

Sample Question Paper - 20
Chemistry (043)
Class- XII, Session: 2021-22
TERM II

Time allowed : 2 hours

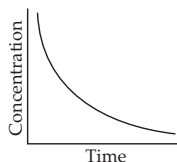
Maximum marks : 35

General Instructions :

1. There are 12 questions in this question paper with internal choice.
2. SECTION A - Q. No. 1 to 3 are very short answer questions carrying 2 marks each.
3. SECTION B - Q. No. 4 to 11 are short answer questions carrying 3 marks each.
4. SECTION C - Q. No. 12 is case based question carrying 5 marks.
5. All questions are compulsory.
6. Use of log tables and calculators is not allowed.

SECTION - A

1. $C_7H_{10}O$ (A) reacts with CH_3MgBr to give a compound, $C_8H_{14}O$ which gives the iodoform test, then find out the structure of A.
2. (a) What is the unit of zero order reaction?
(b) Certain reactions follow the relation between concentrations of the reactant vs time as



What is the expected order for such reactions?

3. (a) Conductivity of 0.01 M NaCl solution is $0.00147 \text{ ohm}^{-1} \text{ cm}^{-1}$. What happens to this conductivity if extra 100 mL of H_2O will be added to the solution?
(b) A conductivity cell has a cell constant of 0.5 cm^{-1} . This cell when filled with 0.01 M NaCl solution has a resistance of 384 ohms at 25°C . Calculate the equivalent conductance of the given solution.

SECTION - B

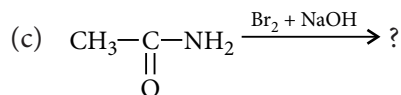
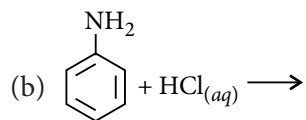
4. How do you convert the following :
(a) Benzamide to Aniline
(b) Aniline to phenol

OR

Illustrate the following reactions giving suitable example in each case :

- (a) Ammonolysis
- (b) Acetylation of amines

5. Complete the following reactions :



OR

Account for the following :

- Cyclohexylamine is a stronger base than aniline.
- It is difficult to prepare pure amines by ammonolysis of alkyl halides.
- Electrophilic substitution in aromatic amines takes place more readily than benzene.

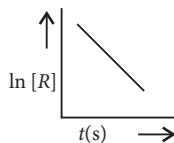
6. Write three differences between adsorption and absorption.

OR

Write one difference in each of the following :

- Multimolecular colloid and associated colloid
- Coagulation and peptization

7. For a chemical reaction $R \longrightarrow P$, the variation in the concentration, $\ln [R]$ vs. time (s) plot is given as



- Predict the order of the reaction.
- What is the slope of the curve?
- Write the unit of the rate constant for this reaction.

OR

For the hydrolysis of methyl acetate in aqueous solution, the following results were obtained :

t/s	0	30	60
$[\text{CH}_3\text{COOCH}_3]/\text{mol L}^{-1}$	0.60	0.30	0.15

- Show that it follows pseudo first order reaction, as the concentration of water remains constant.
- Calculate the average rate of reaction between the time interval 30 to 60 seconds.
(Given : $\log 2 = 0.3010$, $\log 4 = 0.6021$)

8. Define :

- Kohlrausch's law of independent migration of ions.
- Limiting molar conductivity.

9. A solution containing 0.319 g of $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$ was passed through a certain exchange resin and acid coming of cation exchange resin required 28.5 mL of 0.125 M NaOH. What will be the correct formula of complex ?
(mol. wt. of complex = 266.7)

10. Write the name, geometry and the magnetic behaviour of each one of the following complexes :



(At. nos. Co = 27, Ni = 28, Pt = 78)

11. Following are the transition metal ions of 3d series : V^{5+} , Cr^{2+} , Mn^{4+} and Fe^{2+}

(Atomic numbers : Fe = 26, V = 23, Mn = 25, Cr = 24)

Answer the following :

(a) Which ion is most stable in aqueous solution and why?

(b) Which ion is strongest oxidising agent and why?

(c) Which ion is diamagnetic and why?

SECTION - C

12. Read the following passage and answer the questions that follow.

A, B and C are three non-cyclic functional isomers of a carbonyl compound with molecular formula $\text{C}_4\text{H}_8\text{O}$. Isomers A and C give positive Tollens' test whereas isomer B does not give Tollens' test but gives positive iodoform test. Isomers A and B on reduction with $\text{Zn}(\text{Hg})/\text{conc. HCl}$ give the same product D.

(a) Identify compound A.

(b) Identify compound C.

(c) How is compound B obtained?

(d) Out of A, B, C, which will be least reactive towards HCN?

OR

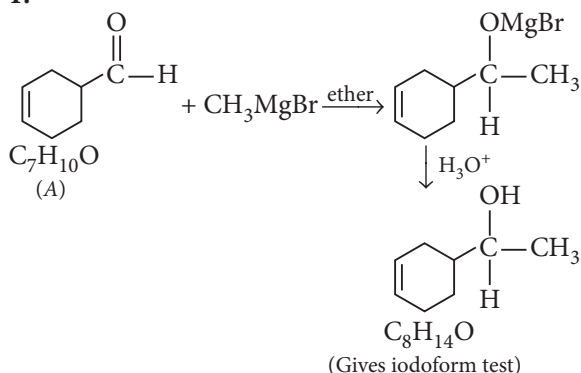
What will be the product when B reacts with ethylene glycol in presence of HCl gas?

Solution

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1.



2. (a) The unit of rate constant, k for zero order reaction is $\text{mol L}^{-1} \text{s}^{-1}$.

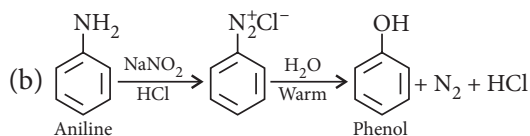
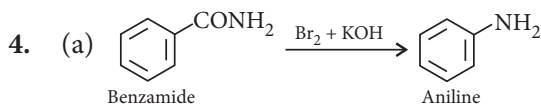
(b) The expected order of reaction is 1.

3. (a) On increasing dilution, the conductivity of the solution decreases.

(b) Equivalent conductance, $\Lambda_{eq} = \frac{\kappa \times 1000}{\text{Normality}}$

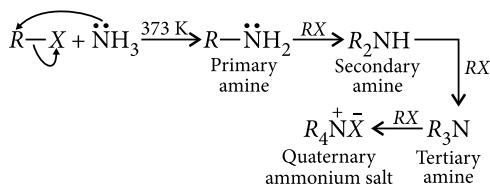
$$\begin{aligned}
 \text{Where, } \kappa \text{ (Specific conductance)} &= G \times \frac{l}{a} \\
 &= \frac{1}{R} \times \frac{l}{a} = \frac{1}{384} \times 0.5 = 1.302 \times 10^{-3} \text{ ohm}^{-1} \text{ cm}^{-1}
 \end{aligned}$$

$$\therefore \Lambda_{eq} = \frac{1.302 \times 10^{-3} \times 1000}{0.01} = 130.2 \text{ ohm}^{-1} \text{ cm}^2 (\text{geq})^{-1}$$

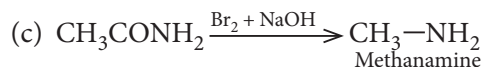
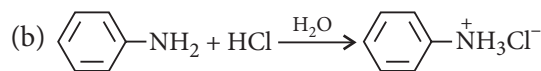
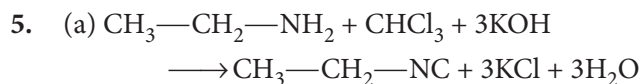
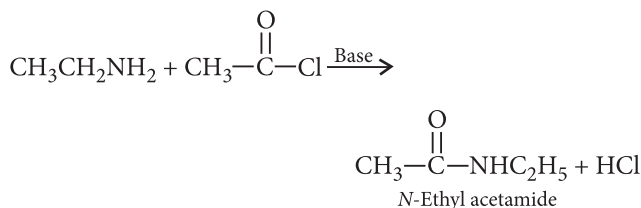


OR

(a) Ammonolysis : Alkyl halides when treated with ethanolic solution of ammonia give a mixture of primary, secondary, tertiary amines and quaternary ammonium salt.

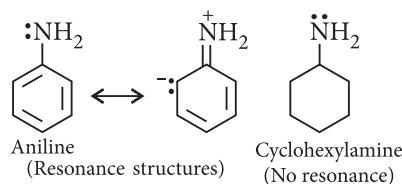


(b) Acetylation of amines : The process of introducing an acetyl group ($\text{CH}_3-\text{C}(=\text{O})-$) into an amine is called acetylation of amines.

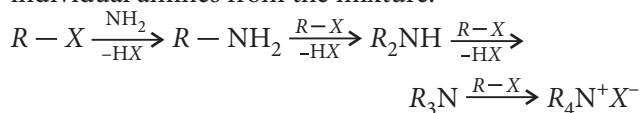


OR

(a) Aniline is weaker base than cyclohexylamine because of resonance. Due to electromeric effect, the lone pair on nitrogen is attracted by benzene ring. Hence, donor tendency of $-\text{NH}_2$ group decreases. There is no resonance in cyclohexylamine. Electron repelling nature of cyclohexyl group further increases the donor property of NH_2 group. So, cyclohexylamine is a stronger base.



(b) The ammonolysis of alkyl halides with ammonia is a nucleophilic substitution reaction in which ammonia acts as a nucleophile by donating the electron pair on nitrogen atom to form primary amine as the initial product. Now, the primary amine can act as a nucleophile and combine with alkyl halide (if available) to give secondary amine and the reaction continues in the same way to form tertiary amine and finally quaternary ammonium salt. Thus, a mixture of products is formed and it is not possible to separate individual amines from the mixture.



(c) Benzene ring in aromatic amines is highly activated due to the displacement of lone pair of nitrogen towards the ring. It results, increase in the electron density on the ring. This facilitates the electrophilic attack on the ring.

6. Three differences between adsorption and absorption :

	Adsorption	Absorption
(i)	It is a surface phenomenon, <i>i.e.</i> , it occurs only at the surface of the adsorbent.	It is a bulk phenomenon, <i>i.e.</i> , occurs throughout the body of the material.
(ii)	In this phenomenon, the concentration on the surface of adsorbent is different from that in the bulk.	In this phenomenon, the concentration is same throughout the material.
(iii)	Its rate is high in the beginning and then decreases till equilibrium is attained.	Its rate remains same throughout the process.

OR

(a) Difference between multimolecular colloid and associated colloid :

Multimolecular colloid	Associated colloid
The particles of this type of colloids are aggregates of atoms or molecules with diameter less than 1 nm. <i>e.g.</i> , sulphur sol consists of colloidal particles which are aggregate of S ₈ molecules.	They are substances which at low concentration behave as true solution and at higher concentration exhibit colloidal behaviour due to formation of aggregated particles.

(b) Difference between coagulation and peptization :

Coagulation	Peptization
It is the process of settling of colloidal particles.	It is the process responsible for the formation of stable dispersion of colloidal particles in dispersion medium.

7. (a) The reaction is of 1st order.

(b) For first order reaction

$$\ln[R] = -kt + \ln[R]_0$$

comparing with equation $y = m \times x + c$

we get a straight line with slope = $-k$ and intercept equal to $\ln[R]_0$.

(c) Unit of rate constant for first order reaction

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

OR

(a) For a first order reaction, $k = \frac{2.303}{t} \log \frac{[A]_0}{[A]}$

When $t = 30$ s

$$k = \frac{2.303}{30} \log \left(\frac{0.60}{0.30} \right) = \frac{2.303}{30} \times 0.3010 = 0.0231 \text{ s}^{-1}$$

When $t = 60$ s

$$k = \frac{2.303}{60} \log \left(\frac{0.60}{0.15} \right) = \frac{2.303}{60} \times 0.602 = 0.0231 \text{ s}^{-1}$$

As the value of k is constant at different time intervals, by using when calculated equation of first order reaction is a first order w.r.t. ester when $[\text{H}_2\text{O}]$ is constant. Hence, it is pseudo first order reaction.

$$\begin{aligned} \text{(b) Average rate} &= -\frac{C_2 - C_1}{t_2 - t_1} = \frac{-(0.15 - 0.30)}{60 - 30} \\ &= \frac{0.15}{30} = 5 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1} \end{aligned}$$

8. (a) Kohlrausch's law of independent migration of ions states that limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolyte.

If $\lambda_{\text{Na}^+}^\circ$ and $\lambda_{\text{Cl}^-}^\circ$ are limiting molar conductivities of the sodium and chloride ions respectively then the limiting molar conductivity for sodium chloride is given by $\Lambda_m^\circ(\text{NaCl}) = \lambda_{\text{Na}^+}^\circ + \lambda_{\text{Cl}^-}^\circ$

Kohlrausch's law helps in the calculation of degree of dissociation of weak electrolyte like acetic acid.

The degree of dissociation α is given by

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

where, Λ_m is the molar conductivity and Λ_m° is the limiting molar conductivity.

(b) The limiting molar conductivity of an electrolyte is defined as its molar conductivity when the concentration of the electrolyte in the solution approaches zero. The limiting molar conductivity of an electrolyte decreases with dilution because the number of current carrying particles *i.e.*, ions present per cm³ of the solution becomes less and less on dilution.

9. Let the number of Cl⁻ ions outside the coordination sphere or number of chloride ions which can be ionised be n . When the solution of the complex is passed through cation exchanger, $n\text{Cl}^-$ ions will combine with H⁺ (of the cation exchanger) to form HCl.



Thus, 1 mole of the complex will form n mole of HCl.

1 mol of complex = n mol HCl = n mol NaOH

$$\text{mol of the complex} = \frac{0.319}{266.7} = 0.0012$$

$$\text{mol of NaOH used} = \frac{28.5 \times 0.125}{1000} = 0.0036 \text{ mol}$$

$$0.0012 \text{ mol of complex} = 0.0036 \text{ mol NaOH} \\ = 0.0036 \text{ mol HCl}$$

$$1 \text{ mol of complex} = \frac{0.0036}{0.0012} = 3 \text{ mol HCl}$$

$$\therefore n = 3$$

Thus, all the Cl^- ions are outside the coordination sphere. Hence, complex is $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$.

10. (a) $[\text{Pt}(\text{NH}_3)_2\text{Cl}(\text{NO}_2)]$:

Diamminechloridonitrito-N-platinum(II)

It is square planar and diamagnetic.

(b) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$:

Tetraamminedichloridocobalt(III) chloride

It is octahedral and diamagnetic.

(c) $\text{Ni}(\text{CO})_4$: Tetracarbonylnickel(0)

It is tetrahedral and diamagnetic.

11. (a) V^{5+} has highest oxidation state among the given ions. V^{5+} has stable inert gas configuration and hence, most stable in aqueous solution.

On the other hand, Cr^{2+} , Mn^{4+} and Fe^{2+} have unstable electronic configuration and hence, are less stable.

(b) Due to presence of highest oxidation state of V, it acts as the strongest oxidising agent among the given ions.

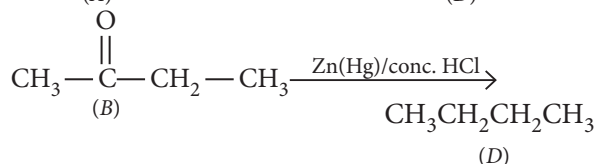
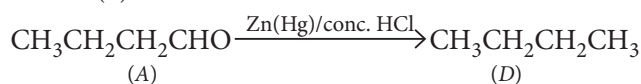
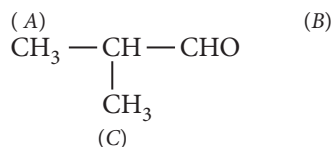
(c) Due to absence of unpaired electron in V^{5+} , it is diamagnetic.

Electronic configuration of $\text{V}^{5+} = [\text{Ar}]3d^04s^0$

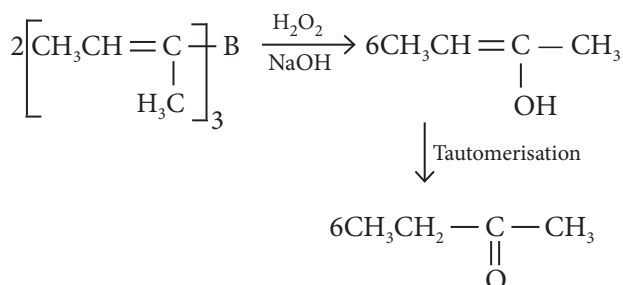
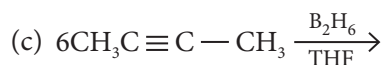
12. (a) As A and C gives positive Tollens' test thus these two should be aldehydes while B should be a ketone (does not give Tollens' test) with $-\text{C}(=\text{O})-\text{CH}_3$

group (as it gives positive iodoform test).

Three isomers are, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$, $\text{CH}_3-\text{C}(=\text{O})-\text{CH}_2-\text{CH}_3$



(b) The compound C is $\text{CH}_3-\text{CH}(\text{CH}_3)-\text{CHO}$



(d) B is least reactive among the three isomers towards addition of HCN as aldehydes are more reactive than ketones towards nucleophilic addition reactions.

OR

When butanone reacts with ethylene glycol in presence of HCl, it forms a ketal.

