# Sample Question Paper - 12
# Chemistry (043)
# Class- XII, Session: 2021-22
# TERM II

*Time allowed : 2 hours* *Maximum marks : 35*

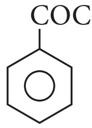
## *General Instructions :*

**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.** Complete the following reactions. (*any two*)

(a)  $+ 4[H] \xrightarrow[\text{HCl}]{\text{Zn-Hg}}$

(b) $2CH_3CHO \xrightarrow[\Delta]{\text{dil. NaOH}}$

(c) $>C{=}O + NaHSO_3 \longrightarrow$

**2.** For a reaction $X \longrightarrow P$ it was observed that half life of the reaction does not change on changing the concentration of $X$. What is the order of the reaction. Give graphical representation of log[$X$] *v/s* time.

**3.** (a) Arrange the following compounds in increasing order of their boiling points.
$CH_3CHO$, $CH_3CH_2OH$, $CH_3OCH_3$, $CH_3CH_2CH_3$

(b) Which acid of each pair would be stronger ?

(i) $CH_2FCO_2H$ or $CH_2ClCO_2H$

(ii) $CH_2FCH_2CH_2CO_2H$ or $CH_3CHFCH_2CO_2H$

## SECTION - B

**4.** Convert the following.

(a) Propanone to Propane

(b) Ethanal to Propanone

(c) Acetylchloride to Ethanal oxime

**OR**

A compound '$A$' of molecular formula $C_2H_3OCl$ undergoes a series of reactions as shown below. Identify $A$, $B$, $C$ and $D$ in the following reactions :

$(C_2H_3OCl)A \xrightarrow{H_2/\text{Pd-BaSO}_4} B \xrightarrow{\text{dil. NaOH}} C \xrightarrow{\text{Heat}} D$

**5.** (a) Give the chemical equation involved in carbylamine reaction of aniline.

(b) Complete the following reaction.

$$CH_3CN \xrightarrow{H_2O/H^+} A \xrightarrow[\Delta]{NH_3} B \xrightarrow{Br_2 + NaOH} C \xrightarrow{CHCl_3 + NaOH} D$$

**OR**

(a) Write the chemical reaction of methyl amine with benzoyl chloride and write the IUPAC name of the product obtained.

(b) Arrange the following in the increasing order of their p$K_b$ values :

$C_6H_5NH_2$, $NH_3$, $C_2H_5NH_2$, $(C_2H_5)_2NH$

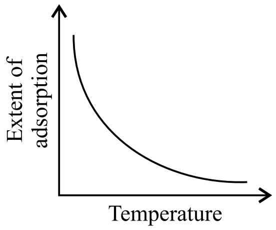
**6.** The decomposition of $NH_3$ on platinum surface is zero order reaction. What are the rates of production of $N_2$ and $H_2$ if $k = 2.5 \times 10^{-4}$ mol $L^{-1}$ $s^{-1}$?

**7.** (a) Transition metals have very high melting and boiling points. Why?

(b) In *d*-block elements, ionic radii of ions of the same charge decreases progressively with increasing atomic number in a series. Why?

(c) Transiton metals and their compounds show catalytic activity. Why?

**8.** Observe the graph given below and answer the following the questions that follow.



(a) Which phenomenon is represented in the graph? Define it.

(b) Explain the phenomenon with respect to the following :

(i) Specificity

(ii) Temperature dependence

(iii) Reversibility

**OR**

(a) In reference to Freundlich adsorption isotherm, write the expression for adsorption of gases on solids in the form of an equation.

(b) What are protective colloids? Which type of colloids are used as protective colloids?

**9.** (a) Chelates are generally more stable than the complexes of unidentate ligands. Explain.

(b) What will be the electronic configuration of $[Cu(NH_3)_6]^{2+}$ on the basis of crystal field splitting theory.

(c) What will be the correct order of absorption of wavelength of light in the visible region for the complexes, $[Co(NH_3)_6]^{3+}$, $[Co(CN)_6]^{3-}$, $[Co(H_2O)_6]^{3+}$ ?

**10.** (a) How is *p*-*n*itroaniline prepared from aniline?

(b) What product is obtained when aniline reacts with concentrated sulphuric acid?

**OR**

(a) Convert benzene to benzylamine.

(b) Aniline is more reactive than benzene towards electrophilic substitution reaction. Explain.

**11.** (a) Give the oxidation state, *d*-orbital occupation and coordination number of the central metal ion in the following complexes :

(i) $K_3[Co(C_2O_4)_3]$

(ii) $[Cr(en)_2Cl_2]Cl$

(b) Write the IUPAC name of $[Cr(NH_3)_6][Co(CN)_6]$.

## SECTION - C

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

Nernst equation relates the reduction potential of an electrochemical reaction to the standard potential and activities of the chemical species undergoing oxidation and reduction.

Let us consider the reaction, $M^{n+}_{(aq)} \longrightarrow nM_{(s)}$

For this reaction, the electrode potential measured with respect to standard hydrogen electrode can be given as

$$E_{(M^{n+}/M)} = E^\circ_{(M^{n+}/M)} - \frac{RT}{nF}\ln\frac{[M]}{[M^{n+}]}$$

(a) Give the reactions at anode and cathode and the Nernst equation for the cell

$Fe_{(s)}|Fe^{2+}(0.001\text{ M})||H^+\ (1\text{ M})\ |\ H_{2(g)}(1\text{ bar})|Pt_{(s)}$

(b) What will be the standard reduction potential for the half-cell reaction, $Cl_2 + 2e^- \longrightarrow 2Cl^-$

$(Pt^{2+} + 2Cl^- \longrightarrow Pt + Cl_2\ , E^\circ_{cell} = -0.15\text{ V}\ ;\ Pt^{2+} + 2e^- \longrightarrow Pt, E^\circ = 1.20\text{ V})$

(c) In a cell reaction, $Cu_{(s)} + 2Ag^+_{(aq)} \longrightarrow Cu^{2+}_{(aq)} + 2Ag_{(s)}; E^\circ_{cell} = +0.46\text{ V}$.

If the concentration of $Cu^{2+}$ ions is doubled then find the new $E^\circ_{cell}$ .

(d) For concentration cell, $Zn_{(s)}|Zn^{2+}_{(aq)}(C_1)\ ||\ Zn^{2+}_{(aq)}(C_2)|Zn$

For spontaneous cell reaction, $C_1 < C_2$. Give reason.

**OR**

Which of the electrode is negatively charged for the cell reaction

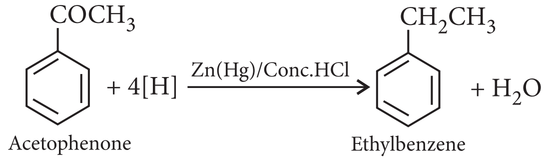
$Zn_{(s)} + 2Ag^+_{(aq)} \rightarrow Zn^{2+}_{(aq)} + 2Ag_{(s)}$

# Solution

## CHEMISTRY - 043

## Class 12 - Chemistry

**1.** (a)



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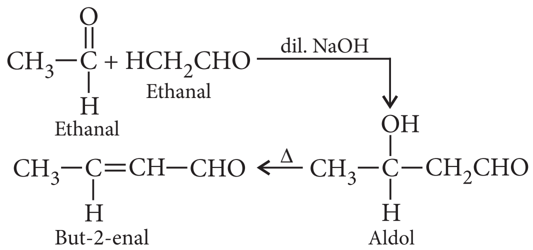
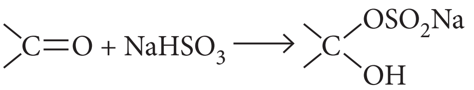
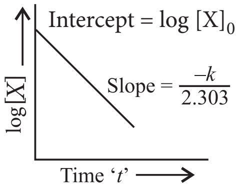


(c)



**2.** Order of the reaction is one as, $t_{1/2}$ of given reactions is independent of its initial concentration.

For first order reactions, $\log[X] = \log[X]_0 - \frac{kt}{2.303}$

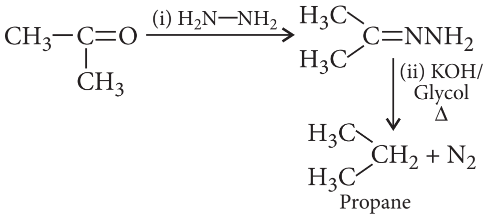


**3.** (a) $CH_3CH_2CH_3 < CH_3OCH_3 < CH_3CHO < CH_3CH_2OH$

(b) (i) $CH_2FCO_2H$ is a stronger acid for the same reason as stated above. F is more electronegative than Cl, so it withdraws electrons from the carboxyl group to a greater extent.

(ii) $CH_3CHFCH_2COOH$ is stronger. Although both the given acids have F atom in them, it is the proximity of F in $CH_3CHFCH_2COOH$ to the COOH group which makes it more acidic.

**4.** (a)



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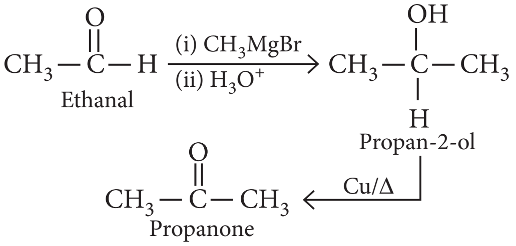

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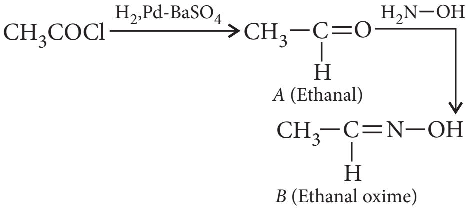
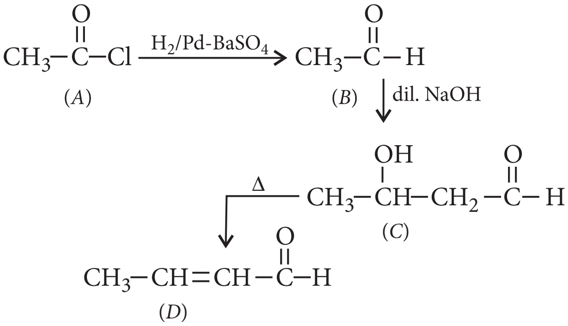
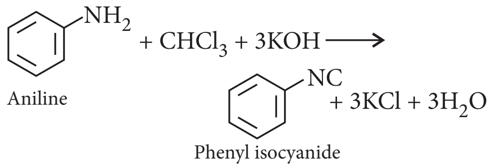


**OR**



**5.** (a)



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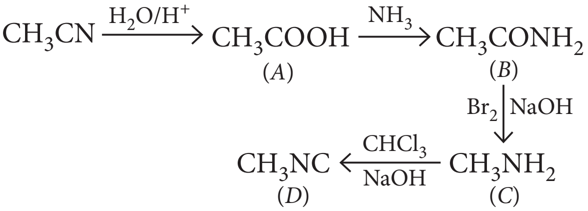
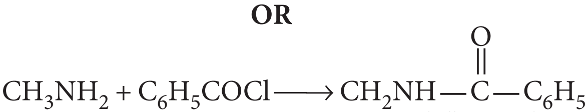


**OR**

(a)



$$CH_3NH_2 + C_6H_5COCl \longrightarrow CH_2NH-\overset{\overset{\displaystyle O}{\|}}{C}-C_6H_5$$

*N*-Methylbenzamide

(b) Stronger the base, lower will be its $pK_b$ value. Hence increasing order of $pK_b$ values is,

$(C_2H_5)_2NH < C_2H_5NH_2 < NH_3 < C_6H_5NH_2$

**6.** For the reaction, $2NH_3 \rightarrow N_2 + 3H_2$

$$\text{Rate} = -\frac{1}{2}\frac{d[NH_3]}{dt} = \frac{d[N_2]}{dt} = \frac{1}{3}\frac{d[H_2]}{dt} \quad \text{...(i)}$$

For zero order reaction

$$\text{Rate} = k \quad \text{...(ii)}$$

From equation (i) and (ii)

$$\text{Rate} = -\frac{1}{2}\frac{d[NH_3]}{dt} = \frac{d[N_2]}{dt} = \frac{1}{3}\frac{d[H_2]}{dt} = k \quad \text{...(iii)}$$

$\therefore$ Rate of production of $N_2 = \frac{d[N_2]}{dt} = k$

$k = 2.5 \times 10^{-4}$ mol $L^{-1}$ $s^{-1}$

$\therefore$ Rate of production of $N_2 = k = 2.5 \times 10^{-4}$ mol L$^{-1}$ s$^{-1}$

From equation (iii)

Rate of production of $H_2 = \frac{d[H_2]}{dt} = 3k$

$= 3 \times 2.5 \times 10^{-4}$ mol L$^{-1}$ s$^{-1}$ $= 7.5 \times 10^{-4}$ mol L$^{-1}$ s$^{-1}$

**7.** (a) The high melting and boiling points of transition metals are attributed to the involvement of greater number of electrons from $(n - 1)$ $d$-orbital in addition to the *ns* electrons in the interatomic metallic bonding ($d$-$d$ overlap).

(b) As the atomic number increases the new electron enters the $d$-orbital and expected to increase in atomic size, but due to poor shielding effect of $d$-orbitals the electrostatic attraction between nucleus and outermost orbital increases and hence, the ionic radii decreases.

(c) The transition metals and their compounds, are known for their catalytic activity. This activity is ascribed to their ability to adopt multiple oxidation states, ability to adsorb the reactant(s) and ability to form complexes. Vanadium(V) oxide (in Contact Process), finely divided iron (in Haber's Process), and nickel (in catalytic hydrogenation) are some of the examples. Catalysis involves the formation of bonds between reactant molecules and atoms at the surface of the catalyst.

**8.** (a) Physical adsorption : When the particles are held to the surface by the physical forces like van der Waals forces, the adsorption is called physical adsorption or physisorption.

(b) Physisorption :

(i) It is not specific in nature.

(ii) It decreases with increase in temperature. Thus, low temperature is favourable for physisorption.

(iii) Reversible in nature.

**OR**

(a) $\frac{x}{m} = kp^{1/n} (n > 1)$

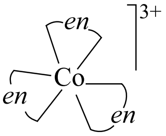
$$\log\frac{x}{m} = \log k + \frac{1}{n}\log p$$

where, $x$ is the mass of gas adsorbed on mass $m$ of the adsorbent at pressure $p$.

(b) The colloids which protect coagulation of other colloids from the electrolytes are called protective colloids. Lyophilic colloids are used as a protective colloid for lyophobic colloids.

**9.** (a) : Chelates have closed or cyclic ring structure so they are more stable than normal complexes. In chelates, ligands are held by two or more bonds with the transition metals. *e.g.*,

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



(b) In $[Cu(NH_3)_6]^{2+}$, oxidation state of Cu = +2, $Cu^{2+} = 3d^9$

$3d^9 = t_{2g}^6 e_g^3$

(c) The CFSE of the ligands is in the order :

$H_2O < NH_3 < CN^-$

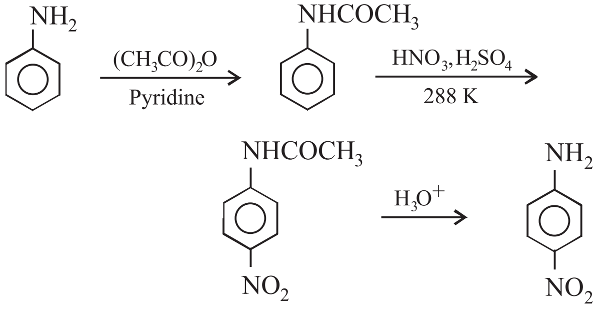
Hence, excitation energies is in the order:

$[Co(H_2O)_6]^{3+} < [Co(NH_3)_6]^{3+} < [Co(CN)_6]^{3-}$

From the relation $E = \frac{hc}{\lambda} \Rightarrow E \propto \frac{1}{\lambda}$

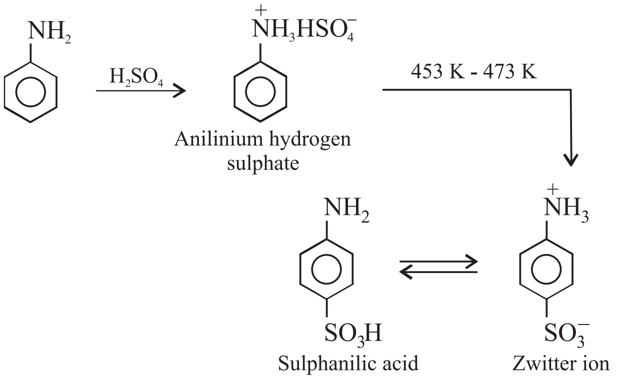
The order of absorption of wavelength of light in the visible region : $[Co(H_2O)_6]^{3+} > [Co(NH_3)_6]^{3+} > [Co(CN)_6]^{3-}$

**10.** (a) $p$-Nitroaniline can be obtained by protecting $-$ $NH_2$ group by acetylation reaction with acetic anhydride followed by the nitration and hydrolysis.



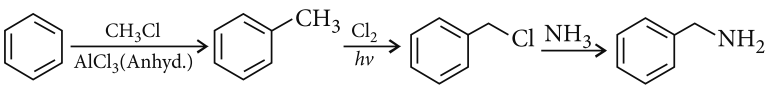
$p$-Nitroaniline

(b) Aniline reacts with conc. $H_2SO_4$ to give sulphanilic acid.



**OR**

(a) Friedel-Crafts alkylation followed by reaction with halogen and ammonia produces benzylamine. The sequence of the reaction is



(b) Due to resonance in aniline, the electron density on benzene ring increases and the electrophile can easily attack on it. Thus, aniline is more reactive than benzene towards electrophilic substitution reaction.

**11.** (a)

| S.No. | Complex | Oxidation state of metal atom | Coordination number of central metal atom | *d*-orbital occupation |
|---|---|---|---|---|
| (i) | $K_3[Co(C_2O_4)_3]$ | +3 | 6 | $Co^{3+} = 3d^6; (t_{2g})^6, (e_g)^0$ |
| (ii) | $[Cr(en)_2Cl_2]Cl$ | +3 | 6 | $Cr^{3+} = 3d^3; (t_{2g})^3, (eg)^0$ |

(b) Hexaamminechromium(III) hexacyanocobaltate(III).

**12.** (a) At anode : $Fe \rightarrow Fe^{2+}(0.001\ M) + 2e^-$

At cathode : $2H^+\ (1\ M) + 2e^- \rightarrow H_2\ (1\ bar)$

Net reaction : $Fe + 2H^+ \rightarrow Fe^{2+} + H_2$

Nernst equation for the given cell,

$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{2}\log\frac{[Fe^{2+}][H_2]}{[Fe][H^+]^2}$$

(b) $Pt + Cl_2 \rightarrow Pt^{2+} + 2Cl^- ;\ E^\circ_{cell} = -0.15\ V$

$+\ \ Pt^{2+} + 2e^- \rightarrow Pt ;\ E^\circ = 1.20\ V$

$Cl_2 + 2e^- \rightarrow 2Cl^- ;\ E^\circ = 1.35\ V$

(c) $E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$

It will remain unchanged. $E^\circ_{cell}$ does not depend on concentration.

(d) For concentration cell,

$$E_{cell} = \frac{RT}{nF}\log\frac{C_2}{C_1}$$

For spontaneous reaction,

$E_{cell}$ = +ve so, $C_2 > C_1$.

**OR**

Anode, *i.e.*, zinc electrode will be negatively charged.