = $[\text{Ar}]^{18} 3d^5$ (2)

- (ii) (a) In case of,



In case of,



Thus, the order of strength for Cr^{2+} and Fe^{2+} as reducing agents is $\text{Cr}^{2+} > \text{Fe}^{2+}$. (1)

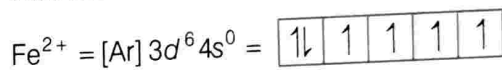
- (b) High sublimation and ionisation enthalpies and low enthalpy of hydration are responsible for possible $E^\circ \text{Cu}^{2+} / \text{Cu}^+$. (1)

- (c) Cobalt (III) ion has greater tendency to form complexes than cobalt (II) ion. Therefore, Co (II) ion being stable in aqueous solution, changes to Co (III) ion in the presence of complexing reagents and gets oxidised. (1)

Or

- (i) Magnetic moment (μ) = $\sqrt{n(n+2)}$ BM

Atomic number of Fe = 26 = $[\text{Ar}] 3d^6 4s^2$

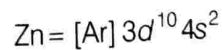
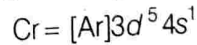


So, $\mu = \sqrt{n(n+2)} = \sqrt{4(4+2)} = \sqrt{24} = 4.89 \text{ BM}$ (2)

- (ii) (a) Since, Cu lies below hydrogen in electro-chemical series and has a positive value of electrode potential, it cannot displace hydrogen from acids.

- (b) Mn^{2+} and Zn^{2+} have stable half-filled and fully-filled electronic configuration respectively. Ni has highest negative enthalpy of hydration. Therefore, the E° values for Mn, Ni and Zn are more negative than expected.

- (c) The electronic configuration of Cr and Zn are,



By losing an electron, Cr attains stable d^5 configuration. In Zn, electron has to be removed from 4s orbital which is held more strongly by the nucleus. Therefore, the first ionisation enthalpy of Cr is lower than that of Zn. (3)