CBSE Class 12 Chemistry
Sample paper 04 (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. A Lead storage battery is the most important type of secondary cell having a lead anode and a grid of lead packed with PbO_2 as a cathode. A 38% solution of sulphuric acid is used as the electrolyte (Density=1.294 g mL^{-1}). The battery holds 3.5 L of the acid. During the discharge of the battery, the density of H_2SO_4 falls to 1.139 g mL^{-1}. (20% H_2SO_4 by mass)

   i. Write the reaction taking place at the cathode when the battery is in use.
   ii. How much electricity in terms of Faraday is required to carry out the reduction of one mole of PbO_2?
   iii. What is the molarity of sulphuric acid before discharge?

iv. Lead storage battery is considered a secondary cell. Why?
v. Write the products of electrolysis when dilute sulphuric acid is electrolysed using Platinum electrodes.

2. Name the method used for refining copper metal.
3. Name the location where protein synthesis occur in our body.
4. Why cannot vitamin C be stored in our body?
5. Write some examples of condensation polymers.
6. Give chemical test to distinguish between benzophenone and acetophenone.
7. The reaction of $CH_3CH =$  OH with HBr gives
   a. $CH_3CHBrCH_2$  Br
   b. $CH_3CHBrCH_2$  OH
   c. CH_3CH_2CHBr  OH
   d. CH_3CH_2CHBr  Br
8. Blister copper is about
   a. 30% Cu
   b. 90% Cu
   c. 60% Cu
   d. 98% Cu
9. The percentage of nickel in the alloy steel that is used for making pendulum is
   a. 19%
   b. 36%

c. 0%

d. 10%

10. When 0.1 mol $CoCl_3$ $(NH_3)_5$ is treated with excess of $AgNO_3$, 0.2 mol of AgCl are obtained. The conductivity of solution will correspond to

    a. 3:1 electrolyte

    b. 1:2 electrolyte

    c. 1:3 electrolyte

    d. 1:1 electrolyte

11. PHBV is developed because:

    a. it is resistant to attack of chemicals

    b. it is more easily prepared by copolymerisation

    c. it is an alternative to natural rubber

    d. it reduces accumulation of the synthetic solid polymer waste

12. **Assertion:** Fats and oils are one of the main sources of food for all living organisms.
    Reason: Lipids act as energy reserves.

    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 CCI_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:** Boron has relatively higher melting point and boiling point in its own group.
Reason: Boron exists as a giant covalent Polymeric structure both in solid and in the liquid state.

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:** Ethanol gives iodoform test while methanol does not.
Reason: Ethanol is less reactive than methanol towards nucleophilic addition reactions.

    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. Define the terms polymer and monomer.

18. For a first order reaction, show that time required for 99% completion is twice the time required for the completion of 90% of reaction.

19. Define Henry's law about solubility of a gas in a liquid.

20. Name the hybridization and the orbitals involved in the shape of $[Ni(CN)_4]^{2-}$

21. Using the valence bond approach, deduce the shape and magnetic character of $[Co(NH_3)_6]^{3+}$. [Atomic number of Co = 27]

OR

What is the basis of formation of spectro-chemical series?

22. Write the relationship between change in Gibbs free energy, enthalpy change and change in entropy at temperature T.

OR

The reaction, $Cr_2O_3 + 2Al \rightarrow Al_2O_3 + 2Cr\,(\Delta G_0 = -421kJ)$ is thermodynamically feasible as is apparent from the Gibbs energy value. Why does it

not take place at room temperature?

23. Give reason for the following.

    i. m-amino phenol is a stronger acid than O-amino phenol.
    ii. Alcohols act as weak bases.

Section C

24. An aqueous of glucose is made by dissolving 10 g of glucose ($C_6H_{12}O_6$) in 90 g of water at 303 K. If the vapour pressure of pure water at 303 K be 32.8 mm Hg. What would be the vapour pressure of the solution?

25. A reaction is second order with respect to a reactant. How is the rate of reaction affected if the concentration of the reactant is:

    i. doubled
    ii. reduced to half?

OR

Consider the reaction:

2A + B $\rightarrow$ C + D

Following results were obtained in experiments designed to study the rate of reaction:

Exp. No.	Initial concentration (mol L^{-1}) [A]	[B]	Initial rate of formation [D] (m/min)
1.	0.10	0.10	1.5×10^{-3}
2.	0.20	0.20	3.0×10^{-3}
3.	0.20	0.40	6.0×10^{-3}

    i. Write the rate law for the reaction.
    ii. Calculate the value of rate constant for the reaction.
    iii. Which of the following possible reaction mechanism is consistent with the rate law?
        I. $\mathrm{A} + \mathrm{B} \rightarrow \mathrm{C} + \mathrm{E}\,(\text{slow})$
        $A + E \rightarrow D\ (fast)$

II. $B \rightarrow C + E(slow)$
$A + E \rightarrow F\ (fast)$
$A + F \rightarrow D\ (fast)$

26. Explain Kohlrausch's law of independent migration of ions. Mention one application of Kohlrausch's law.

27. Can PCl_5 act as an oxidizing but not reducing agent? Explain.

28. How can the following conversions be carried out?

    i. Aniline to bromobenzene
    ii. Chlorobenzene to 2-chloroacetophenone
    iii. Chloroethane to butane

29. Write the steps for the conversion of ethyl alcohol to acetone.

OR

Two moles of compound (A) on treatment with a strong base gives two compounds (B) and (C). The compound (B) on dehydrogenation with Cu gives (A) while acidification of (C) gives carboxylic acid (D) having molecular formula CH_2O_2. Identify (A) to (D).

30. With reference to which classification has the statement, 'Ranitidine is an antacid' been given?

Section D

31. a. What is electrochemical equivalent?
    b. Calculate the cell emf and $\Delta G°$ for the cell reaction at 25^0C. Zn / Zn^{+2}(0.1M) // Cu^{+2}(0.01M) /Cu electrode potential for Zn is - 0.403 volt and for Cu is -0.763 volt

OR

Define conductivity and molar conductivity for the solution of an electrolyte. Discuss their variation with concentration.

32. i. Write the structures of main products when benzene diazonium chloride ($C_6H_5N_2^+Cl^-$) reacts with the following reagents :

a. HBF_4/Δ

b. Cu /HBr

ii. Write the structures of A, B and C in the following reactions :

a. $C_6H_5NO_2 \xrightarrow{Sn/HCl} A \xrightarrow[273K]{NaNO_2 + HCl} B \xrightarrow[\Delta]{H_2O} C$

b. $CH_3Cl \xrightarrow{KCN} A \xrightarrow{LiAlH_4} B \xrightarrow[273K]{HNO_2} C$

OR

a. An aromatic compound 'A' on treatment with aquecous ammonia and heating forms compound 'B' which on heating with Br_2 and KOH forms a compound 'C' of molecular formula C_6H_7N. Write the structures and IUPAC names of compounds A, B and C.

b. Complete the following reactions:

i. $C_6H_5NH_2 + CHCl_3 + \text{alc. KOH} \rightarrow$

ii. $C_6H_5N_2Cl + H_3PO_2 + H_2O \rightarrow$

33. i. Complete the following equations:

a. $Cr_2O_7^{2-} + 2OH^- \longrightarrow$

b. $MnO_4^- + 4H^+ + 3e^- \longrightarrow$

ii. Account the following:

a. Zn is not considered as a transition element.

b. Transition metals form a large number of complexes.

c. The E^o value for the Mn^{3+}/Mn^{2+} couple is much more positive than that for Cr^{3+}/Cr^{2+} couple.

OR

a. Write one difference between transition elements and p-block elements with reference to variability of oxidation states.

b. Why do transition metals exhibit higher enthalpies of atomization?

c. Name an element of lanthanoid series which is well known to shown +4 oxidation state. Is it a strong oxidising agent or reducing agent?

d. What is lanthanoid contraction? Write its one consequence.

e. Write the ionic equation showing the oxidation of Fe(II) salt by acidified dichromate solution.

CBSE Class 12 Chemistry

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Solution

Section A

1. i. Reaction taking place at cathode when the battery is in use:

   $PbO_2(s) + SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \rightarrow PbSO_4(s) + 2H_2O(l)$

   ii. 2 F

   iii. Molarity = $\frac{38 \times 1.294 \times 1000}{98 \times 100}$ = 5.02M

   iv. It can be recharged after use.

   v. At anode: O_2 (g)

   At cathode: H_2 (g)

2. Electrolytic refining method used for refining copper metal.

3. Cytoplasm

4. Vitamin C cannot be stored in our body because it is water soluble. As a result, it is readily excreted in the urine.

5. Examples of condensation polymers are Nylon- 6, 6, Dacron, Nylon 6, terylene, glyptal, etc.

6. Benzophenone ($C_6H_5COC_6H_5$) and acetophenone ($C_6H_5COCH_3$) can be distinguished by the iodoform test.

   $$\underset{\text{Acetophenone}}{C_6H_5COCH_3} + 3NaOI \longrightarrow C_6H_5COO^-Na^+ + \underset{\text{Iodoform (Yellow ppt)}}{CHI_3 \downarrow} + 2NaOH$$

   $C_6H_5COC_6H_5 \xrightarrow{NaOI}$ No yellow ppt. of iodoform

7. (c) CH_3CH_2CHBr  OH

   Explanation:

   CH_3CH_2CHBr  OH

8. (d) 98% Cu
   Explanation:

   Blister copper contains is 98% Cu and very small percentage of other impurities.

9. (b) 36%
   Explanation:

   The percentage of nickel in the alloy steel that is used for making pendulum is 36%

10. (b) 1:2 electrolyte
    Explanation: 1:2 electrolyte
11. (d) it reduces accumulation of the synthetic solid polymer waste
    Explanation: PHBV is an aliphatic polyester used in speciality packaging, orthopaedic devices and in controlled release of drugs. PHBV undergoes bacterial degradation in the environment. So it reduces accumulation of synthetic solid polymer waste.
12. (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.
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    Explanation: Both assertion and reason are CORRECT but, reason is NOT THE

CORRECT explanation of the assertion.

Section B

17. Polymers are high molecular mass macromolecules composed of repeating structural units derived from monomers. Polymers have a high molecular mass (103 - 107 u). In a polymer, various monomer units are joined by strong covalent bonds. Polymers can be natural as well as synthetic. Polythene, rubber, and nylon 6, 6 are examples of polymers.
    Monomers are simple, reactive molecules that combine with each other in large numbers through covalent bonds to give rise to polymers. For example, ethene, propene, styrene, vinyl chloride.

18. For a first order reaction, the time required for 99% completion is
    $t_1 = \frac{2.303}{k}\log\frac{100}{100-99}$
    $= \frac{2.303}{k}\log 100$
    $= 2 \times \frac{2.303}{k}$
    For a first order reaction, the time required for 90% completion is
    $t_2 = \frac{2.303}{k}\log\frac{100}{100-99}$
    $= \frac{2.303}{k}\log 10$
    $= \frac{2.303}{k}$
    Therefore, $t_1 = 2t_2$
    Hence, the time required for 99% completion of a first order reaction is twice the time required for the completion of 90% of the reaction.

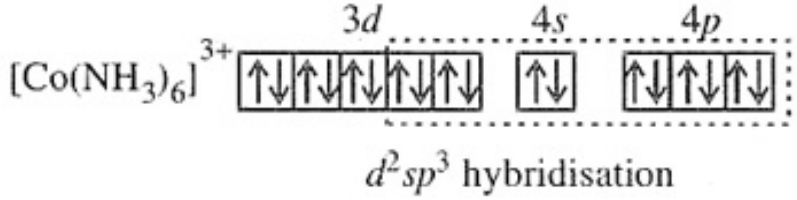
19. Henry's law states that the solubility of a gas in a liquid is directly proportional to the pressure of the gas. Alternatively, Henry's law states that,' the mass of a gas dissolved per unit volume of the solvent at a given temperature is proportional to the pressure of the gas in equilibrium with the solution.

20. Hybridisation = dsp^2
    Orbitals involved 3d, 4s and 4p and shape is square planner.

21. Electronic configuration of Co : [Ar]$4s^2 3d^7$

Electronic configuration of Co^{3+} : [Ar]$^4s^0 3d^6$

NH_3 is strong field ligand, it will cause pairing of electrons. Hence,



d^2sp^3 hybridisation

It has octahedral shape and is diamagnetic due to the absence of unpaired electrons.

OR

Spectrochemical series: The arrangements of ligands in order of their increasing field strength, i.e. increasing crystal field splitting energy (CFSE) value is called spectrochemical series.

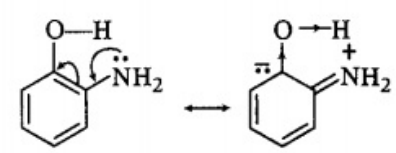
Crystal field splitting energy is the basis of formation of the spectrochemical series.

22. When ΔS is entropy change and ΔH is enthalpy change at temperature T, then change in Gibbs free energy is given by $\Delta G = \Delta H - T\Delta S$

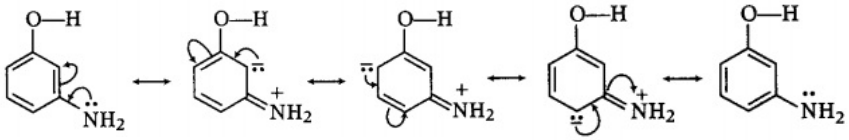
OR

The change in Gibbs energy is related to the equilibrium constant, K as $\Delta G = -RT\,In\,K$. At room temperature, all reactants and products of the given reaction are in the solid state. As a result, equilibrium does not exist between the reactants and the products. Hence, the reaction does not take place at room temperature. However, at a higher temperature, chromium melts and the reaction takes place. We also know that according to the equation $\Delta G = \Delta H - T\Delta S$. Increasing the temperature increases the value of making the value of more and more negative. Therefore, the reaction becomes more and more feasible as the temperature is increased.

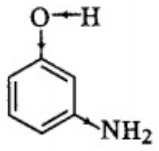
23. i. An amino group, when attached to the benzene ring, has +R-effect due to the presence of lone pair of electron on N-atom present. When -NH_2 is present at ortho-position it increases the electron density of the O-H bond.



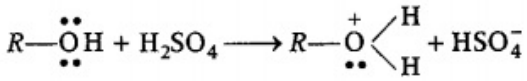
But at m-position, it cannot push electrons into the O-H bond since a negative charge cannot move to the carbon atom to which the OH group is attached as shown below:



Since -NH_2 group cannot exert its +R-effect at m-position, Hence, m-aminophenol is more acidic than o-aminophenol.



ii. Alcohols act as Bronsted bases in the presence of strong acids due to the presence of lone pair of electrons on oxygen, which makes them proton acceptors.



Section C

24. W_1 = 90 g

W_2 = 10g

M_2 = (6×12)+(12×1)+(6×16) =180 g mol^{-1}

P_1^0 = 32.8 mm Hg

M_1 = 18 g mol^{-1}

$$\frac{P_1^0 - P_1}{P_1^0} = \frac{n_2}{n_1 + n_2} = \frac{W_2}{M_2} \times \frac{M_1}{W_1}$$

$$\frac{P_1^0 - P_1}{P_1^0} = \frac{92}{180} \times \frac{18}{90}$$

$$1 - \frac{P_1}{P_1^0} = \frac{92 \times 18}{180 \times 90}$$

$$-\frac{P_1}{P_1^0} = \frac{92 \times 18}{180 \times 90} - 1$$

$$\frac{P_1}{P_1^0} = \left(1 - \frac{92 \times 18}{180 \times 90}\right)$$

$$\frac{P_1}{32.8} = 1 - \frac{92 \times 18}{180 \times 90}$$

P_1 = 29.45 mmHg

25. Let the concentration of the reactant be [A] = a
    Rate of reaction,$R = k[A]_2 = ka^2$

    i. If the concentration of the reactant is doubled, i.e. [A] = 2a, then the rate of the reaction would be
    $R' = k(2a)^2 = 4ka^2$
    = 4 R
    Therefore, the rate of the reaction would increase by 4 times.

    ii. If the concentration of the reactant is reduced to half, i.e.,$[A] = \frac{1}{2}a$ then the rate of the reaction would be $R' = k\left(\frac{1}{2}a\right)^2$
    $= \frac{1}{4}ka^2 = \frac{1}{4}R$ Therefore, the rate of the reaction would be reduced to $\frac{1}{4}th$

    OR

    i. Let rate law is
    $Rate = k[A]^x[B]^y$
    $So,\ 1.5 \times 10^{-3} = k[0.1]^x[0.1]^y \ldots (i)$
    $3.0 \times 10^{-3} = k[0.2]^x[0.2]^y \ldots (ii)$
    $6.0 \times 10^{-3} = k[0.2]^x[0.4]^y \ldots (iii)$
    From eq.(ii) and (iii)
    $\frac{6\times10^{-3}}{3\times10^{-3}} = \frac{k[0.2]^x[0.4]^y}{k[0.2]^x[0.2]^y}$
    $2^y = 2$
    $\Rightarrow$ y = 1
    From eq.(i) and (ii)
    $\frac{3\times10^{-3}}{1.5\times10^{-3}} = \frac{k[0.2]^x[0.2]^1}{k[0.1]^x[0.1]^1}$
    $2 = 2^x \times 2$
    $2^x = 1$
    $\Rightarrow$ x = 0
    Thus, the rate is given as Rate =k$[B]^1$

    ii. Rate = k[B]
    $k = \frac{Rate}{[B]} = \frac{3\times10^{-3}}{0.2}$

$= 15 \times 10^{-3} \text{min}^{-1}$

iii. B $\rightarrow$ C + E (slow) is the possible reaction with is consistent with the rate law i.e., $Rate = k[B]^1$.
Hence, mechanism II is appropriate for the reaction.

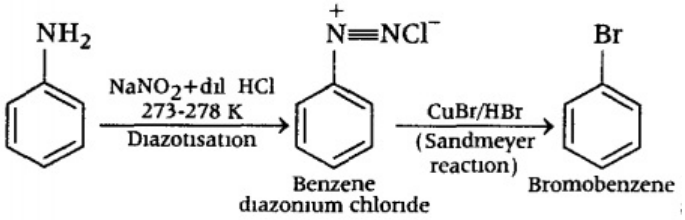
26. It states that at infinite dilution molar conductivity of an electrolyte is equal to the sum of contributions due to cation as well as anion.
Application :

1. Calculation of limiting conductivities of weak electrolytes: The Kohlrausch law can be used to calculate the limiting conductivities of weak electrolytes.
E.g., The calculation of limiting equivalent conductance of acetic acid, a weak electrolyte is illustrated below.
According to Kohlrausch law, the limiting equivalent conductance values of CH_3COOH, CH_3COONa, HCl and NaCl can be written as follows:
$\Lambda_o^{CH_3COOH} = \lambda_o^{CH_3COO^-} + \lambda_0^{H^+}$
$\Lambda_o^{CH_3COOHa} = \lambda_o^{CH_3COO^-} + \lambda_o^{Na^+}$
$\Lambda_o^{HCl} = \lambda_o^{H^+} + \lambda_o^{Cl^-}$
$\Lambda_o^{NaCl} = \lambda_o^{Na^+} + \lambda_o^{Cl^-}$
Therefore
$\Lambda_o^{CH_3COOH} = \Lambda_o^{CH_3COOHa} = \Lambda_o^{HCl} = \Lambda_o^{NaCl}$
2. Determination of degree of ionization (α) of weak electrolyte: The degree of ionization of a weak electrolyte at a particular concentration is equal to the ratio of actual number of ions formed due to partial ionization to the expected number of ions formed upon complete dissociation.
$\alpha = \frac{\text{Actual no. ofions formed due to partial dissociation}}{\text{Expected no. of particles formed due to complete dissociation}}$
Since the conductance is proportional to the number of ions in the solution, the degree of ionization is equal to the conductance ratio as given below.
$\alpha = \frac{\Lambda_c}{\Lambda_o} = \frac{\Lambda_c}{\lambda_o^+ + \lambda_o^-}$
Where
Λ_c = equivalent conductivity at given concentration.
Λ_o = limiting equivalent conductivity.
λ_0^+ = limiting equivalent conductivity of cation.

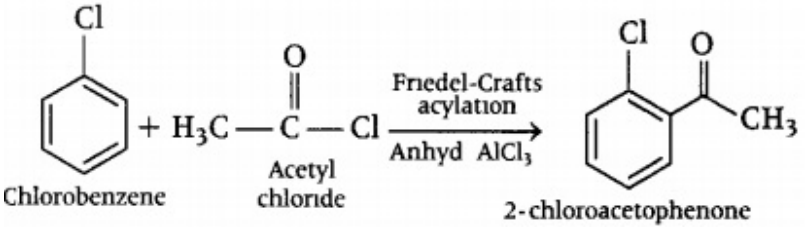
λ_0^- = limiting equivalent conductivity of anion.

27. Oxidation state of P in PCl_5 is +5. Since P has five valence electrons in its valence shell, therefore, it cannot increase its oxidation state beyond +5 by donating electrons, therefore PCl_5 cannot act as a reducing agent. However, it can decrease its oxidation number from +5 to +3 or some lower value, therefore PCl_5 acts as an oxidizing agent. For example, it oxidizes Ag to AgCl.

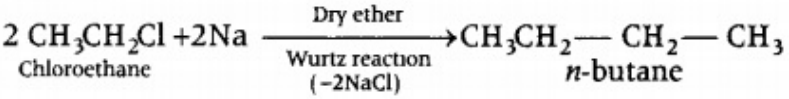
28. i. Aniline can be converted into bromobenzene by using Sandmeyer reaction followed by benzene diazotisation reaction :



ii. Chlorobenzene can be converted into 2-chloroacetophenone by using Friedel crafts acylation reaction:

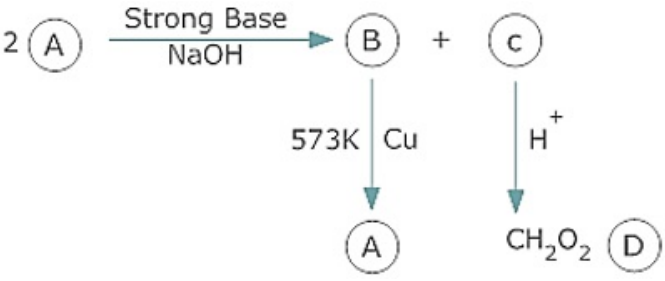


iii. Chloroethane can be converted into butane by using wurtz reaction:

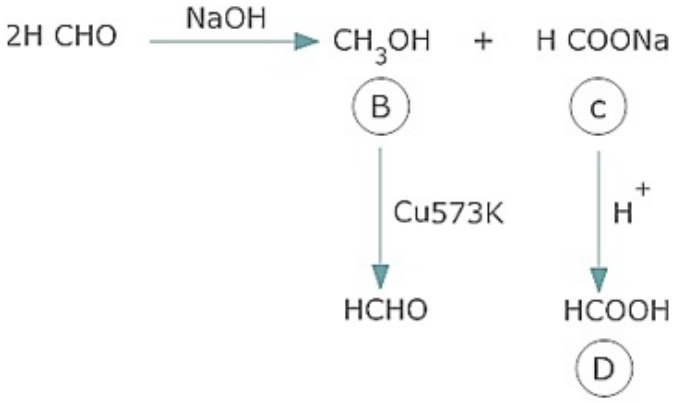


29. $CH_3CH_2OH \xrightarrow[KMnO_4]{(O)} CH_3COOH \xrightarrow{slaked\ lime,\ Ca(OH)_2} Ca(CH_3\ COO)_2$

OR



Since (D) is a carboxylic acid with one carbon only, it is HCOOH. As it is obtained from (C) acidification, (C) COONa and (A) is HCHO which on treatment with strong base (NaOH) gives CH_3OH & HCOONa. This is Cannizzaro reaction in which formaldehyde undergoes self oxidation and reduction(disproportion) on treatment with concentrated alkali. The reactions are as follows:-



30. The given statement refers to the classification of pharmacological effects of the drug. This is because any drug that is used to counteract the effects of excess acid in the stomach is called an antacid.

Section D

31. a. The electrochemical equivalent is the mass of ions deposited or liberated on an electrode during the electrolysis, when 1C of charge is passed through it.

b. $E^{\Theta}_{cell} = E^{\Theta}_{right} - E^{\Theta}_{left}$

= -0.403 - (- 0.763V)

= 0.36V

$$E_{cell} = E^{\Theta}_{cell} - \frac{0.059}{n}\log\frac{[Zn^{2+}]}{[Cu^{2+}]}$$

$$E_{cell} = 0.36 - \frac{0.059}{n}\log\frac{0.1}{0.01}\ [\because n = 2]$$

$$E_{cell} = 0.36 - 0.0295\log 10$$

$$= 0.36 - 0.0295 \times 1$$

= 0.3305V

$$\Delta G^{\Theta} = -nFE^{\Theta}_{cell}$$

$$= -2 \times 96500 \times 0.36$$

$$\Delta G^{\Theta} = 69480 J\,mol^{-1}$$

= 69.48J mol^{-1}

OR

Both conductivity and molar conductivity change with the concentration of the electrolyte. Conductivity always decreases with decrease in concentration both, for weak and strong electrolytes. This can be explained by the fact that the number of ions per unit volume that carry the current in a solution decreases on dilution. The conductivity of a solution at any given concentration is the conductance of one unit volume of solution kept between two platinum electrodes with unit area of cross section and at a distance of unit length.

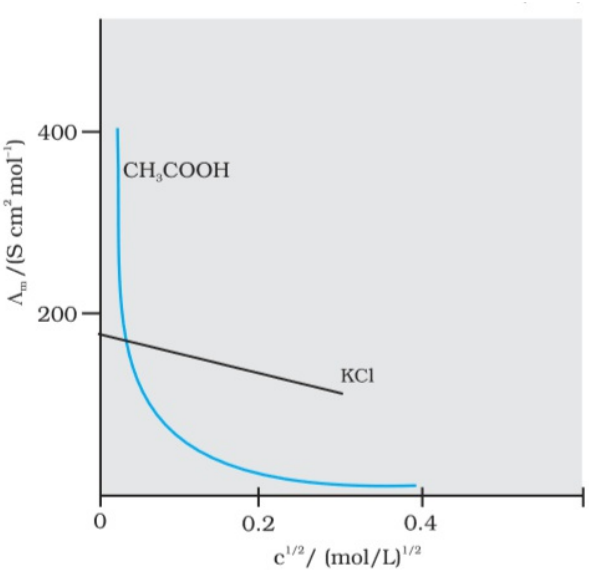
This is clear from the equation:

$G = \frac{\kappa A}{l} = \kappa$ (both A and l are unity in their appropriate units in m or cm)

Molar conductivity of a solution at a given concentration is the conductance of the volume V of solution containing one mole of electrolyte kept between two electrodes with area of cross section A and distance of unit length. Since l = 1 and A = V (Volume containing 1 mole of electrolyte). Therefore,

$\Lambda_m = \frac{\kappa A}{l} = \kappa V$

Molar conductivity increases with decrease in concentration. This is because the total volume, V, of solution containing one mole of electrolyte also increases. It has been found that decrease in κ on dilution of a solution is more than compensated by increase in its volume. Physically, it means that at a given concentration, Λ_m can be defined as the conductance of the electrolytic solution kept between the electrodes of a conductivity cell at unit distance but having area of cross section large enough to accommodate sufficient volume of solution that contains one mole of the electrolyte. When concentration approaches zero, the molar conductivity is known as limiting molar conductivity and is represented by the symbol Λ_m° . The variation in Λ_m with concentration is different for strong and weak electrolytes as shown in the figure.



Molar conductivity versus c½ for acetic acid (weak electrolyte) and potassium chloride (strong electrolyte) in aqueous solutions.

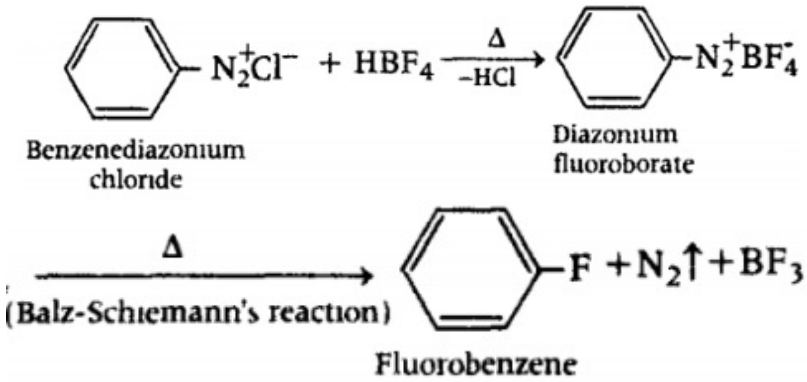
For strong electrolytes, Λ_m increases slowly with dilution and can be represented by the equation:

$\Lambda_m = \Lambda_m^\circ - Ac^{1/2}$

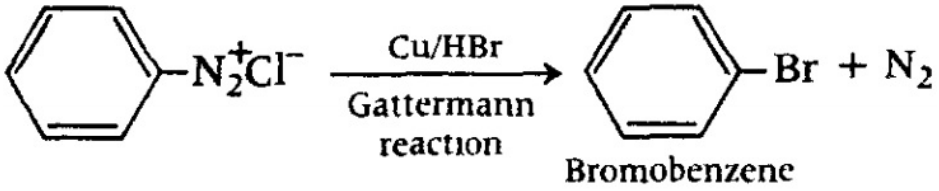
Weak electrolytes like acetic acid have lower degree of dissociation at higher concentrations and hence for such electrolytes, the change in Λ_m with dilution is due to increase in the degree of dissociation and consequently the number of ions in total volume of solution that contains 1 mol of electrolyte. In such cases Λ_m increases steeply on dilution, especially near lower concentrations as shown in the given figure above.

32. i.

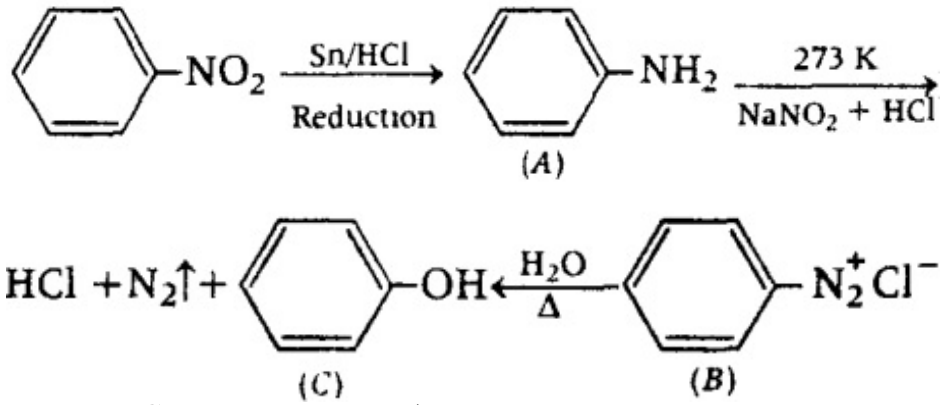
a.



b.



ii.

a. 

b. $CH_3Cl \xrightarrow{KCN} \underset{(A)}{CH_3CN} \xrightarrow{LiAlH_4} \underset{(B)}{CH_3CH_2NH_2} \xrightarrow[HNO_2]{273K} \underset{(C)}{CH_3CH_2OH} + N_2\uparrow +$ H_2O

OR

a. i. Since the compound C of molecular formula C_6H_7N is formed B on treatment with Br_2 and KOH (Hoffmann bromamide reaction), therefore, the compound 'B' must be an amide and 'C' must be an amine. The only aromatic amine having molecular formula C_6H_7N is $C_6H_5NH_2$ (aniline).

ii. Since 'C' is aniline, the amide from which is formed by must be benzamide ($C_6H_5CONH_2$).

$\underset{Aniline\ (C)}{C_6H_5NH_2} \xleftarrow{Br_2,\ KOH} \underset{Benzamide\ (B)}{C_6H_5CONH_2}$

Thus, B is benzamide.

iii. Since B is formed from A with aqueous ammonia and heating, therefore, compound 'A' must be benzoic acid.

$\underset{Benzoic\ acid\ (A)}{C_6H_5COOH} \xrightarrow[Heat]{aq.NH_3} \underset{Benzamide\ (B)}{C_6H_5CONH_2}$

Thus, A = C_6H_5COOH, B = $C_6H_5CONH_2$, C = $C_6H_5NH_2$.

b. i. $C_6H_5NH_2 + CHCl_3 + \underset{(alc)}{3KOH} \rightarrow \underset{Phenyl\ isocyanide}{C_6H_5NC} + 3KCl + 3H_2O$

ii. $C_6H_5N_2Cl + H_3PO_2 + H_2O \rightarrow \underset{Benzene}{C_6H_6} + N_2 + H_3PO_3 + HCl$

33. i. a. $Cr_2O_7^{2-} + 2OH^- \rightarrow 2CrO_4^{2-} + H_2O$

b. MnO_4^- + $4H^+$ + $3e^-$ ⟶ MnO_2 + $2H_2O$

ii. a. Zn ($3d^{10}4s^2$) has completely filled d-orbitals in its atomic as well as in its

common oxidation state (Zn^{2+} state). Therefore, it is not regarded as a transition element.

b. Transition metals form a large number of complex compounds due to the comparatively smaller size of the metal ions, high ionic charges and the availability of vacant d-orbitals for bond formation.

c. The comparatively high E^o value for Mn^{3+}/Mn^{2+} is due to the fact that $Mn^{2+}(d^5)$ is quite stable, while the electronic configuration of Mn^{3+} is $3d^4$ which is less stable than $3d^5$ hence, the conversion from 3+ to 2+ is very feasible whereas comparatively low value for Cr^{3+}/Cr^{2+} is because of the extra stability of Cr^{3+} ($3d^5$) than Cr^{+2} . Therefore, Cr^{3+} cannot be reduced to Cr^{2+} easily.

OR

a. Transition elements show variable oxidation states that differ by 1 unit. p-block elements show variable oxidation states that differ by 2 units.
Heavier transition elements are stable in higher oxidation state whereas p-block elements are stable in lower oxidation state.

b. Transition metals exhibit higher enthalpies of atomization because of strong interatomic interactions and strong metallic bonding between atoms.

c. Element: Cerium or Terbium.
It is a strong oxidizing agent.

d. The steady decrease in atomic radii with an increase in the atomic number due to the poor shielding effect of 4f orbital electrons is known as lanthanoid contraction.
Consequence: 5d series have almost same size as 4d series.

e. Ionic equation:

$Cr_2O_7^{2-} + 14\ H^+ + 6\ Fe^{2+}\ 2\ Cr^{3+} + 6\ Fe^{3+} + 7\ H_2O$