CBSE Class 12 Chemistry
Sample paper - 01 (2019-20)

Maximum Marks: 70

Time Allowed: 3 hours

General Instructions:

a. All questions are compulsory.
b. Section A: Q.no. 1 to 16 are very short answer questions (objective type) and carry 1 mark each.
c. Section B: Q.no. 17 to 23 are short answer questions and carry 2 marks each.
d. Section C: Q.no. 24 to 30 are long answer questions and carry 3 marks each.
e. Section D: Q.no. 31 to 33 are also long answer questions and carry 5 marks each.
f. There is no overall choice. However an internal choice has been provided in two questions of two marks, two questions of three marks and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.
g. Use log tables if necessary, use of calculators is not allowed.

Section A

1. Conductors allow the passage of electric current through them. Metallic and electrolytic are the two types of conductors. Current carriers in metallic and electrolytic conductors are free electrons and free ions respectively. Specific conductance or conductivity of the electrolyte solution is given by the following relation:

$$k = c \times \frac{l}{A}$$

where c = 1/R is the conductance and l/A is the cell constant. Molar conductance (Λ_m) and equivalence conductance (Λ_e) of an electrolyte solution are calculated using the following similar relations:

$$\Lambda_m = k \times \frac{1000}{M}$$

$$\Lambda_e = k \times \frac{1000}{N}$$

where M and N are the molarity and normality of the solution respectively. Molar conductance of strong electrolyte depends on concentration:

$$\Lambda_m = \Lambda_m^\circ - b\sqrt{c}$$

where A_m° = molar conductance at infinite dilution

c = concentration of the solution

b = constant

The degrees of dissociation of weak electrolytes are calculated as:

$$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ} = \frac{\Lambda_e}{\Lambda_e^\circ}$$

Answer the following questions:

i. Out of specific conductance and molar conductance, which one of the following decreases on dilution of electrolyte solution?

ii. What is the correct order of equivalent conductance at infinite dilution for LiCl, NaCl & KCl?

iii. Out of $BaCl_2$ and KCl for which electrolyte solutions Λ_m and Λ_e are equal?

iv. Which one of the following equality holds good for the strong electrolyte?
(a) $\Lambda = \Lambda^\circ$ as $c \to 1$ (b) $\Lambda = \Lambda^\circ$ as $c \to 0$

v. What is equal to the cell constant of the conductivity cell when the conductance of a solution of an electrolyte is equal to that of its specific conductance?

2. Indicate the temperature at which carbon can be used as reducing agent for FeO.

3. State a use of streptokinase in protein.

4. Write two main functions of carbohydrates in plants.

5. Define polymerization.

6. Write the name of

$$CH_3 - \underset{\underset{O}{\|}}{C} - CH = \underset{\underset{CH_3}{|}}{C} - CH_3$$

7. The process of converting alkyl halides into alcohols involves _____.

a. substitution reaction

b. addition reaction

c. rearrangement reaction

d. dehydrohalogenation reaction

8. Which among the following act as flux , if iron oxide is present as an impurity?

   a. MnO

   b. SiO_2

   c. H_2SO_4

   d. NaOH

9. Which of the following pair of ions have same magnetic moment?

   a. Ti^{4+}, Cu^{2+}

   b. Ti^{3+}, Ni^{2+}

   c. Mn^{2+}, Cu^{2+}

   d. Cu^{2+}, Ti^{3+}

10. The correct IUPAC name of $K_2[Zn(OH)_4]$ is

    a. Potassium hydroxozinc(II)

    b. Potassium tetrahydroxyzinc(II)

    c. Potassium tetrahydroxidozincate(II)

    d. Potassium tetrahydroxyzincate(IV)

11. One of the following is used in the making of rain coats

    a. Polyvinyl chloride

b. Glyptal

c. Polypropene

d. Polystyrene

12. **Assertion:** The newly formed RNA dictates the synthesis of protein at the ribosome.
    Reason: DNA has a double helical structure while RNA has single stranded structure.

   a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

   b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

   c. Assertion is CORRECT but, reason is INCORRECT.

   d. Assertion is INCORRECT but, reason is CORRECT.

13. **Assertion:** Iodine is more soluble in CCl_4 than in water.

    Reason: Non-polar solutes are more soluble in non-polar solvents.

   a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

   b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

   c. Assertion is CORRECT but, reason is INCORRECT.

   d. Assertion is INCORRECT but, reason is CORRECT.

14. **Assertion:** Graphite is a good conductor of heat and electricity.
    Reason: Free electrons are spread out in the structure of graphite.

   a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

   b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT

explanation of the assertion.

c. Assertion is CORRECT but, reason is INCORRECT.

d. Assertion is INCORRECT but, reason is CORRECT.

15. **Assertion:** Alcohols have higher boiling points than ethers of comparable molecular masses.
Reason: Alcohols and ethers are isomeric compounds.

a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

c. Assertion is CORRECT but, reason is INCORRECT.

d. Assertion is INCORRECT but, reason is CORRECT.

16. **Assertion:** Aryl halogen undergoes nucleophilic substitution reactions with ease.
Reason: The carbon halogen bond in aryl halides has partial double bond character.

a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

c. Assertion is CORRECT but, reason is INCORRECT.

d. Assertion is INCORRECT but, reason is CORRECT.

Section B

17. Discuss the main purpose of vulcanization of rubber.

18. Define each of the following.

i. Specific rate of a reaction

    ii. Energy of activation of a reaction

19. 1.00 g of a non-electrolyte solute, when dissolved in 50 g of benzene, lowered the freezing point of benzene by 0.40 K. Find the molar mass of the solute.

    (K_f for benzene = 5.12K kg mol^{-1})

20. Write the formula of the following complexes:

    i. Hexaammine platinum (IV) chloride.
    ii. Dichloro tetrammine cobalt (III) ion.

21. Using IUPAC norms, write the formulae for the following:

    i. Potassium trioxalatoaluminate (Ill)
    ii. Dichlorido bis(ethane-1, 2-diamine) cobalt(Ill) ion

OR

Give some example showing importance of complexes in biological system?

22. Differentiate between minerals and ores.

OR

Write the principle behind the froth floatation process. What is the role of collectors in the process.

23. Why are higher ethers insoluble in water?

Section C

24. 19.5 g of CH_2FCOOH is dissolved in 500 g of water. The depression in the freezing point of water observed is 1.0°C. Calculate the Van't Hoff factor and dissociation constant of fluoroacetic acid.

25. Some $PH_3(g)$ is introduced into a flask at 600°C containing an inert gas. $PH_3(g)$ decomposes to $P_4(g)$ and $H_2(g)$ and the reaction goes to completion. The total pressure is given below as function of time.
    Find the order of reaction and calculate the rate constant.

Time (sec)	0	60	120	∞
P (mm)	262.40	272.90	275.51	276.40

OR

For the reaction: $2A + B \rightarrow A_2B$, the rate $=k[A][B]^2$ with $k = 2.0 \times 10^{-6} \, mol^{-2} L^2 s^{-1}$. Calculate the initial rate of the reaction when $[A] = 0.1 \, mol \, L^{-1}, [B] = 0.2 \, mol \, L^{-1}$. Calculate the rate of reaction after [A] is reduced to $0.06 \, mol \, L^{-1}$.

26. Write the chemistry of recharging the lead storage battery, highlighting all the materials that are involved during recharging?

27. Explain why NH_3 is basic while BiH_3 is only feebly basic.

28. Point out the difference between:

    i. Chirality and chiral centre.
    ii. Diastereoisomers and Enantiomers.

29. Discuss the boiling of the carbonyl group in formaldehyde,
    $$H - C = O.$$
    $$\overset{|}{H}$$

OR

Write chemical equations to illustrate each of the following reactions:

    i. Acylation reaction
    ii. Rosenmund reduction

30. How do antiseptics differ from disinfectants? Give one example of each.

Section D

31. Using the standard electrode potentials given below, predict if the reaction between the following is feasible or not:

i. $Fe^{3+}(aq)$ and $I^-(aq)$

ii. $Ag^+(aq)$ and $Cu(s)$

iii. $Fe^{3+}(aq)$ and $Br^-(aq)$

iv. $Ag(s)$ and $Fe^{3+}(aq)$

v. $Br_2(aq)$ and $Fe^{2+}(aq)$

Note: Standard Electrode Potentials of Fe^{3+}(+0.77 V), I^-(-0.54 V), Ag^+(+0.80 V), Cu(-0.34 V), Br^-(-1.09 V), Br_2(+1.09 V), Ag(-0.80 V), Fe^{2+}(-0.77 V)

OR
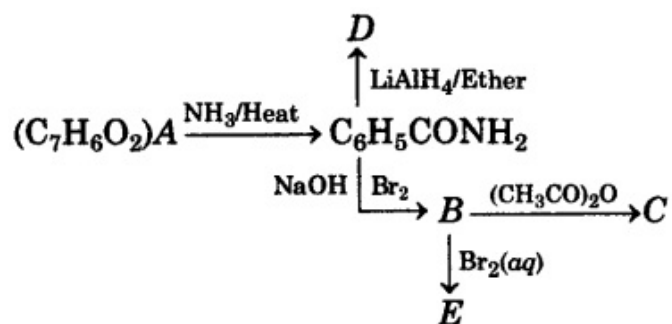
State the products of electrolysis obtained on the cathode and the anode in the following cases:

i. A dilute solution of H_2SO_4 with platinum electrodes.

ii. An aqueous solution of $AgNO_3$ with silver electrodes.

32. Give one chemical test to distinguish between the following pairs of compounds:

i. Methylamine and dimethylamine
ii. Secondary and tertiary amines
iii. Ethylamine and aniline
iv. Aniline and benzylamine
v. Aniline and N-methyl aniline

OR

An aromatic compound 'A' of molecular formula $C_7H_6O_2$ undergoes a series of reactions as shown below. Write the structures of A, B, C, D and E in the following reactions.

$$\text{(C}_7\text{H}_6\text{O}_2\text{)A} \xrightarrow{\text{NH}_3/\text{Heat}} \text{C}_6\text{H}_5\text{CONH}_2 \xrightarrow{\text{LiAlH}_4/\text{Ether}} D$$

NaOH | Br$_2$ → B $\xrightarrow{\text{(CH}_3\text{CO)}_2\text{O}}$ C

Br$_2$(aq) ↓ E

33. Assign reason for the following:

   i. The enthalpies of atomization of transition metals are high.
   ii. The transition metals and many of their compounds act as catalysts.
   iii. From element to element, the actinoid contraction is greater than lanthanoid contraction.
   iv. The E^0 value for Mn^{3+}/Mn^{2+} couple is much more positive than that for Cr^{3+}/Cr^{2+}
   v. Scandium (Z = 21) does not exhibit variable oxidation states and yet it is regarded as a transition element.

OR

a. Account for the following :
   i. Manganese shows maximum number of oxidation states in 3d series.
   ii. E^0 value for Mn^{3+}/Mn^{2+} couple is much more positive than that for Cr^{3+}/Cr^{2+}.
b. Write the chemical equations for the preparation of $KMnO_4$ from MnO_2.

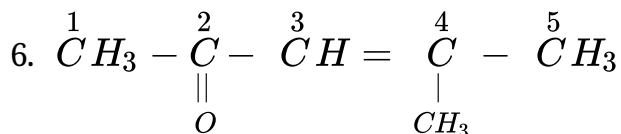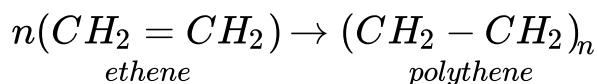# CBSE Class 12 Chemistry
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Answer
Section A

1.   i. Specific condutance decreases on dilution of electrolyte solution.

    ii. The correct order of equivalent conductance at infinite dilution is KCl>NaCl>LiCl

    iii. In KCl electrolyte solution Λ_m and Λ_e are equal.

    iv. (b) $\Lambda = \Lambda^\circ$ as $c \to 0$ equality holds good for a strong electrolyte.

    v. The conductance of a solution of an electrolyte is equal to that of its specific conductance. The cell constant of the conductivity cell is equal to the Unity

2. Carbon can be used as reducing agent above 1123 K.
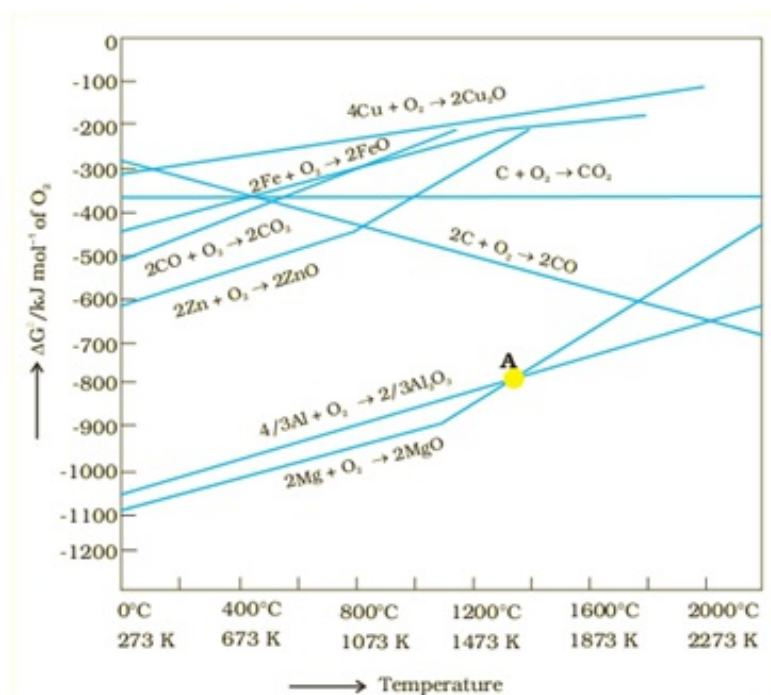
3. It dissolves blood clots and used in the treatment of heart diseases.

4. Two main functions of carbohydrates in plants are:

    i. Polysaccharides such as starch serve as storage molecules.

    ii. Cellulose, a polysaccharide, is used to build the cell wall.

5. The process of formation of polymers by doing the repeating structural units on a

large scale is called polymerisation.

$$n(CH_2 = CH_2) \rightarrow (CH_2 - CH_2)_n$$
$$\underset{ethene}{} \qquad \underset{polythene}{}$$

6. $\overset{1}{C}H_3 - \overset{2}{\underset{||}{C}} - \overset{3}{C}H = \overset{4}{\underset{|}{C}} - \overset{5}{C}H_3$
   $\qquad\quad O \qquad\quad CH_3$

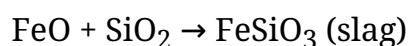**The IUPAC name is 4-methylpent-3-en-2-one**

7. (a) substitution reaction

   Explanation: Alkyl halides are converted into alcohols by substitution reaction. When alkyl halides are treated with aqueous KOH, alcohols are formed. This is a nucleophilic substitution reaction.

8. (b) SiO_2

   Explanation: Iron oxide is basic oxide so flux should be acidic.

   $FeO + SiO_2 \rightarrow FeSiO_3$ (slag)

9. (d) Cu^{2+}, Ti^{3+}

   Explanation: Cu^{2+}, Ti^{3+} have same number of unpaired electrons i.e.1 and hence have same magnetic moment.

10. (c) Potassium tetrahydroxidozincate(II)

    Explanation: In an ionic compound cation is named first and then the anion. When the complex is anion we add -ate to the central metal. Here the cation is Potassium K^+ and the anion is the complex. There are 2 K^+ and hence a total of +2 charge which is balanced by -2 charge on the complex. OH⁻ is hydroxido ligand. Ligand is named first followed by the name of the central metal atom/ion with its oxidation state in paranthesis in roman numerals. Here there are 4 OH⁻ and each carries a -1 charge. Let the oxidation state of Zn be x. Then

    x + 4(-1) = -2

    x - 4 = -2

    x = -2 + 4 = +2

    So, oxidation state of Zn=+2

So, the IUPAC name is Potassium tetrahydroxidozincate(II).

11. (a) Polyvinyl chloride
Explanation: PVC is a thermoplastic polymer which possesses intermolecular forces of attraction intermediate between elastomers and fibres. It is used in making rain coats, hand bags, water pipes etc.

12. (b) Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
Explanation: Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

13. (a) Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
Explanation: Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

14. (a) Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
Explanation: Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

15. (b) Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
Explanation: Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

16. (d) Assertion is INCORRECT but, reason is CORRECT.
Explanation: Assertion is INCORRECT but, reason is CORRECT.

Section B

17. To improve the physical properties of rubber like hardness its elasticity. After vulcanization rubber becomes resistant to the action of organic solvents and oxidizing agents.

18.
    i. Rate of chemical reaction when concentration of each reactant is unity is called rate constant. It is also known as specific rate of reaction.
    ii. It is the extra energy contained by reactant molecules that results into effective collisions between them to form the products. It is denoted by E_a.
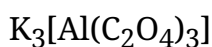
19. Given, W_2 = 1.00 g, W_1 = 50 g, K_f = 5.12 K kg mol^{-1}

ΔT_f = 0.40 K, $\Delta T_f = \dfrac{K_f \times W_2 \times 1000}{M_2 \times W_1}$

$M_2 = \dfrac{K_f \times W_2 \times 1000}{W_1 \times \Delta T_f} = \dfrac{5.12 \times 1 \times 1000}{50 \times 0.40}$
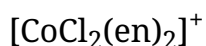
= 256 g mol^{-1}

20. 1. $[Pt(NH_3)_6]Cl_4$

    2. $[CoCl_2(NH_3)_4]^+$

21. i. Potassium trioxolatoaluminate(III)

    $K_3[Al(C_2O_4)_3]$

    ii. Dichloridobis(ethane-1, 2-diamine)cobalt (III)

    $[CoCl_2(en)_2]^+$

OR

Examples of complexes in biological system.-

1. Chlorophyll is a complex of Mg.
2. Haemoglobin is a complex of iron.
3. Cyanocobalamine , Vitamin B_{12},is a complex of cobalt.

22. **Minerals:** Minerals are naturally occurring substances from which metals may or may not be extracted profitably.
    Ores: Ores are the minerals from which metal can be extracted profitably.

OR

Principle involved in froth floatation process is that the ore particles are wetted by pine oil and the gangue particles are wetted by water. Collectors enhance non-wettability of the ore- particles.

23. Higher ethers are insoluble in water because due to the bigger size of the alkyl groups the oxygen atom in ethers fails to form intermolecular hydrogen bonding with water.

Section C

24. W_2 = 19.5 g

    W_1 = 500 g

    ΔT_f (observed) = 1.0°C

    K_f for water = 1.86 K Kg mol^{-1}

    $$M_2\left(observed\right) = \frac{1000 K_f W_2}{W_1 \Delta T_f}$$

    $= \frac{1000 \times 1.86 \times 19.5}{500 \times 1.0}$ = 72.54 g mol^{-1}
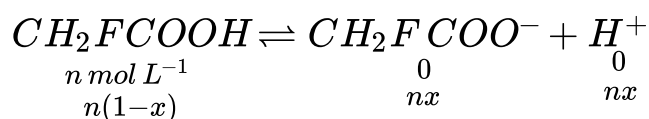
    M_2(calculated) = CH_2FCOOH

    $$= M_2 = \left(2 \times 12\right) + \left(3 \times 1\right) + \left(2 \times 16\right) + \left(1 \times 19\right) = 78 g/mol$$

    Van't Hoff factor $\left(i\right) = \frac{M_2\left(calculated\right)}{M_2\left(observed\right)}$

    $= \frac{78}{72.54}$ = 1.0753

    Calculation of dissociation constant: Suppose degree of dissociation at the given concentration is x.

    Then

    $$\underset{\substack{n\,mol\,L^{-1} \\ n(1-x)}}{CH_2FCOOH} \rightleftharpoons \underset{\substack{0 \\ nx}}{CH_2FCOO^-} + \underset{\substack{0 \\ nx}}{H^+}$$

    Total no. of moles = n(1 - x + x + x)

    = n (1 + x)

    $i = \frac{n(1+x)}{n} = 1 + x$

    x = i - 1

    = 1.0753 - 1 = 0.0753

    $$K_a = \frac{\left[CH_2FCOO^-\right]\left[H^+\right]}{\left[CH_2FCOOH\right]}$$

    $= \frac{nx \times nx}{n(1-x)} = \frac{nx^2}{1-x}$

    $n = \frac{19.5}{78} \times \frac{1}{500} \times 1000$ = 0.5 M

    $K_a = \frac{(0.5)(0.0753)^2}{1-0.0753} = 3.07 \times 10^{-3}$

25. We know that

    $$R_0 \propto P_\infty - P_0$$

    where R_0 = Initial concentration of the reactant, P_0 = Initial pressure of reactant, P_∞ = Pressure after a long time

$R_0 \propto (\underline{276.40} - \underline{262.40})$

$R_0 \propto 14.0 \, mm$

$P_t - P_0 \propto x$ (where x = amount decomposed, P_t = Pressure at time t)

$R \propto [P_\infty - P_0] - [P_t - P_0]$ (where R = Concentration at time t)

$R \propto P_\infty - P_t$

We know that

$k = \frac{2.303}{t} \log \frac{[R_0]}{[R]}$

where k = rate constant, t = time

$= \frac{2.303}{t} \log \frac{P_\infty - P_0}{P_\infty - P_t}$

$k = \frac{2.303}{60} \log \frac{276.4 - 262.4}{276.4 - 272.9}$

$= 2.31 \times 10^{-2} s^{-1}$

$k = \frac{2.303}{120} \times \log \frac{14}{0.89}$

$= 2.296 \times 10^{-2} s^{-1}$

This implies that the reaction is of first order

$k = \frac{2.310 + 2.296}{2} \times 10^{-2} s^{-1}$

$k = 2.303 \times 10^{-2} s^{-1}$

OR

The initial rate of the reaction is:

Rate = $k[A][B]^2$

$= \left(2.0 \times 10^{-6} mol^{-2} L^2 s^{-1}\right) \left(0.1 mol L^{-1}\right)$

$\left(0.2 mol L^{-1}\right)^2 = 8.0 \times 10^{-9} mol^{-2} L^2 s^{-1}$

When [A] is reduced from $0.1 mol L^{-1} to 0.06 mol^{-1}$, the concentration of A reacted

$= (0.1 - 0.06) mol L^{-1} = 0.004 mol L^{-1}$

Therefore, concentration of B reacted $= \frac{1}{2} \times 0.04 mol L^{-1} = 0.02 mol L^{-1}$

Then, concentration of B available, $[B] = (0.2 - 0.02) mol L^{-1}$

$= 0.18 mol L^{-1}$
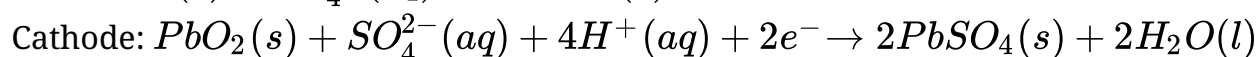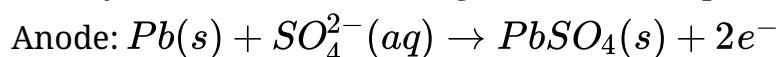
After [A] is reduced to $0.06 mol^{-1}$, the rate of the reaction is given by,

Rate = $k[A][B]^2$

$= \left(2.0 \times 10^{-6} mol^{-2} L^2 s^{-1}\right) \left(0.06 mol L^{-1}\right)$

= 6 x 10^{-8} mol^{-1} L^{-1}s^{-1}

26. A lead storage battery consists of anode of lead, cathode of a grid of lead packed with lead dioxide (PbO_2) and 38% solution of sulphuric acid as electrolyte. When the battery is in use, the following reaction takes place:
Anode: $Pb(s) + SO_4^{2-}(aq) \rightarrow PbSO_4(s) + 2e^-$
Cathode: $PbO_2(s) + SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \rightarrow 2PbSO_4(s) + 2H_2O(l)$
On charging the battery, the reverse reaction takes place, i.e. PbSO$_4$ deposited on the electrodes is converted back into Pb and PbO$_2$, and H$_2$SO$_4$ is regenerated.

27. NH$_3$ is distinctly basic while BiH$_3$ is feebly basic. Nitrogen has a small size due to which the lone pair of electrons is concentrated in a small region. This means that the charge density per unit volume is high. On moving down a group, the size of the central atom increases and the charge gets distributed over a large area decreasing the electron density. Hence, the electron donating capacity of group 15 element hydrides decreases on moving down the group.

28. i. **Chirality**: Chirality is the property of a molecule, containing a carbon attached to four different groups, having a non-superimposable mirror image.
     Chiral centre: The carbon which is attached to four different groups is called chiral centre.
   ii. **Diastereoisomers:** Those pairs of stereoisomers which are not mirror images of each other. They differ in optical rotation.
     Enantiomers: They are non-superimposable mirror images of each other. They have optical rotation equal in magnitude but opposite in sign.

29. The carbonyl carbon in HCHO is sp2 hybridisation. The C atom has formed one sigma bond with oxygen and other two sigma bonds with hydrogen atoms. The carbonyl carbon and the three atoms bonded to it are all lie in one plane. Carbonyl carbon has one unhybridised p-orbital present perpendicular to the plane and overlaps sideways with oxygen p-orbital.
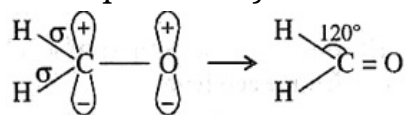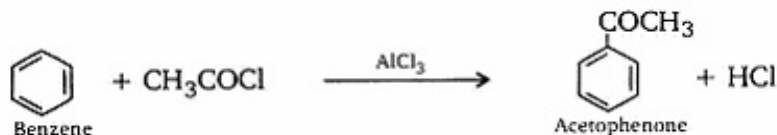

The π electron cloud is present above and below this plane. Due to this, they have
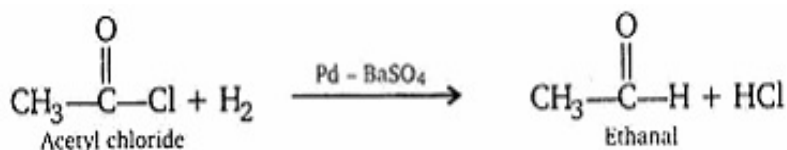
dipole - dipole interaction and have boiling point greater than comparable molecular mass of non-polar hydrocarbons.

OR

i. **Acylation reaction:**
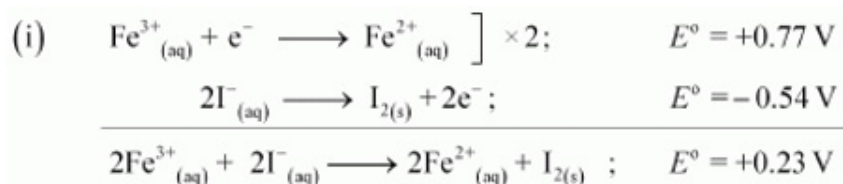

ii. **Rosenmund reduction:**

30. **Antiseptics** are chemical substances which present the growth of micro-organisms and may even kill them but are not harmful to human or animal tissues. For example, Dettol and Savlon.
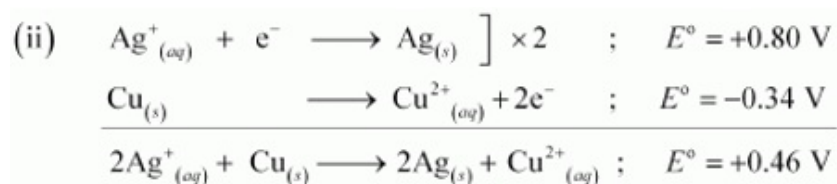
    Disinfectants are chemical substances which kill micro organisms but are not safe to be applied to the living tissues. These are generally used to kill micro organisms present in the drains, toilets, floor etc.

Section D

31. A reaction is feasible if EMF of the cell is positive.

(i)
$$Fe^{3+}_{(aq)} + e^- \longrightarrow Fe^{2+}_{(aq)} \bigg] \times 2; \qquad E° = +0.77 \text{ V}$$
$$2I^-_{(aq)} \longrightarrow I_{2(s)} + 2e^-; \qquad E° = -0.54 \text{ V}$$
$$\overline{2Fe^{3+}_{(aq)} + 2I^-_{(aq)} \longrightarrow 2Fe^{2+}_{(aq)} + I_{2(s)}}; \qquad E° = +0.23 \text{ V}$$

Since E^0 for the overall reaction is positive, the reaction between Fe^{3+}(aq) and I⁻(aq) is feasible.

(ii)
$$Ag^+_{(aq)} + e^- \longrightarrow Ag_{(s)} \bigg] \times 2 \quad ; \quad E° = +0.80 \text{ V}$$
$$Cu_{(s)} \longrightarrow Cu^{2+}_{(aq)} + 2e^- \quad ; \quad E° = -0.34 \text{ V}$$
$$\overline{2Ag^+_{(aq)} + Cu_{(s)} \longrightarrow 2Ag_{(s)} + Cu^{2+}_{(aq)}} \quad ; \quad E° = +0.46 \text{ V}$$

Since E^0 for the overall reaction is positive, the reaction between Ag^+(aq) and Cu(s) is feasible.

(iii)

$$Fe^{3+}_{(aq)} + e^- \longrightarrow Fe^{2+}_{(aq)}] \times 2 \quad ; \quad E° = +0.77 \text{ V}$$

$$2Br^-_{(aq)} \longrightarrow Br_{2(l)} + 2e^- \quad ; \quad E° = -1.09 \text{ V}$$

$$2Fe^{3+}_{(aq)} + 2Br^-_{(aq)} \longrightarrow 2Fe^{2+}_{(aq)} \text{ and } Br_{2(l)} \quad ; \quad E° = -0.32 \text{ V}$$
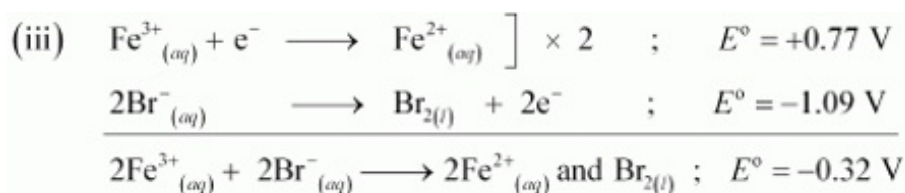
Since E^0 for the overall reaction is negative, the reaction between Fe^{3+}(aq) and Br^-(aq) is not feasible.

(iv)

$$Ag_{(s)} \longrightarrow Ag^+_{(aq)} + e^- \quad ; \quad E° = -0.80 \text{ V}$$

$$Fe^{3+}_{(aq)} + e^- \longrightarrow Fe^{2+}_{(aq)} \quad ; \quad E° = +0.77 \text{ V}$$

$$Ag_{(s)} + Fe^{3+}_{(aq)} \longrightarrow Ag^+_{(aq)} + Fe^{2+}_{(aq)} \quad ; \quad E° = -0.03 \text{ V}$$
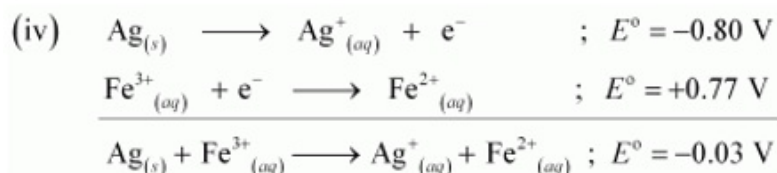
Since E^0 for the overall reaction is negative, the reaction between Ag(s) and Fe^{3+}(aq) is not feasible.

(v)

$$Br_{2(aq)} + 2e^- \longrightarrow 2Br^-_{(aq)} \quad ; \quad E° = +1.09 \text{ V}$$

$$Fe^{2+}_{(aq)} \longrightarrow Fe^{3+}_{(aq)} + e^-] \times 2 \quad ; \quad E° = -0.77 \text{ V}$$

$$Br_{2(aq)} + 2Fe^{2+}_{(aq)} \longrightarrow 2Br^-_{(aq)} + 2Fe^{3+}_{(aq)} \quad ; \quad E° = +0.32 \text{ V}$$
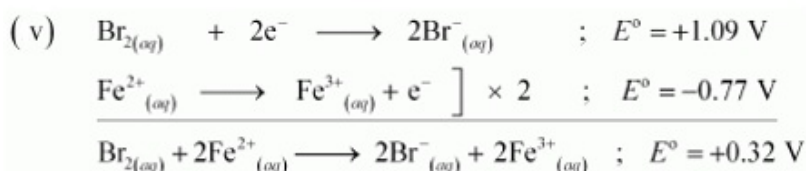
Since E^0 for the overall reaction is positive, the reaction between Br_2(aq) and Fe^{2+}(aq) is feasible.

OR

i. **At cathode:** $2H^+$(aq) + 2e$^-$ $\rightarrow$ H_2(g)

   At anode: $2OH^-$(aq) $\rightarrow$ O_2(g) + $2H^+$(aq) + 4e$^-$

   H_2(g) is evolved at cathode and O_2(g) is evolved at anode.

ii. **At cathode:** Ag^+(aq) + e$^-$ $\rightarrow$ Ag(s)

   At anode: Ag(s) $\rightarrow$ Ag^+(aq) + e$^-$

32. i. These can be distinguished by the carbylamine test.

$$CH_3NH_2 + CHCl_3 + 3KOH \xrightarrow{\Delta} CH_3NC + 3KCl + 3H_2O$$
$$\underset{\underset{(1^0 \ Amine)}{Methylamine}}{} \quad \underset{(alc)}{} \quad \underset{\underset{(offensive\,smell)}{Methylisocyanide}}{}$$

$$\underset{\underset{(2^0) \ amine}{Dimethylamine}}{CH_3NH} \xrightarrow{CHCl_3/KOH(alc)} No\,reaction$$
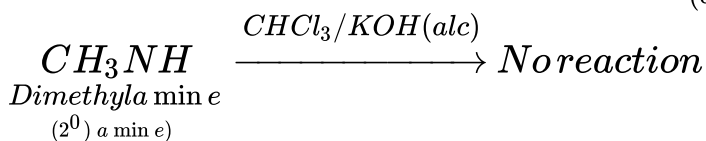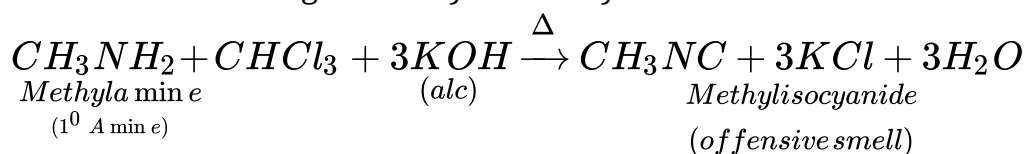
ii. Secondary and tertiary amines can be distinguished by Libermann nitrosoamine test. 2° amines react with nitrous acid to form N-nitrosamines while 3° do not.
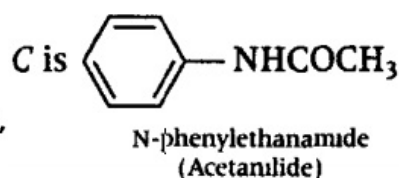
$$(CH_3CH_2)_2\,NH + HO - N = 0 \rightarrow (CH_3CH_2)_2 N - N = O + H_2O$$

$\underset{Diethyla\min e}{}$ $\qquad\qquad\qquad\qquad$ $\underset{N-Nitrosodiethyla\min e}{}$
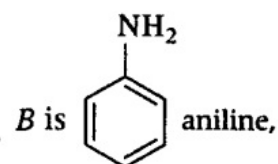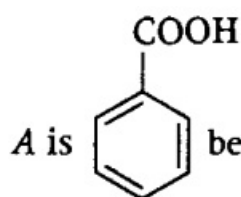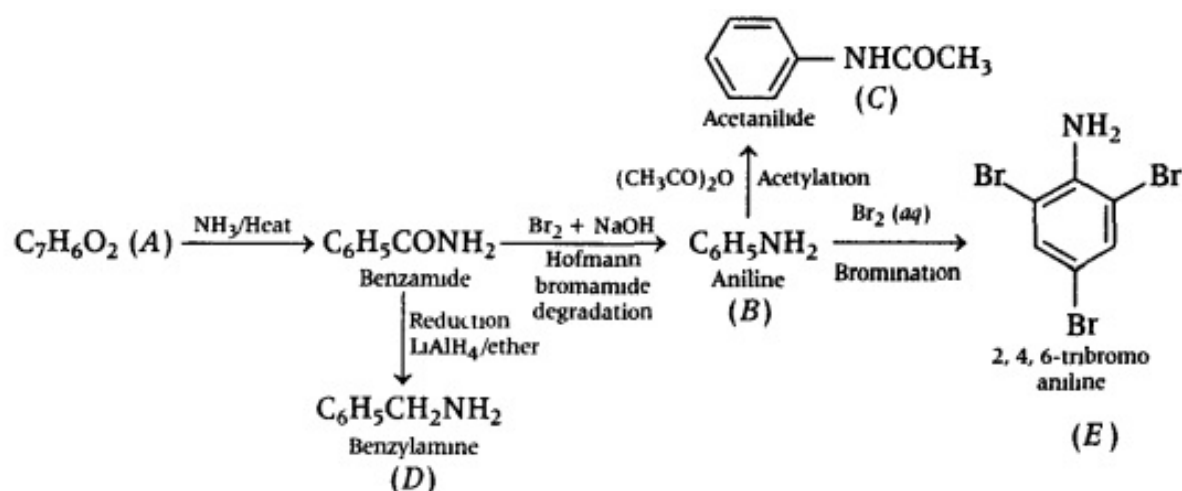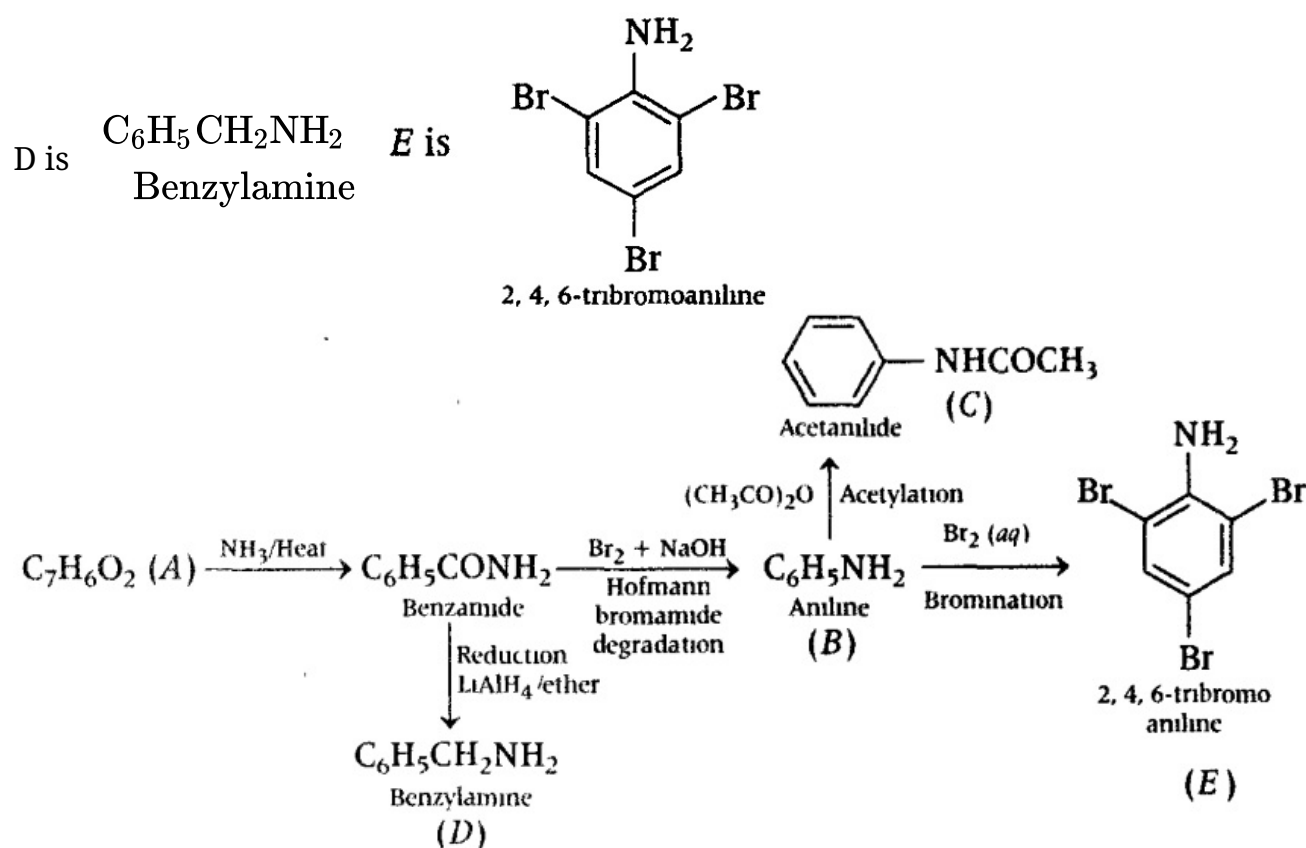
$$(Yellow\ colour)$$
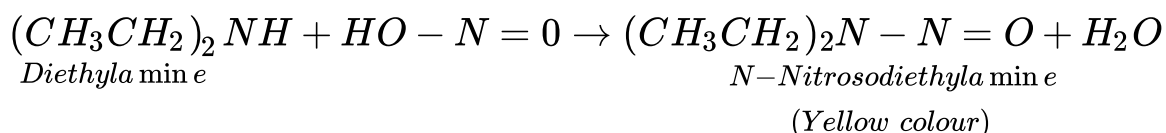
iii. **Azo dye test:** Aniline and ethylamine can be distinguished by azo dye test. It involves the reaction of aniline with HNO_2 at 273-278 K followed by treatment with an alkaline solution of β-naphthol, which gives a brilliant yellow, orange or red coloured dye. Ethylamine under these condition gives a brisk evolution of N_2 gas with the formation of primary alcohol.

iv. **Nitrous acid test:** Benzylamine reacts with nitrous acid to form a diazonium salt which being unstable even at low temperature, decomposes with evolution of N_2 gas.

Aniline, on the other hand, reacts with nitrous acid to form benzene diazonium chloride which is stable at 273 - 278 K and hence does not decompose to evolve N_2 gas.

v. **Carbylamine test:** Aniline being a primary amine gives carbylamine test whereas N-methylamine being a secondary amine does not give this test. when aniline is heated with an alcoholic solution of KOH and $CHCl_3$, it gives the offensive smell of phenyl isocyanide.

OR

A is benzoic acid, B is aniline, C is N-phenylethanamide (Acetanilide)

D is $C_6H_5CH_2NH_2$ Benzylamine

E is

$$\text{NH}_2$$

2, 4, 6-tribromoaniline

(structure: benzene ring with NH₂ at top, Br at positions 2 and 6, Br at position 4)

Reaction scheme:

$C_7H_6O_2$ (A) $\xrightarrow{NH_3/Heat}$ $C_6H_5CONH_2$ Benzamide $\xrightarrow[\text{Hofmann bromamide degradation}]{Br_2 + NaOH}$ $C_6H_5NH_2$ Aniline (B) $\xrightarrow[\text{Bromination}]{Br_2\ (aq)}$ 2, 4, 6-tribromo aniline (E)

(Benzamide) $\downarrow$ Reduction LiAlH$_4$/ether

$C_6H_5CH_2NH_2$ Benzylamine (D)

Acetanilide — $NHCOCH_3$ (C)

$\uparrow$ $(CH_3CO)_2O$ Acetylation (from $C_6H_5NH_2$ Aniline (B))

(E) structure: benzene ring with NH₂ at top, Br at positions 2 and 6, Br at position 4 — 2, 4, 6-tribromo aniline

33. i. High enthalpies of atomization of transition elements are attributed to the involvement of (n - 1)d electrons in addition to ns electrons in the interatomic metallic bonding. In, general , greater the number of valence electrons, stronger is the resultant bonding and higher will be enthalpy of atomization.

ii. The molecules of the reactants form unstable intermediates with the surface of transition metals due to presence of unpaired d- electrons. The unstable intermediates then decompose to give the products and hence transition metal act as catalyst.

iii. Actinoid contraction from element to element, is greater than lanthanoid contraction because the 5f electrons, have more poor shielding effect compared to 4f electrons. Because of poor shielding effect, effective nuclear charge increases and size decreases.

iv. One of the factors that contributes to the more positive value of reduction potential E^0 is the stable oxidation state of the metal. Mn shows +2 as stable oxidation state, as Mn^{+2} has $3d^5$ configuration which is stable due to half filled configuration. On the other hand Cr has +3 as stable oxidation state because Cr^{+3} has half filled t_{2g} configuration.

v. In Sc, has ground state electronic configuration as $3d^1 4s^2$. So, it has incompletely filled d orbital in its ground state. Therefore, it is regarded as a transition element.

OR

a. i. Manganese shows maximum number of oxidation states in 3d series due to the presence of maximum number of unpaired electrons.

   ii. E^o value for Mn^{3+}/Mn^{2+} couple is much more positive than that for Cr^{3+}/Cr^{2+} because Cr is more stable in +3 oxidation state due to stable t^3_{2g} configuration whereas Mn is more stable in +2 oxidation state due to half filled $3d^5$ configuration.

b. Preparation of $KMnO_4$ from MnO_2 :

$2MnO_2 + 4KOH + O_2 \rightarrow 2K_2MnO_4 + 2H_2O$

$2K_2MnO_4 + 4HCl \rightarrow 2KMnO_4 + MnO_2 + H_2O + 4KCl$