Sample Question Paper - 9
Chemistry (043)
Class- XII, Session: 2021-22
TERM II

Time allowed : 2 hours *Maximum marks : 35*

General Instructions :

Read the following instructions carefully.

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.*

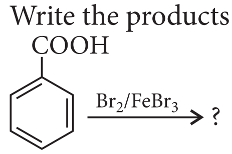
SECTION - A

1. Calculate Λ^{∞}_{HOAc} (in S cm^2 mol^{-1}) using appropriate molar conductances of the electrolytes listed in the given table.

Electrolyte	KCl	HCl	NaOAc	NaCl
Λ^{∞} **(S cm^2 mol^{-1})**	149.9	426.2	91.0	126.5

2. (a) The rate law for the reaction
$xA + yB \longrightarrow mP + nQ$ is Rate $= k\,[A]^c[B]^d$.
What is the order of the reaction?
(b) What happens to the rate of first order reaction when the concentration is doubled?

3. (a) Write the chemical equation to illustrate the following name reaction :
Hell-Volhard-Zelinsky reaction
(b) Write the products of the following reaction :

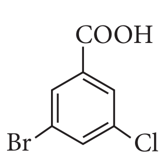


SECTION - B

4. Write the IUPAC names of following compounds:

(a) $CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_2-COOH$

(b) $CH_3-C\equiv C-CH=CH-\overset{\displaystyle O}{\overset{\|}{C}}-OH$

(c) 

5. Out of $[CoCl_6]^{3-}$ and $[Co(en)_3]^{3+}$, which complex is
   (a) paramagnetic and diamagnetic
   (b) more stable and less stable
   (c) outer and inner orbital complex ?

6. Write the products formed when CH_3CHO reacts with the following reagents :
   (a) HCN
   (b) $H_2N - OH$
   (c) CH_3CHO in the presence of dilute NaOH

OR

How do you convert the following :
   (a) Ethyne to ethanal?
   (b) Phenol to benzaldehyde?
   (c) Cyclohexanol to cyclohexan-1-one?

7. Define the following :
   (a) Micelles
   (b) Aerosol
   (c) Coagulation of colloids

OR

Describe the following processes :
   (a) Dialysis
   (b) Electrophoresis
   (c) Tyndall effect

8. (a) A reactant has a half-life of 10 minutes.
      (i) Calculate the rate constant for the first order reaction.
      (ii) What fraction of the reactant will be left after an hour of the reaction has occurred?
   (b) A first order reaction has a rate constant value of 0.00510 min^{-1}. If we begin with 0.10 M concentration of the reactant, how much of the reactant will remain after 3.0 hours?

OR

   (a) Write two differences between 'order of reaction' and 'molecularity of reaction'.
   (b) Define rate of reaction. Write two factors that affect the rate of reaction.

9. Arrange the following in decreasing order as indicated :
   (a) Cu, Ag, Au (Melting point)
   (b) Zn, Hg, Cd (Thermal stability)
   (c) Co^{2+}, Ni^{2+}, Cu^{2+} (Stability of complexes)

10. Explain the following :
   (a) There is hardly any increase in atomic size with increasing atomic numbers in a series of transition metals.
   (b) The enthalpies of atomization of transition metals are quite high.
   (c) Melting points of transition elements are high.

11. (a) The molar conductance of 0.001 M acetic acid is 50 $ohm^{-1}\ cm^2\ mol^{-1}$. The maximum value of molar conductance of acetic acid is 250 $ohm^{-1}\ cm^2\ mol^{-1}$. What is the degree of dissociation (α) of acetic acid?

(b) The conductivity of 0.001028 mol L^{-1} acetic acid is $4.95 \times 10^{-5}\ S\ cm^{-1}$. Calculate its dissociation constant, if Λ_m° for acetic acid is 390.5 $S\ cm^2\ mol^{-1}$.

OR

(a) The standard reduction potential at 298 K for the following half cell reactions are given below :

$Zn^{2+}_{(aq)} + 2e^- \longrightarrow Zn_{(s)}$; $E^\circ = -0.762$ V

$Cr^{3+}_{(aq)} + 3e^- \longrightarrow Cr_{(s)}$; $E^\circ = -0.740$ V

$2H^+_{(aq)} + 2e^- \longrightarrow H_{2(g)}$; $E^\circ = 0.0$ V

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

Which is the strongest reducing agent?

(b) Arrange the following in the increasing order of their oxidising ability.

Pb^{2+}, Ni^{2+}, Cr^{3+}, Al^{3+}

SECTION - C

12. Read the passage given below and answer the questions that follow.

Amines are alkyl or aryl derivatives of ammonia formed by replacement of one or more hydrogen atoms. Alkyl derivatives are called aliphatic amines and aryl derivatives are known as aromatic amines. The presence of aromatic amines can be identified by performing dye test. Aniline is the simplest example of aromatic amine. It undergoes electrophilic substitution reactions in which $—NH_2$ group strongly activates the aromatic ring through delocalisation of lone pair of electrons of N-atom. Aniline undergoes electrophilic substitution reactions. *Ortho* and *para* positions to the $–NH_2$ group become centres of high electrons density. Thus, $–NH_2$ group is *ortho* and *para*-directing and powerful activating group.

(a) How will you distinguish cyclohexylamine and aniline?

(b) What is the major product obtained by acetylation of aniline followed by nitration (conc.HNO_3 + conc. H_2SO_4) and then alkaline hydrolysis?

(c) What product is formed when aniline reacts with conc. HNO_3/H_2SO_4?

(d) What does oxidation of aniline in presence of MnO_2 and H_2SO_4 produce?

OR

What does aniline produce in carbylamine reaction? Write chemical equation of the reaction involved.

Solution

CHEMISTRY - 043

Class 12 - Chemistry

1. $\Lambda^{\infty}_{HOAc} = \Lambda^{\infty}_{NaOAc} + \Lambda^{\infty}_{HCl} - \Lambda^{\infty}_{NaCl}$

$= (91.0 + 426.2 - 126.5)\ S\ cm^2\ mol^{-1} = 390.7\ S\ cm^2\ mol^{-1}$

2. (a) Order is the sum of the powers to which the concentration terms are raised in the rate equation. The order of the reaction is $(c + d)$.

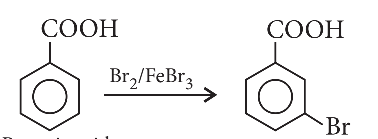
(b) For a first order reaction, rate = $k[A]$, when concentration of A is doubled, the rate becomes double.

3. (a) Hell-Volhard-Zelinsky reaction : Carboxylic acids react with chlorine or bromine in the presence of phosphorous to give compounds in which α-hydrogen atom is replaced by halogen atom.

$$\underset{\text{Acetic acid}}{CH_3COOH} + Cl_2 \xrightarrow{\text{Red P}} \underset{\text{Chloroacetic acid}}{ClCH_2{-}COOH} + HCl$$

$$ClCH_2{-}COOH + Cl_2 \xrightarrow{\text{Red P}} \underset{\text{Dichloroacetic acid}}{Cl_2CHCOOH} + HCl$$

$$Cl_2CHCOOH + Cl_2 \xrightarrow{\text{Red P}} \underset{\text{Trichloroacetic acid}}{Cl_3CCOOH} + HCl$$

(b) 

Benzoic acid 3-Bromobenzoic acid

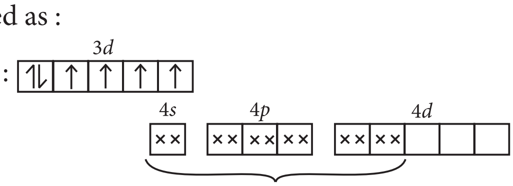
4. (a) $\overset{4}{C}H_3{-}\overset{3}{C}H(OH){-}\overset{2}{C}H_2{-}\overset{1}{C}OOH$

3-Hydroxybutan-1-oic acid

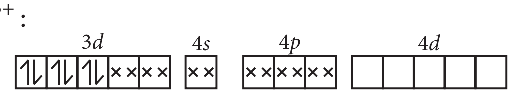
(b) Hex-2-en-4-yn-oic acid

(c) 3-Bromo-5-chlorobenzoic acid

5. Formation of $[CoCl_6]^{3-}$ and $[Co(en)_3]^{3+}$ can be represented as :

$[CoCl_6]^{3-}$: 

six electron pairs donated by Cl^- ions (sp^3d^2 hybridization)

$[Co(en)_3]^{3+}$: 

six electron pairs donated by *en* ions (d^2sp^3 hybridization)

(a) $[Co(en)_3]^{3+}$ is diamagnetic as all electrons are paired.

$[CoCl_6]^{3-}$ is paramagnetic as it has four unpaired electrons.

(b) $[Co(en)_3]^{3+}$ is more stable as *en* is a chelating ligand and forms chelate rings.

$[CoCl_6]^{3-}$ is less stable complex.

(c) $[CoCl_6]^{3-}$ is outer orbital complex as it undergoes sp^3d^2 hybridization using the outer 4d-orbital.

$[Co(en)_3]^{3+}$ is inner orbital complex as it undergoes d^2sp^3 hybridisation.

6. (a) $CH_3CHO + HCN \longrightarrow CH_3{-}\underset{H}{\overset{OH}{C}}{-}CN$

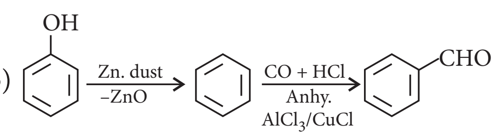
(b) $CH_3CHO + H_2NOH \longrightarrow CH_3{-}CH{=}N{-}OH$

(c) $2CH_3CHO + \text{dil. NaOH} \longrightarrow$

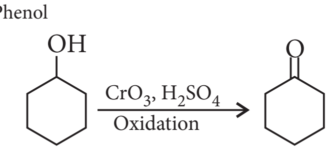
$$CH_3{-}\overset{OH}{C}H{-}CH_2{-}CHO$$

OR

(a) $\underset{\text{Ethyne}}{CH{\equiv}CH} \xrightarrow[HgSO_4]{\text{dil. } H_2SO_4} \underset{\text{Ethanal}}{CH_3{-}CHO}$

(b) 

Phenol Benzaldehyde

(c) 

Cyclohexanol Cyclohexan-1-one

7. (a) Aggregated particles of associated colloids at high concentration are called micelles, *e.g.*, soaps.

(b) Colloid of a liquid in a gas is called aerosol, *e.g.*, fog, sprays, etc.

(c) The process of aggregating together the colloidal particles into large sized particle which ultimately settle down under the force of gravity as a precipitate is called coagulation.

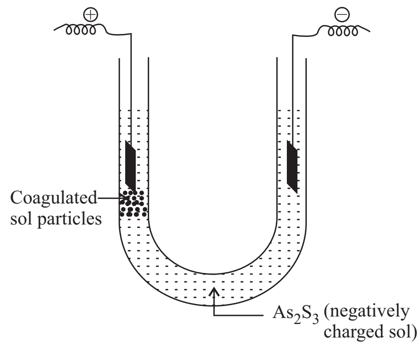
OR

(a) Dialysis is the process of removing a dissolved substance from a colloidal solution by means of diffusion through a suitable membrane.

A bag of suitable membrane containing the colloidal solution is suspended in a vessel through which fresh water is continuously flowing.

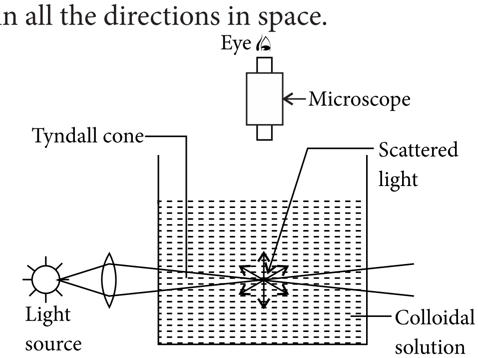
The molecules and ions diffuse through membrane into the water and pure colloidal solution is left behind.

(b) The movement of colloidal particles under an applied electric potential is called electrophoresis. Positively charged colloidal particles move towards the cathode, while negatively charged particles move towards the anode.



Electrophoresis

(c) When a beam of light is passed through a colloidal solution and viewed perpendicular to the path of incident light, the path of beam is illuminated by a bluish light. This phenomenon is called Tyndall effect. This is due to the fact that colloidal particles scatter light in all the directions in space.



8. (a) (i) $k = \dfrac{0.693}{t_{1/2}} = \dfrac{0.693}{10} = 0.0693\ \text{min}^{-1}$

(ii) $N = N_0\left(\dfrac{1}{2}\right)^n$

where, $n = \dfrac{\text{Total time}}{t_{1/2}} = \dfrac{60}{10} = 6$

$\dfrac{N}{N_0} = \left(\dfrac{1}{2}\right)^6 = \dfrac{1}{64}$

[where N_0 = initial amount of reactant and N = amount of reactant left after time, t].

(b) Given : $k = 5.10 \times 10^{-3}\ \text{min}^{-1}$,
$t = 3 \times 60\ \text{min} = 180\ \text{min}$
$[R]_0 = 0.1\ \text{M}$
Substituting these values in the equation

$$t = \frac{2.303}{k}\log\frac{[R]_0}{[R]}$$

We get, $180\ \text{min} = \dfrac{2.303}{5.1 \times 10^{-3}\ \text{min}^{-1}}\log\dfrac{0.1}{[R]}$

$$\log\frac{0.1}{[R]} = \frac{180\ \text{min} \times 5.1 \times 10^{-3}\ \text{min}^{-1}}{2.303} = 0.398$$

$\dfrac{0.1}{[R]} = \text{Antilog}\ (0.398) = 2.50$

$[R] = 0.1/2.5 = 0.04\ \text{M}$

OR

(a) Distinction between order and molecularity of a reaction :

	Order of a reaction	**Molecularity of a reaction**
1.	It is the sum of powers of the concentration of the reactants in the rate law expression.	It is the number of reacting species (atoms, ions or molecules) taking part in an elementary reaction which must collide simultaneously in order to bring about a chemical reaction.
2.	It can be zero or even a fraction.	It is always a whole number.

(b) Change in concentration (*i.e.*, either decrease in concentration of reactant or increase in concentration of product) per unit time is called rate of reaction**.**

Rate of reaction = $\dfrac{C_2 - C_1}{t_2 - t_1} = \dfrac{\Delta C}{\Delta t}$

Following factors affect the rate of reaction :
(i) Concentration of reactants : Higher the concentration of reactants, faster would be the rate of reaction.
Rate = $k\,C^n$**,** where C = concentration of reactant.
(ii) Temperature : The rate of reaction increases with the temperature. For every 10°C rise in temperature rate of reaction increases 2 folds.

9. (a) Melting point of Cu, Ag and Au follows the order :

Cu > Au > Ag

(b) Melting point of Zn, Cd, and Hg follows the order :

Zn > Cd > Hg

Higher the m.pt., higher will be the thermal stability. Hence order of thermal stability is Zn > Cd > Hg.
(c) $Cu^{2+} > Ni^{2+} > Co^{2+}$

10. (a) As one proceeds along a transition series, the nuclear charge increases which tends to decrease the size but the addition of electrons in the *d*-subshell increases the screening effect which counterbalances the effect of increased nuclear charge. As a result, the atomic radii remain practically same after chromium.

(b) As transition metals have a large number of unpaired electrons in the *d*-orbitals of their atoms they have strong interatomic attraction or metallic bonds. Hence, they have high enthalpy of atomization.

(c) The melting points of transition elements are high due to the presence of strong inter-metallic bonds (formed by valence electrons) and covalent bonds (formed due to *d-d* overlapping of unpaired *d*-electrons).

11. (a) Degree of dissociation = $\alpha = \frac{\Lambda_c}{\Lambda_\infty} = \frac{50}{250} = 0.2$

(b) $\Lambda_m = \frac{\kappa}{C} = \frac{4.95\times10^{-5}\ \text{S cm}^{-1}}{0.001028\ \text{mol L}^{-1}} \times \frac{1000\ \text{cm}^3}{\text{L}}$

$= 48.15\ \text{S cm}^2\ \text{mol}^{-1}$

$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ} = \frac{48.15}{390.5} = 0.1233$

$K_a = \frac{C\alpha^2}{(1-\alpha)} = \frac{0.001028\times(0.1233)^2}{1-0.1233}$

$= 1.78 \times 10^{-5}$ mol L^{-1}

OR

(a) Zn has lowest reduction potential value and it will be easily oxidised. Therefore, it acts as strongest reducing agent.

(b) $E^\circ_{Ni^{2+}/Ni} = -0.25$ V

$E^\circ_{Cr^{3+}/Cr} = -0.74$ V

$E^\circ_{Al^{3+}/Al} = -1.66$ V

$E^\circ_{Pb^{2+}/Pb} = -0.13$ V

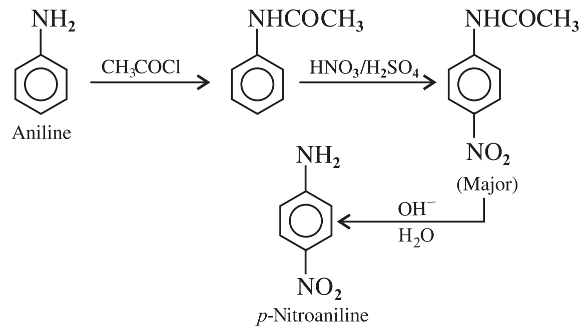
Higher the value of reduction potential (high positive), stronger will be oxidising capacity.

Thus, oxidising ability is in the order :

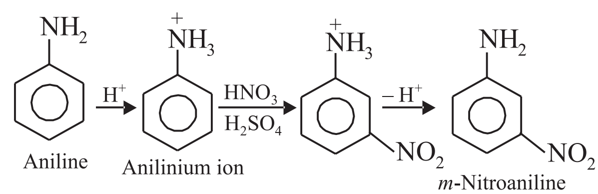
$Al^{3+} < Cr^{3+} < Ni^{2+} < Pb^{2+}$

12. (a) Azo dye test is used to distinguish between cyclohexylamine and aniline.

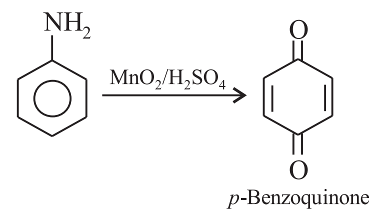
(b)



(c) In acidic medium aniline gets protonated to anilinium ion which is *meta*-directing.



(d)



OR

Aniline gives phenyl isocyanide in carbylamine reaction.