

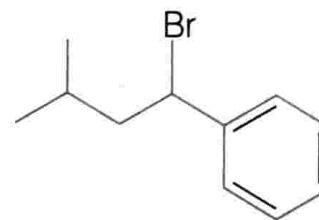
MARKING SCHEME

PRACTICE PAPER - 07

1. (i) (b) In haloalkanes, C-atom with which halogen is attached is sp^3 -hybridised but in haloarene is sp^2 -hybridised.

Or

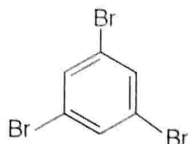
- (b) Benzyl halogen compound is the one in which the halogen atom is bonded to an sp^3 -hybridised carbon atom next to an aromatic ring, e.g.



- (ii) (c) The IUPAC name of the compound is 4-bromopent-2-ene.

(iii) (b) For dihalogen derivatives, the prefixes *o*, *m*, *p* are used in common system but in IUPAC system, the numerals 1, 2; 1, 3 and 1, 4 are used.

(iv) (b)



Common name *sym*-tribromobenzene

IUPAC name 1, 3,5-tribromobenzene

2. (i) (b) Amorphous solids soften over a range of temperature due to their short range order of arrangement of constituents. These can be moulded and blown into various shapes. Both assertion and reason are correct but reason is not the correct explanation of assertion.

Or

(d) Crystalline solids are anisotropic as these have different arrangement of particles along different directions. Hence, assertion is incorrect whereas reason is correct.

(ii) (a) In covalent solids, atoms are held very strongly due to strong and directional nature of covalent bonds. Both assertion and reason are correct and reason is the correct explanation of assertion.

(iii) (c) Although HCl and SO₂ are polar molecular solids but they have neither free electrons nor free ions. Due to the absence of free electrons or ions these are non-conductors of electricity. Hence, assertion is correct and reason is incorrect.

(iv) (b) Ionic solids have strong intermolecular forces of attraction which make them hard and brittle. Because of the presence of free ions, these can conduct electricity in molten state or in aqueous solution.

$$3. (c) \text{ Unit of rate constant} = \frac{\text{time}^{-1}}{\text{concentration}^{(n-1)}}$$

where, n = order of reaction

Given, unit of rate constant = $\text{L mol}^{-1} \text{s}^{-1}$

$$\therefore \text{L mol}^{-1} \text{s}^{-1} = \frac{(\text{s})^{-1}}{(\text{L mol}^{-1})^{n-1}}$$

$$= \frac{(\text{s})^{-1}}{(\text{L mol}^{-1})^{n-1}}$$

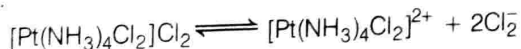
$$= \text{s}^{-1} (\text{L mol}^{-1})^{n-1}$$

$$\text{or } 1 = n - 1 \Rightarrow n = 2$$

$$\therefore \text{Order of reaction} = 2 \quad (1)$$

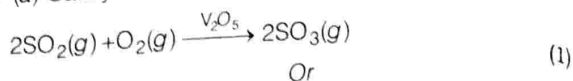
4. (a) Formula of tetramminedichloroplatinum (IV) chloride is $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}_2$.

In aqueous solution, the above compound ionises as:



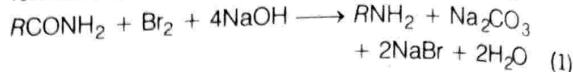
So, the number of chloride ion is 2. (1)

5. (a) Catalyst used is V_2O_5



(b) On moving down the group H—X bond length increases so correct increasing order of their acidic strength is $\text{HF} < \text{HCl} < \text{HBr} < \text{HI}$. (1)

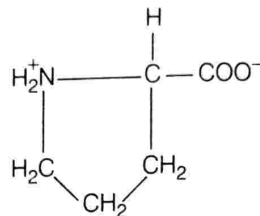
6. (c) In the Hofmann bromamide degradation, amine is formed with side products Na_2CO_3 , NaBr and H_2O .



Or

(c) $(\text{CH}_3)_3\text{N} < (\text{CH}_3)_2\text{NH} < \text{CH}_3\text{NH}_2$, because the order of boiling points is $1^\circ > 2^\circ > 3^\circ$. (1)

7. (a) Proline has an imino ($\triangleright\text{NH}$) group instead of amino group.



(1)

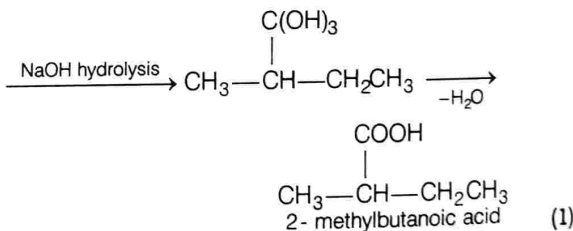
8. (a) Melting point of group 15 elements increases upto arsenic and then decreases upto bismuth.

So, the correct order is $\text{N} < \text{P} < \text{As} > \text{Sb} > \text{Bi}$ (1)

Or

(d) N_2 molecule, $\text{N} \equiv \text{N}$, has one σ -bond and two π -bonds. (1)

9. (b) $\text{CH}_3\text{CH}=\text{CH}-\text{CH}_3 + \text{CHCl}_3$
But-2-ene Chloroform



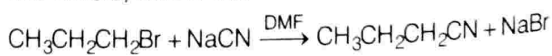
10. (d) Alkyl iodides are often prepared by the reaction of alkyl chlorides/bromides with NaI in dry acetone. This reaction is known as Finkelstein reaction.



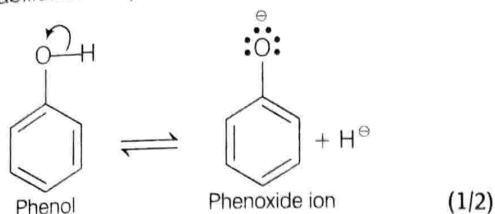
NaCl or NaBr thus formed is precipitated in dry acetone. It facilitates the forward reaction according to Le-Chatelier's principle.

Or

(c) The given reaction follows $\text{S}_{\text{N}}2$ mechanism and $\text{S}_{\text{N}}2$ reactions are favoured in polar aprotic medium like DMSO, DMF... etc.



11. (b) Phenols are much more acidic than alcohols due to stabilisation of phenoxide ion by resonance.



Ortho-nitrophenol is most acidic because in it $-NO_2$, an electron attracting group, is attached on *ortho* position which helps in stabilising negative charge on the oxygen of phenoxide ion. Due to this reason, acidic character of phenol is increased, while on attachment of $-CH_3$ group acidic strength of phenol is decreased in cresol due to destabilisation of phenoxide ion. (1/2)

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

Correct Reason The total number of ions in solution increases on dilution but the number of ions per unit volume that carry current in solution decreases on dilution. (1)

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

Or

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

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

Correct Assertion For d^4 configuration, high spin complex with configuration $t_{2g}^3 e_g^1$ is formed. (1)

15. (a) Both Assertion and Reason are correct statements and Reason is correct explanation of Assertion. (1)

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

17. The depression in freezing point are in order:



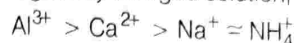
Fluorine, being the most electronegative, has the highest negative inductive effect. As a result of this, F_3C COOH is the strongest acid while CH_3COOH is the weakest acid. Hence, CF_3-COOH ionises to the largest extent while CH_3COOH ionises to the minimum extent to give ions in their solutions in water. Greater the ions produced, greater is the depression in freezing point. Hence, the depression in freezing point is the maximum for the trifluoroacetic acid and minimum for acetic acid. (2)

18. (i) As $-\frac{d[B]}{dt} = 1 \times 10^{-2} \text{ mol L}^{-1} \text{ s}^{-1}$
 $\therefore \text{Rate} = -\frac{1}{2} \frac{d[B]}{dt} = \frac{1}{2} \times 1 \times 10^{-2}$
 $= 0.5 \times 10^{-2} \text{ mol L}^{-1} \text{ s}^{-1}$ (1)

(ii) $\text{Rate} = -\frac{d[A]}{dt} = -\frac{1}{2} \frac{d[B]}{dt} = +\frac{1}{3} \frac{d[C]}{dt}$
 Rate of change in concentration of A
 $= -\frac{d[A]}{dt} = -\frac{1}{2} \frac{d[B]}{dt} = 0.5 \times 10^{-2} \text{ mol L}^{-1} \text{ s}^{-1}$
 Rate of change in concentration of C
 $= \frac{d[C]}{dt} \Rightarrow -\frac{3}{2} \frac{d[B]}{dt} = \frac{3}{2} \times 1 \times 10^{-2} = 1.5 \times 10^{-2}$ (1)

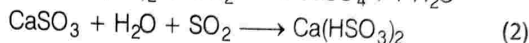
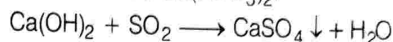
19. The solution Sb_2S_3 is a negatively charged solution.

Greater the valency of the flocculating ion, greater is the coagulation. This is known as Hardy-Schulze rule. For a negatively charged solution,



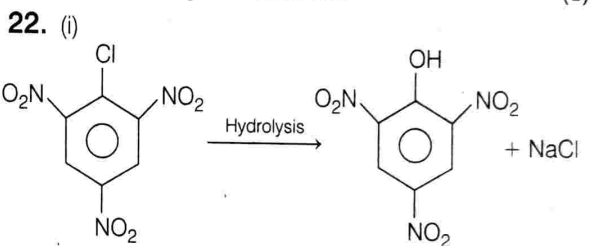
Hence, the most effective coagulating agent for Sb_2S_3 solution is $Al_2(SO_4)_3$. (2)

20. When SO_2 gas is passed through lime **water first** slowly, milky appearance arises due to formation of insoluble $CaSO_4$. On passing excess SO_2 through this solution, milky appearance disappears because of formation of soluble $Ca(HSO_3)_2$.



21. (i) The oxide of a transition metal in low oxidation state is basic, e.g. TiO , VO , MnO , FeO , Cu_2O , NiO . The oxides of transition elements in higher oxidation states are acidic. e.g. V_2O_5 , CrO_3 . (1)

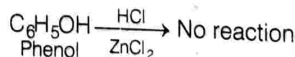
- (ii) This is because oxygen and fluorine are highly electronegative elements. (1)



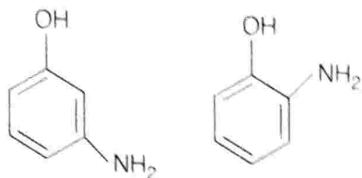
- (ii) $CH_3Cl + AgCN \longrightarrow CH_3N \equiv C + AgCl$ (1)

Or

Due to resonance in phenol, C—O bond of phenol has some partial double bond character. Partial double bond character strengthens the bond. So, it is difficult to break this C—O bond of phenol while the C—O bond of alcohol is purely single bond and comparatively weaker bond. So alkyl halides can be prepared by the reaction of alcohols with HCl in the presence of $ZnCl_2$ while aryl halides can not be prepared by reaction of phenol with HCl in the presence of $ZnCl_2$. (1)



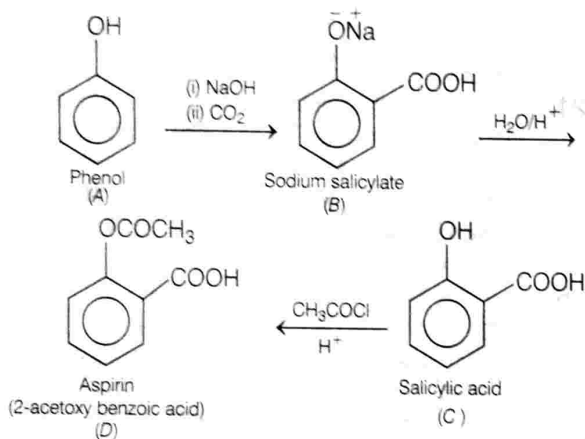
23. (i) The structures of *m*-aminophenol and *o*-amino phenol are as follows :



The —NH_2 group is an electron releasing group. Thus, the presence of —NH_2 group on the ring decreases the acid strength of phenol. The effect of any substituent is more significant when it is in *ortho* or *para* position than in *meta* position. Thus, *m*-amino phenol is stronger than *o*-aminophenol. (1)

- (ii) In alcohols, the alkyl group is an electron releasing group. As a result, the electron density on oxygen increases. This effect along with the presence of two lone pairs of electrons on O-atom makes alcohols weakly basic. (1)

Or



24. For NaCl, $Z = 4$, Molar mass, $M = 58.5 \text{ g mol}^{-1}$

$$\text{Density, } d = 2.165 \text{ g cm}^{-3}$$

$$\text{Density, } d = \frac{Z \times M}{a^3 \times N_A}$$

$$= \left(\frac{4 \times 58.5 \text{ g mol}^{-1}}{2.165 \text{ g cm}^{-3} \times 6.02 \times 10^{23} \text{ mol}^{-1}} \right)^{1/3}$$

$$a = (179.54)^{1/3} \times 10^{-8} \text{ cm} = 5.64 \times 10^{-8} \text{ cm} \quad (3)$$

$$\text{Distance between } \text{Na}^+ \text{ and } \text{Cl}^- \text{ ions} = a/2$$

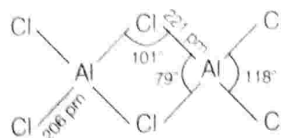
$$= \frac{5.64 \times 10^{-8} \text{ cm}}{2}$$

$$= 2.82 \times 10^{-8} \text{ cm}$$

25. (i) Due to inert-pair effect Bi(V) has a strong tendency to accept two electrons from any other species, thus acting as an oxidising agent. (1)
 (ii) H_3PO_3 has two oxygenated H-atoms. Since, P—OH hydrogen is ionisable, hence H_3PO_3 is a diprotic acid. (1)

Or

- (i) The structural formula of Al_2Cl_6 is shown below :

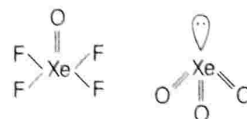


- (ii) The structural formula of $\text{SF}_4(\text{g})$ is shown below. (1)

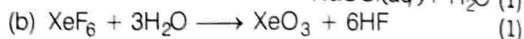
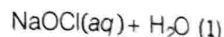


26. (i) The noble gas species which is isostructural with ICl_4^- is XeF_4 and BrO_3^- is isostructural with XeO_3 .

Structures of XeF_4 and XeO_3 are as follows:



- (ii) (a) $2\text{NaOH} + \text{Cl}_2(\text{g}) \rightarrow \text{NaCl}(\text{aq}) +$
 (Cold, dilute)



27. (i) The outer electronic configuration of the given ions are:

| | | | |
|------------------|------------------|--------------------------|------------------|
| Tl^{3+} | V^{3+} | Cu^+ | Sc^{3+} |
| $3d^1$ | $3d^2$ | $3d^{10}$ | $3d^0$ |
| Coloured | Coloured | No <i>d-d</i> transition | |
| Mn^{2+} | Fe^{3+} | Co^{2+} | MnO_4^- |
| $3d^5$ | $3d^5$ | $3d^7$ | $3d^0$ |
| Coloured | Coloured | Coloured | Coloured |

- (ii) (a) Due to lanthanoid contraction, the ionic size decreases on moving from La^{3+} to Lu^{3+} . As a result, the covalent character in bonding increases in the direction $\text{La}^{3+} \rightarrow \text{Lu}^{3+}$. La_2O_3 is more ionic and Lu_2O_3 is more covalent. (1)

- (b) Radii of $4d$ and $5d$ -block elements are almost equal. (1)

28. (i) Amino acids may be acidic, basic or neutral depending upon the relative number of amino and carboxyl groups present in the molecule. Equal number of amino carboxyl groups makes it neutral, more number of amino than carboxyl groups makes it basic and more carboxylic groups as compared to amino groups makes it acidic. (1½)
 (ii) The amino acids exist as Zwitter ions ($\text{H}_3\text{N}^+\text{—CHR—COO}^-$) in aqueous solution. Due to this, dipolar salt like structure amino acids have strong dipole-dipole attractions.

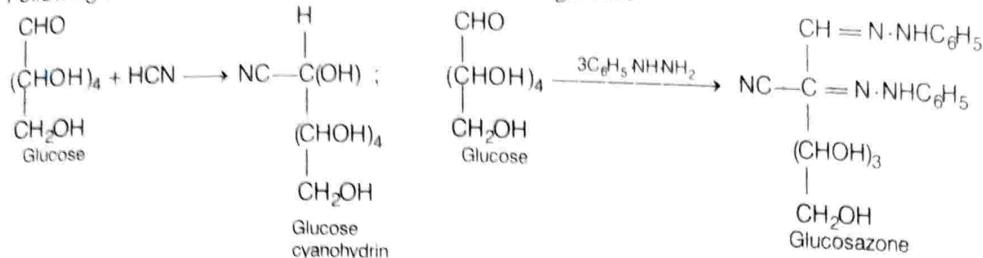
Thus, their melting points are higher than corresponding halo acids which do not have salt like character. Secondly, they interact strongly with H_2O due to their salt like character.

As a result, polar amino acids dissolve in polar solvents like H_2O . Hence, the solubility of amino acids in water is higher than that of corresponding halo acids, which do not have any salt like character.

(1½)

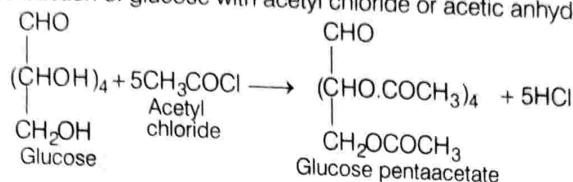
Or

Following are the two reactions for the identification of glucose.



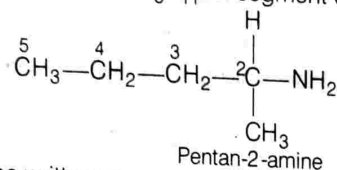
Reaction with acetyl chloride Reaction of glucose with acetyl chloride or acetic anhydride, gives glucose.

(1½)



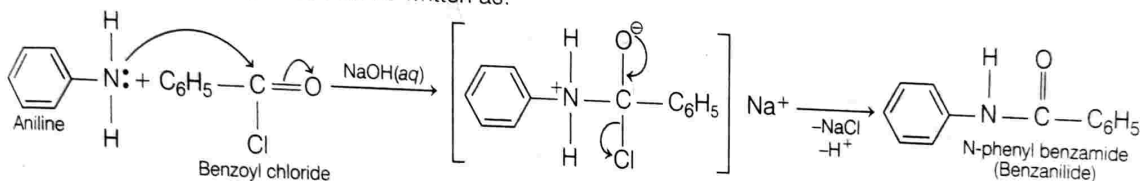
29. (i) HNO_2 reacts with $\text{C}_5\text{H}_{13}\text{N}$ to give an alcohol, means the compound is primary amine. $\text{C}_5\text{H}_{13}\text{N}$ means $\text{C}_5\text{H}_{11}\text{NH}_2$ (primary amine). Optically active alcohol means $\text{C}_5\text{H}_{11}\text{OH}$ segment contain a chiral carbon.

(1½)



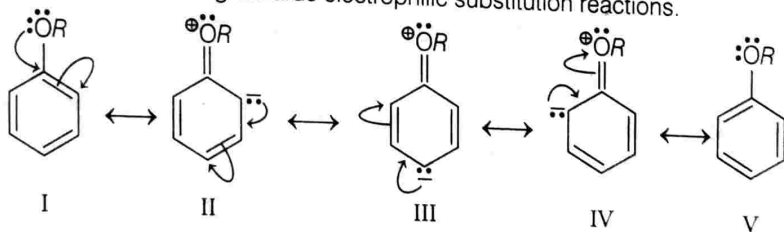
- (ii) The entire reaction sequence can be written as:

(1½)



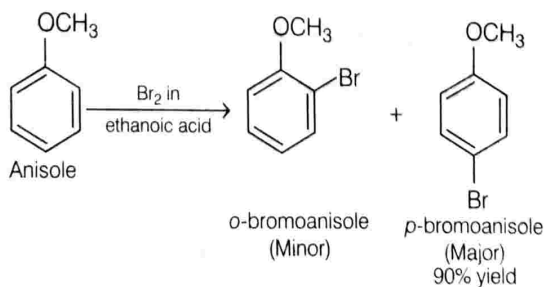
30. (i) In aryl alkyl ethers, +R-effect of the alkoxy group ($-\text{OR}$) increases the electron density in the benzene ring, thereby activating the benzene ring towards electrophilic substitution reactions.

(1½)



- (ii) Electron density is more at *o*- and *p*-positions so, *o*- and *p*-products are mainly formed during electrophilic substitution reactions.

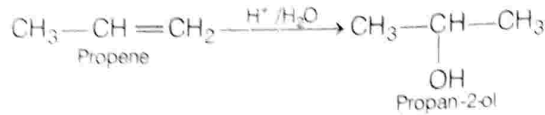
(1½)



(1½)

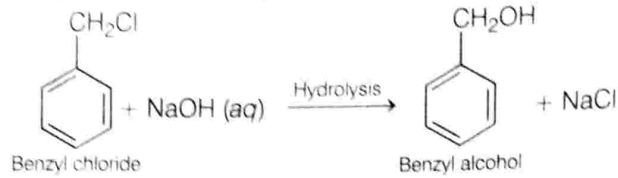
Or

(i) (a) Propene \longrightarrow Propan-2-ol



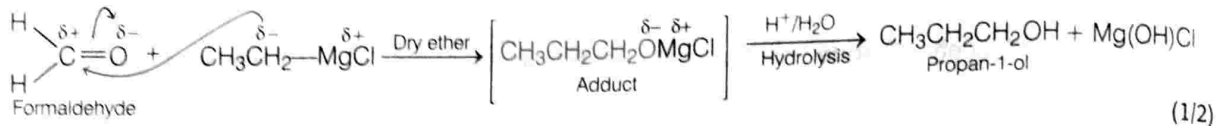
(1/2)

(b) Benzyl chloride \longrightarrow Benzyl alcohol



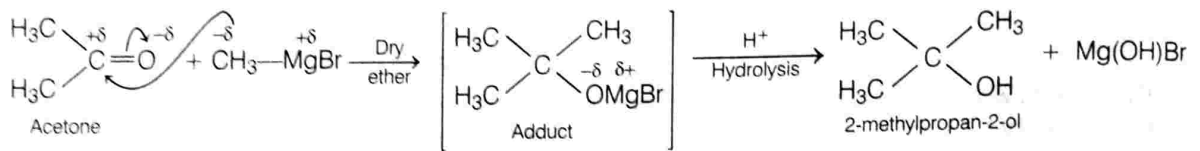
(1/2)

(c) Ethyl magnesium chloride \longrightarrow Propan-1-ol



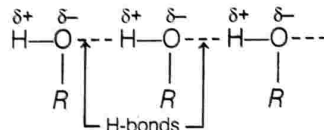
(1/2)

(d) Methyl magnesium bromide \longrightarrow 2-methylpropan-2-ol



(1/2)

(ii) The —OH group in alcohols is involved in intermolecular hydrogen bonding or H-bonding due to which they exist as associated molecules and hence, have higher boiling and melting points in comparison at hydrocarbons.



(1)

31. (i) $2\text{Cr(s)} + 3\text{Cd}^{2+}(\text{aq}) \longrightarrow 3\text{Cd(s)} + 3\text{Cr}^{3+}(\text{aq})$

Thus, $\text{Cr(s)}|\text{Cr}^{3+}(\text{aq})$ is anode and $\text{Cd}^{2+}(\text{aq})|\text{Cd(s)}$ is cathode.

$$\text{Then, } E_{\text{cell}}^{\circ} = E_{\text{cathode}}^{\circ} - E_{\text{anode}}^{\circ} = E_{(\text{Cd}^{2+}/\text{Cd})}^{\circ} - E_{(\text{Cr}/\text{Cr}^{3+})}^{\circ}$$

Taking the values of the standard electrode potentials,

$$E_{\text{cell}}^{\circ} = -0.40 \text{ V} - (0.74 \text{ V}) = +0.34 \text{ V}$$

$$\Delta_r G^{\circ} = -nFE_{\text{cell}}^{\circ} = -6 \times 96500 \times 0.34 \text{ J mol}^{-1} = -196860 \text{ J mol}^{-1}$$

$$\Delta_r G^{\circ} = -196.86 \text{ kJ mol}^{-1}$$

The equilibrium constant of the cell reaction is obtained from equation, $\Delta_r G^{\circ} = -2.303 RT \log K$
 $-196860 \text{ J mol}^{-1} = -2.303 \times 8.314 \text{ J K}^{-1} \text{ mol}^{-1} \times 298 \text{ K} \times \log K$

$$\log K = \frac{-196860 \text{ J mol}^{-1}}{-2.303 \times 8.314 \text{ J K}^{-1} \text{ mol}^{-1} \times 298 \text{ K}} = 34.5 \Rightarrow K = 3.17 \times 10^{34}$$

(2½)

(ii) $\text{Fe}^{2+}(\text{aq}) + \text{Ag}^+(\text{aq}) \longrightarrow \text{Fe}^{3+}(\text{aq}) + \text{Ag(s)}$

Thus, $\text{Pt}/\text{Fe}^{2+}, \text{Fe}^{3+}$ electrode is anode and Ag^+/Ag is cathode in this cell.

$$\text{Then, } E_{\text{cell}}^{\circ} = E_{\text{cathode}}^{\circ} - E_{\text{anode}}^{\circ} = E_{(\text{Ag}^+/\text{Ag})}^{\circ} - E_{(\text{Fe}^{3+}/\text{Fe}^{2+})}^{\circ}$$

Substituting E° values,

$$E_{\text{cell}}^{\circ} = 0.80 \text{ V} - 0.77 \text{ V} = 0.03 \text{ V}$$

$$\Delta_r G^{\circ} = -nFE_{\text{cell}}^{\circ}$$

$$= -1 \times 96500 \times 0.03 \text{ J mol}^{-1} = -2895 \text{ J mol}^{-1} = -2.895 \text{ kJ mol}^{-1}$$

