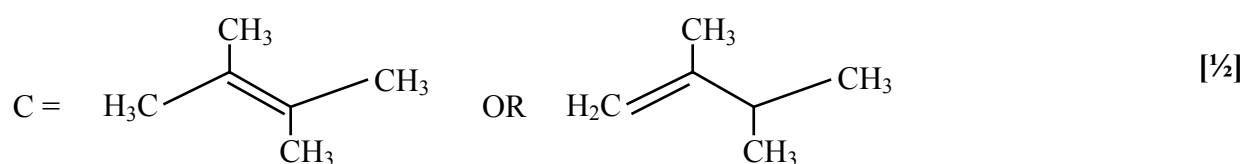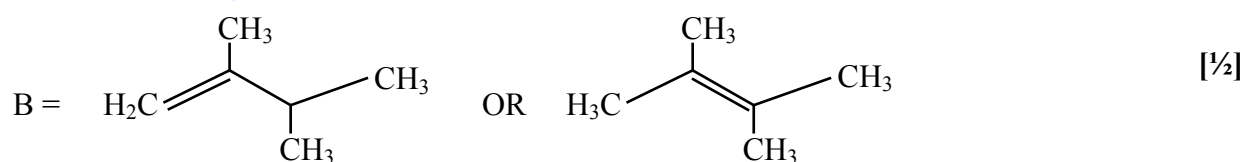# CHEMISTRY

SECTION – A

1. (b) [1]

2. (c) [1]

3. (a) [1]

4. (c) [1]

5. (b) [1]

6. (b) [1]

7. (d) [1]

8. (a) [1]

9. (a) [1]

10. (d) [1]

11. (b) [1]

12. (c) [1]

13. (a) [1]

14. (d) [1]

15. (b) [1]

16. (a) [1]

SECTION – B

17. A = [structure: 2-chloro-2,3-dimethylbutane with CH₃ groups] [1]

B = [two alkene structures] OR [½]

C = [two alkene structures] OR [½]

18. (a) • Positive deviation. **[1]**

• On adding acetone, some of the hydrogen bonds of ethanol are broken down causing an increase in vapour pressure / the ethanol–acetone shows weaker interactions than pure ethanol–ethanol and acetone–acetone interactions. **[1]**

OR

(b) A liquid binary mixture that distills at constant temperature without undergoing a change in composition. **[1]**

Maximum boiling azeotrope **[½]**

68% HNO_3 + 32% H_2O **[½]**

19. (a) Fuel cell

(b) Lead storage

(c) Mercury cell

(d) Dry cell **[4 × ½ = 2]**

20. $\log k = \log A - \dfrac{Ea}{2.303\,RT}$ **[½]**
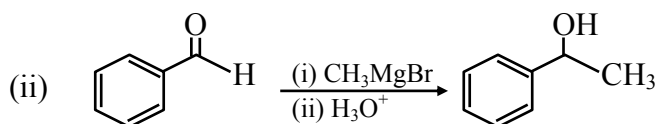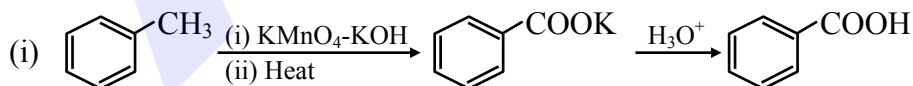
$-\dfrac{Ea}{2.303\,R} = -2 \times 10^4\ K$ **[½]**

$E_a = 2.303 \times 8.314\ J\,K^{-1}\,mol^{-1} \times 2 \times 10^4\ K$ **[½]**

$E_a = 3.830 \times 10^5\ J\,mol^{-1}$ **[½]**
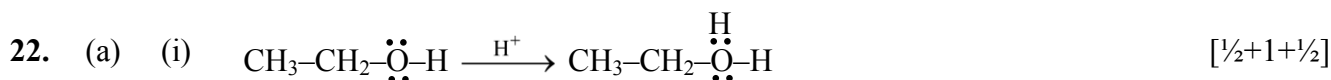
21. (a) (i) **[1]**

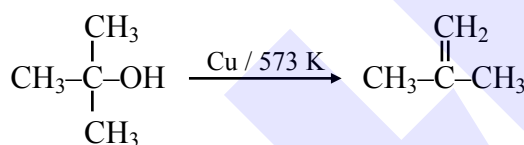(ii) **[1]**

OR

(b) **[2 × 1 = 2]**

(i)

(ii)
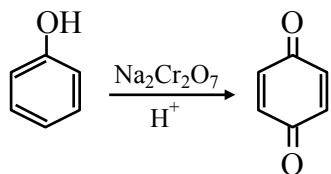
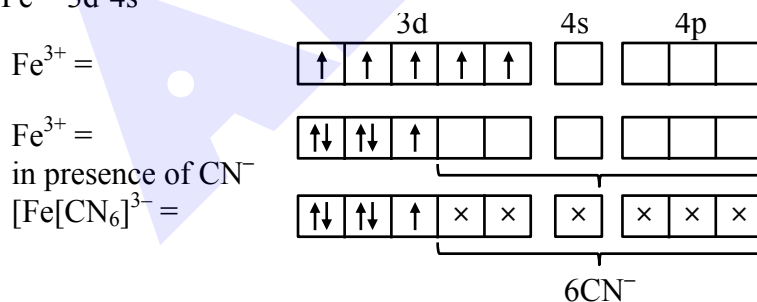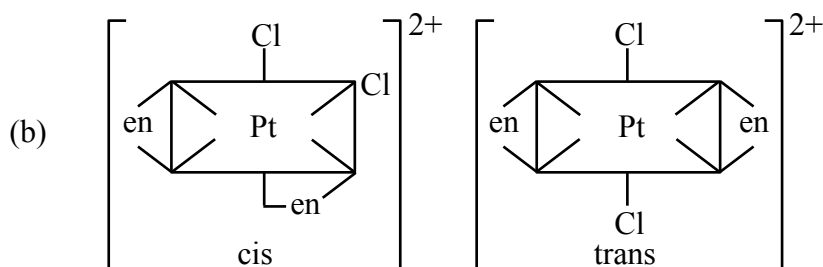(or any other correct method of conversion in not more than two steps)

SECTION – C

22. (a) (i) $CH_3-CH_2-\overset{\bullet\bullet}{\underset{\bullet\bullet}{O}}-H \xrightarrow{H^+} CH_3-CH_2-\overset{\overset{H}{|}}{\underset{\bullet\bullet}{O}}-H$ [½+1+½]

$CH_3CH_2-\overset{\bullet\bullet}{\underset{|}{O}}: + CH_3-CH_2-\overset{+}{O}\overset{H}{\underset{H}{\diagdown}} \longrightarrow CH_3CH_2-\overset{+}{\underset{|}{O}}-CH_2CH_3 + H_2O$
$\qquad\qquad H \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad H$

$CH_3CH_2-\overset{+}{\underset{\underset{H}{|}}{O}}-CH_2CH_3 \longrightarrow CH_3CH_2-O-CH_2CH_3 + H^+$
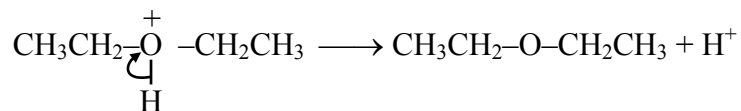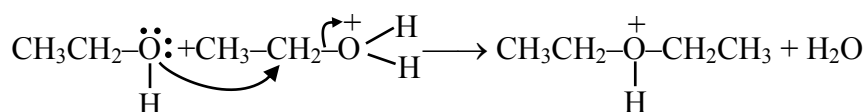
(ii) Due to intramolecular H–bonding in o–nitrophenol while p–nitrophenol has intermolecular H–bonding. **[1]**

(b) (i)
 OCH$_3$ + CH$_3$Cl $\xrightarrow[CS_2]{Anhyd.\ AlCl_3}$ (o-methylanisole) + (p-methylanisole) **[1×3]**

Phenol (OH) $\xrightarrow[H^+]{Na_2Cr_2O_7}$ benzoquinone (O=...=O)

$CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}-OH \xrightarrow{Cu\ /\ 573\ K} CH_3-\overset{\overset{CH_2}{||}}{C}-CH_3$
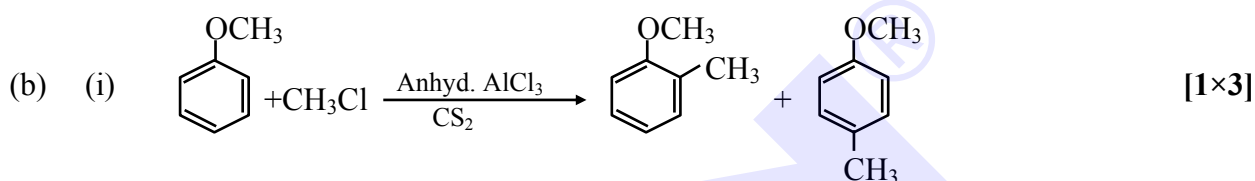
23. (a) Due to the resonance stabilization of benzyl carbocation. **[1]**
(b) Because it is a racemic mixture / it contains an equimolar mixture of the two enantiomers of Butan-2–ol. **[1]**
(c) Because it forms a poisonous gas phosgene in presence of air and light. **[1]**

24. (a) Fe $= 3d^6 4s^2$

Fe^{3+} = [3d: ↑ ↑ ↑ ↑ ↑] [4s] [4p: _ _ _]

Fe^{3+} = in presence of CN$^-$ [3d: ↑↓ ↑↓ ↑] [4s] [4p]

$[Fe[CN_6]^{3-}$ = [3d: ↑↓ ↑↓ ↑ × ×] [4s: ×] [4p: × × ×]

6CN$^-$

Hence hybridization is d^2sp^3.

(b)

cis   trans

(c) Cl^- being a weak field ligand does not cause pairing of electrons and hence $[NiCl_4]^{2-}$ is paramagnetic while CO being a strong field ligand causes pairing of electrons therefore $[Ni(CO)_4]$ is diamagnetic.

(d) Linkage isomerism. Example, $CN^- / NO_2^- / SCN^-$ **[1 × 3 = 3]**

25. $\pi = i \dfrac{n_B}{V} RT$ **[½]**

$6.5 = i \times \dfrac{W_B}{M_B} \times \dfrac{1000}{V} \times 0.0821$

$6.5 = i \times \dfrac{6.1}{122} \times \dfrac{1000}{100\,L} \times 0.0821 \times 300K$ **[1]**

$i = \dfrac{6.5 \times 122}{6.1 \times 0.0821 \times 300 \times 10} = 0.528$ **[½]**

$\alpha = \dfrac{1-i}{1-\dfrac{1}{n}} = \dfrac{1-0.528}{1-\dfrac{1}{2}} = 0.944$ or 94.4% **[1]**

26. $k = \dfrac{2.303}{t} \log \dfrac{P_i}{(2p_i - p_t)}$ **[½]**

$k = \dfrac{2.303}{100} \log \dfrac{0.4}{0.8 - 0.6}$ **[1]**

$= \dfrac{2.303}{100} \log 2$ **[½]**

$= \dfrac{2.303 \times 0.3010}{100}$

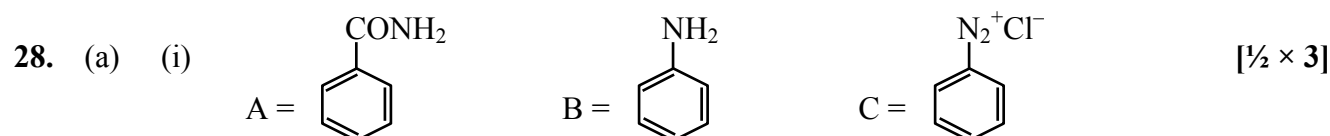$= 0.0069\ s^{-1}$ or $0.007\ s^{-1}$ **[1]**

[Deduct ½ mark for no or incorrect unit]

27. (1) Because of small size, high ionic charge and availability of d–orbital. **[1]**

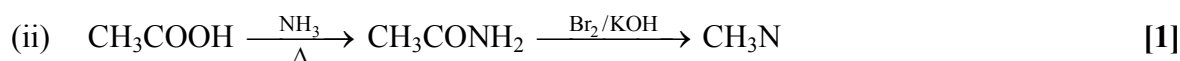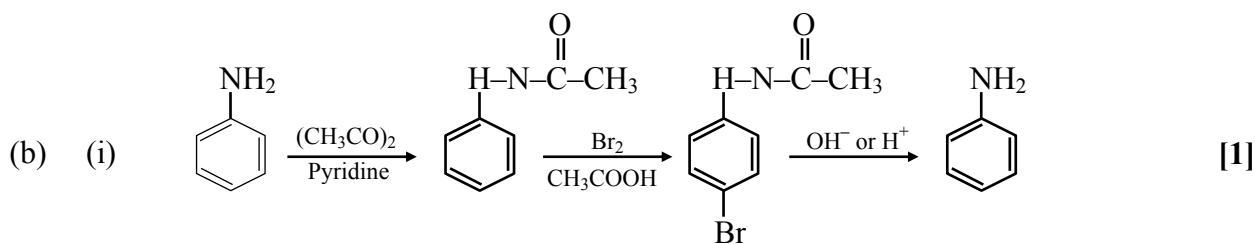(2) Because of stable half–filled $3d^5$ configuration in Mn^{2+}. **[1]**

(3) (i) Cu^+ ion (aq.) $\longrightarrow Cu^{2+}$ (aq.) + Cu. **[1]**

(ii) Cu^+ ion (aq.) undergoes disproportionation to Cu^{2+} (aq.) and

Cu / $2Cu^+$(aq.) $\longrightarrow Cu^{2+}$(aq.) + Cu(s)

28. (a) (i)

$A = $ (benzene ring with $CONH_2$) $B = $ (benzene ring with NH_2) $C = $ (benzene ring with $N_2^+Cl^-$) **[½ × 3]**

(ii) $A = CH_3CH_2CN$ $B = CH_3CH_2CH_2NH_2$ $C = CH_3CH_2CH_2OH$ **[½ × 3]**

OR

(b) (i)   **[1]**

(ii) $CH_3COOH \xrightarrow[\Delta]{NH_3} CH_3CONH_2 \xrightarrow{Br_2/KOH} CH_3N$ **[1]**

(iii) $CH_3CH_2CH_2CN \xrightarrow{LiAlH_4} CH_3CH_2CH_2CH_2NH_2$ **[1]**

SECTION – D

29. (i) **Peptide linkage :** A linkage formed when two amino acids are joined through –CONH –bond. **[1]**

 Glycosidic linkage : When two monosaccharides are joined through oxygen atom.

 (or any other correct difference)

(ii) Those which are not synthesized in the body and must be obtained through diet. **[1]**

(iii) α–helix and β–pleated sheet.

 Hydrogen bond, van der Waals forces, disulphide linkages, electrostatic force or attraction.

 (any two)

OR

(iii) Loos of biological activity when native form of protein is subjected to change in temperature, pH, etc. Example, curdling of milk. **(or any other correct difference)** **[1]**

 Secondary and tertiary structure lose their biological activity. **[1]**
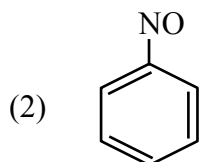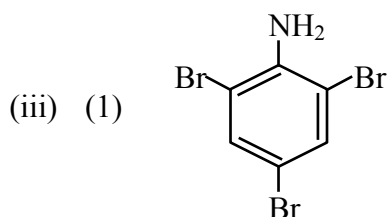
30. (i) $(C_2H_5)_2NH < (C_2H_5)_2N < (C_2H_5NH_2$ **[1]**

(ii) Due to the protonation of aniline to form anilinium ion which makes it deactivating and meta–directing. **[1]**

(iii) A = ⟨◯⟩—COOH **[1]**

 B = ⟨◯⟩—CONH₂ **[½]**

 C = ⟨◯⟩—NH₂ **[½]**

OR

(iii) (1)

(2)

                                                     [1×2=2]

SECTION – E

31. (a) (i) $E_{cell} = E^{\circ}_{cell} - \dfrac{0.059}{6}\log\dfrac{[Al^{3+}]^2}{[Ni^{2+}]^3}$ **[1]**

$E_{cell} = [-0.25+1.66] - \dfrac{0.059}{6}\log\dfrac{[0.001]}{[0.1]^3}$

$= 1.41 - \dfrac{0.059}{6}\log 10^{-6+3}$ **[1]**

$= 1.41 - \dfrac{0.059}{6}\times 3$

$= 1.41 + 0.0295$

$= 1.4395$ V   **[1]**

[Deduct ½ mark for no or incorrect unit]

(ii)

                                                        [1]

As seen from the curve, it runs parallel to the y–axis. So, even on extrapolation, it will not intercept, hence Λ^0_m cannot be obtained.

OR

(b) (i) $\Lambda m^{\circ}(NH_4Cl) = 73.8 + 76.2 = 150.0$ S cm^2 mol^{-1} **[½]**

$\Lambda_m = \dfrac{k}{c}\times 1000\, S\, cm^2\, mol^{-1}$ **[½]**

$$\Lambda_m = \frac{1.29 \times 10^{-2}}{0.1} \times 1000 \, \text{S} \, \text{cm}^2 \, \text{mol}^{-1} \qquad \textbf{[½]}$$

$$\Lambda_m = 1.29 \times 10^2 = 129 \, \text{S} \, \text{cm}^2 \, \text{mol}^{-1} \qquad \textbf{[½]}$$

$$\alpha = \frac{\Lambda_m}{\Lambda_{m°}} \qquad \textbf{[½]}$$

$$\alpha = \frac{129}{150} = 0.86 \qquad \textbf{[½]}$$

(ii) $\quad E_{Zn^{2+}|Zn} = E^°_{Zn^{2+}/Zn} - \dfrac{0.059}{2} \log \dfrac{1}{[Zn^{2+}]}$ $\qquad$ **[½]**

$$E_{Zn^{2+}|Zn} = -0.76V - \frac{0.059}{2} \log \frac{1}{0.1} \qquad \textbf{[½]}$$

$$E_{Zn^{2+}|Zn} = -0.76V - 0.0295$$

$$= -0.7895V \qquad \textbf{[1]}$$

32. (a) (i) (1) Because of no unpaired electron in d–orbitals in Zn^{2+} whereas, Ni^{2+} has 2 unpaired electrons in d–orbitals / Ni^{2+} shows d–d transition while Zn^{2+} does not. $\qquad$ **[1]**

(2) Because Cr is more stable in +3 oxidation state due to stable t^3_{2g} configuration.
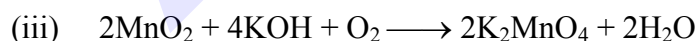
[1]

(3) Because of their ability to show multiple or variable oxidation states / ability to form complex / provide larger surface area for the reactants. $\qquad$ **[1]**

(ii) (1) $\quad 2MnO_4^- + 10 \, I^- + 16H^+ \longrightarrow 2Mn^{2+} + 5I_2 + 8H_2O$ $\qquad$ **[1]**

(2) $\quad MnO_4^- + 5Fe^{2+} \, 8H^+ \longrightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$ $\qquad$ **[1]**
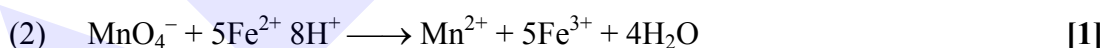
OR

(b) (i) Dichromate ion / Chromate ion / Permanganate ion $\qquad$ [any two]

(ii) Changes to CrO_4^{2-} / K_2CrO_4

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

$3MnO_4^{2-} + 4H^+ \longrightarrow 2MnO_4^- + MnO_2 + 2H_2O$

[or any other suitable method of preparation]

(iv) Cerium / Terbium

(v) Chromium Copper $\qquad$ **[1 × 5]**

33. (a)

[1]

(b)

[1]

(c)

[1]
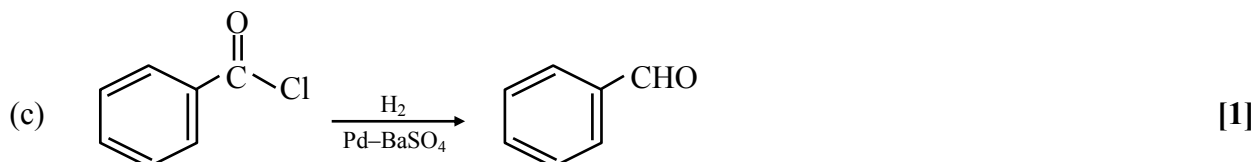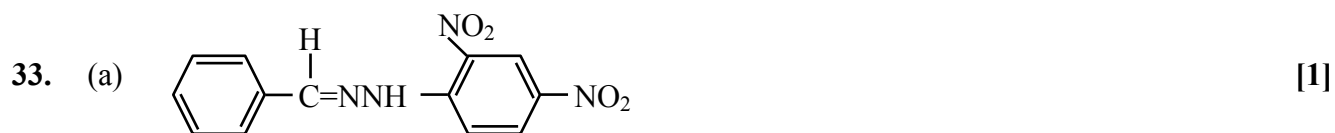
(or any other correct chemical equation)

(d) Due to resonance stabilization of conjugate base enolate ion. **[1]**

(e) On adding $NaHCO_3$ solution, Benzoic acid gives effervescence of CO_2 whereas Benzaldehyde does not. **[1]**

(or any other soitable chemical test)