Date: 07/05/2022

SET No. 3

Question Paper Code

56/5/3

Time: 2 hrs. **Max. Marks: 35**

Class-XII

CHEMISTRY (Theory)

Term-II

(CBSE-2022)

GENERAL INSTRUCTIONS

Read the following instructions very carefully and strictly follow them:

(i) This question paper contains **12** questions. **All** questions are compulsory.

(ii) This question paper comprises of **three** sections - **Section A, B** and **C**.

(iii) **Section A** - Q. No. 1 to 3 are very short-answer type questions carrying **2** marks each.

(iv) **Section B** - Q. No. 4 to 11 are short-answer type questions carrying **3** marks each.

(v) **Section C** - Q. No. 12 is case based question carrying **5** marks.

(vi) Use of log tables and calculators is **not** allowed.

SECTION-A

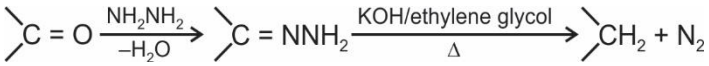
1. Explain the following reactions: [1×2 = 2]

   (a) Wolff-Kishner reduction

   (b) Cannizzaro reaction

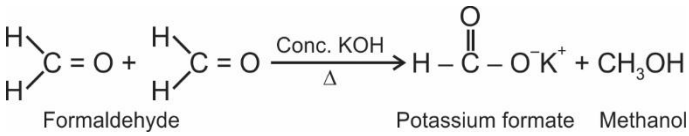
Sol. (a) **Wolff-Kishner reduction:** [1]

The carbonyl group of aldehydes or ketones are reduced to CH_2 group on treatment with hydrazine followed by heating with sodium or potassium hydroxide in high boiling solvent such as ethylene glycol.



(b) **Cannizzaro reaction:** [1]

Aldehydes which do not have an α-hydrogen atom, undergo self reduction and oxidation (disproportionation) reaction on heating with concentrated alkali. In this reaction, one molecule of the aldehyde is reduced to alcohol and another is oxidised to carboxylic acid salt.



2. Arrange the following in the increasing order of the property mentioned: [1×2 = 2]

   (a) CH_3COOH, $ClCH_2COOH$, FCH_2COOH (Acid strength)

   (b) CH_3CHO, CH_3CH_2OH, $CH_3CH_2CH_3$ (Boiling Points)

Sol. (a) Electron withdrawing group increases the acidic strength as it stabilizes the conjugate base. [1]

Order of acidic strength:

$CH_3COOH < ClCH_2COOH < FCH_2COOH$

(b) Stronger the intermolecular forces of attraction, higher will be the boiling point. [1]

Order of boiling point:

$CH_3CH_2CH_3 < CH_3CHO < CH_3CH_2OH$

3. Answer the following questions (Do any two): [1×2 = 2]

   (a) Identify the order of reaction from the following unit for its rate constant:

   $Lmol^{-1}s^{-1}$

   (b) The conversion of molecules A to B follow second order kinetics. If concentration of A is increased to three times, how will it affect the rate of formation of B?

   (c) Write the expression of integrated rate equation for zero order reaction

Sol. (a) Unit of rate constant for any n^{th} order reaction could be written as following

Unit = $(mol\ L^{-1})^{1-n}\ s^{-1}$ [½]

Comparing this with given unit

$L\ mol^{-1}\ s^{-1} = (mol\ L^{-1})^{1-n}\ s^{-1}$

$\Rightarrow$ $(mol\ L^{-1})^{-1}\ s^{-1} = (mol\ L^{-1})^{1-n}\ s^{-1}$

$1 - n = -1$

$\boxed{n = 2}$ [½]

(b) $A \rightarrow B$

$$\frac{-dA}{dt} = \frac{dB}{dt} = r$$

$\frac{-dA}{dt}$ = rate of consumption of 'A'

$\frac{dB}{dt}$ = rate of formation of 'B'

Since given conversion follows 2nd order, rate law could be written as following

$r = k[A]^2$ [½]

If concentration of 'A' made 3 times

$r' = k[3A]^2$

$r' = 9k[A]^2$

$\boxed{r' = 9r}$ [½]

Hence rate of formation of B will become 9 times.

(c) For zero order reaction

$[a]_t = [a]_0 - kt$ [1]

$[a]_t \Rightarrow$ Concentration of reactant at time 't'

$[a]_0 \Rightarrow$ Initial concentration of reactant

$k \Rightarrow$ Rate constant

$t \Rightarrow$ Time taken

SECTION-B

4. (a) Account for the following : [1×3=3]

(i) pk_b of aniline is more than that of methylamine.

(ii) Aniline does not undergo Friedel-Crafts reaction.

(iii) Primary amines have higher boiling points than tertiary amines.

Sol. (a) (i) Since lone pair of electron in case of aniline is involved in conjugation and behaves as delocalised electron pair, it will have less basic strength than methyl amine in which lone pair of electron is localised, hence aniline will have more pk_b value than methyl amine. [1]

(ii) Aniline does not undergo Friedel-Crafts reaction due to salt formation with aluminium chloride, the Lewis acid, which is used as catalyst. Due to this, nitrogen of aniline acquires positive charge and hence acts as a strong deactivating group for further reaction. [1]

(iii) Primary amines tend to have more boiling point than tertiary amine since primary amine can form intermolecular hydrogen bonding, which is absent in tertiary amines. [1]

OR

(b) (i) Arrange the following compounds in the increasing order of their basic strength in aqueous solution: [1×3=3]

CH_3NH_2, $(CH_3)_3N$, $(CH_3)_2NH$

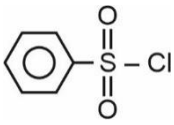
(ii) What is Hinsberg's reagent?

(iii) What is the role of pyridine in the acylation reaction of amines?

Sol. (b) (i) Order of basic strength in aqueous solution is as follows

$(CH_3)_3N < CH_3NH_2 < (CH_3)_2NH$ [1]

(ii) Hinsberg's reagent is as follows



[1]

(iii) In the acylation of amine a stronger base pyridine is used to remove side product HCl, which results into shifting the equilibrium in right hand side for more yield of product. [1]

5. (a) Write the IUPAC name of the following complex: [1×3 = 3]

$K_3[Cr(C_2O_4)_3]$

(b) On the basis of crystal field theory, write the electronic configuration of d^5 ion if $\Delta_0 < P$.

(c) What are ambidentate ligands?

Sol. (a) $K_3[Cr(C_2O_4)_3]$ [½×½ = 1]

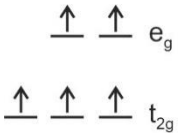
Let oxidation number of Cr is x

$3(+1) + x + 3(-2) = 0$

$\boxed{x = +3}$

IUPAC name → Potassium trioxalatochromate(III)

(b) If $\Delta_0 < P$ then high spin complex will be formed [1]

Electronic configuration  or $t_{2g}^3\ e_g^2$

(c) Ligand which has two different donor atoms and either of the two ligets in the complex is called ambidentate ligand e.g. NO_2^- [1]

6. (a) Write any two consequences of Lanthanoid Contraction. 2+1=3

(b) Name the element of 3*d* series which exhibits the largest number of oxidation states. Give reason.

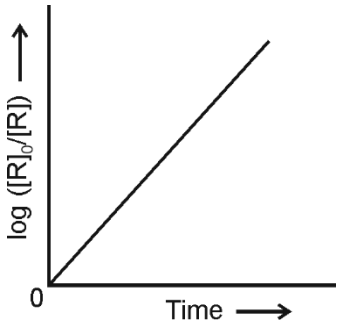
Sol. (a) **Consequences of Lanthanoid Contraction** [1+1]

- Basic strength of Lanthanoid hydroxide $Ln(OH)_3$ gradually decreases with increase in atomic number.
- The almost identical radii of Zr and Hf.

(b) **Manganese (Z = 25) ⇒ [Ar]$4s^2 3d^5$** [1]

Since 3*d* and 4*s* are close in energy, it has maximum number of unpaired electrons to lose or share. Hence it shows highest oxidation state from +2 to +7.

7. Observe the graph shown in figure and answer the following questions: [1×3=3]



(a) What is the order of the reaction?

(b) What is the slope of the curve?

(c) Write the relationship between k and $t_{1/2}$ (half life period).

Sol. For the first order reaction

$$t = \frac{2.303}{k} \log\left(\frac{[R]_0}{[R]}\right)$$

or $$\underset{y}{\log\left(\frac{[R]_0}{[R]}\right)} = \underset{mx}{\frac{kt}{2.303}} + \underset{c}{0} \qquad \ldots(i)$$

(a) Since given graph is straight line, it follows first order reaction. [1]

(b) Comparing equation (i) obtained with standard straight line equation y = mx + c

$$\text{Slope (m)} = \frac{k}{2.303}$$ [1]

(c) For first order reaction, $k = \frac{\ln 2}{t_{1/2}} = \frac{0.693}{t_{1/2}}$ [1]

8. Give reasons for the following statements: [1×3 = 3]

(a) Transition elements and their compounds act as good catalysts.

(b) $E^{o}_{(Mn^{2+}/Mn)}$ value is highly negative as compared to other elements.

(c) Cr^{2+} is a strong reducing agent.

Sol. (a) Transition elements and their compounds act as good catalysts mainly due to two reasons:

(i) Transition metals provide suitable surface for the reaction to occur [½]

(ii) They have the ability to show variable oxidation states and form complexes [½]

(b) Because of the stable half filled *d* subshell ($3d^5$) in Mn^{2+}, $E^{o}_{(Mn^{2+}/Mn)}$ is highly negative as compared to other elements. [1]

(c) Cr^{2+} is strong reducing agent as it has $3d^4$ configuration and upon oxidising itself to Cr^{3+}, it acquires more stable $3d^3$ configuration i.e. half filled t_{2g} orbitals. [1]

9. (a) (i) Define coagulation. [1×3 = 3]

(ii) State Hardy-Schulze rule.

(iii) What is Electrophoresis?

Sol. (a) (i) Coagulation: The process of settling of colloidal particles is called coagulation or precipitation of the sol. [1]

(ii) Hardy-Schulze Rule: The greater the valence of the flocculating ion added, the greater is its power to cause precipitation. [1]

(iii) Electrophoresis: When electric field is applied across two platinum electrodes dipping in a colloidal solution, the colloidal particles move towards one or the other electrode. This movement of colloidal particles under an applied electric field is called electrophoresis. [1]

OR

(b) Write three differences between Physisorption and Chemisorption. [1×3=3]

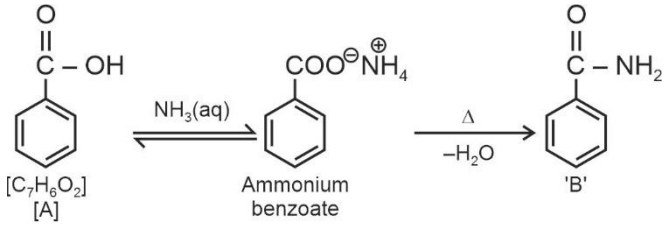
Sol. (b)

	Physisorption		**Chemisorption**
(i)	It arises because of van der Waal's force.	(i)	It is caused by chemical bond formation.
(ii)	It is not specific in nature.	(ii)	It is highly specific in nature.
(iii)	It is reversible.	(iii)	It is irreversible.
(iv)	Enthalpy of adsorption is low.	(iv)	Enthalpy of adsorption is high.

[Any three]

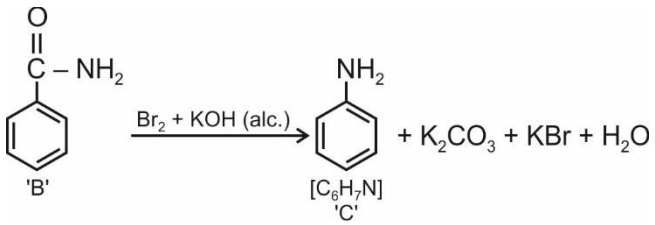
10. (a) An aromatic compound 'A' ($C_7H_6O_2$) on reaction with aqueous ammonia and heating forms compound 'B'. 'B' on heating with Br_2 and alcoholic potash forms a compound 'C' of molecular formula C_6H_7N. Write the reactions involved and identify 'A', 'B', 'C'. [3]

Sol. (a)

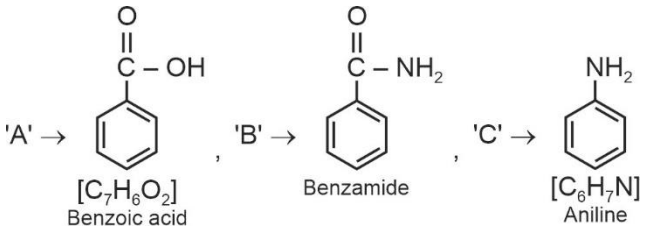


[1]

→ Hoffmann bromamide degradation reaction.



[1]

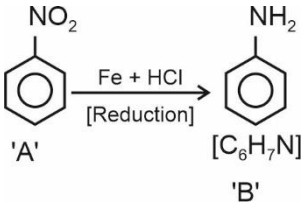


[1]

OR

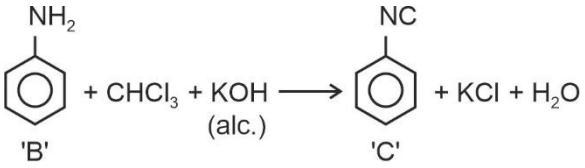
(b) A compound 'A' on reduction with iron scrap and hydrochloric acid gives compound 'B' with molecular formula C_6H_7N. Compound 'B' on reaction with $CHCl_3$ and alcoholic KOH produces an obnoxious smell of carbylamine due to the formation of 'C'. Identify 'A', 'B' and 'C' and write the chemical reactions involved. [3]

Sol. (b) **Reduction of nitro compound.**

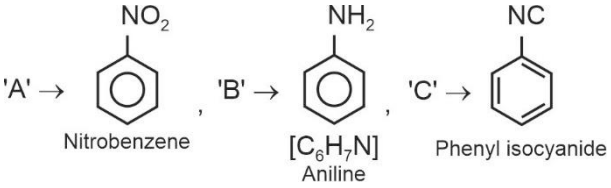


[1]

Carbylamine reaction



[1]



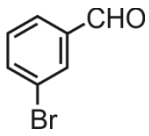
[1]

'C' has obnoxious smell.

11. (a) Complete the following: [1×3=3]

(i) $CH_3CN \xrightarrow[2.\ H_2O]{1.\ AlH(i\text{-}Bu)_2} \text{'A'} \xrightarrow[H^+]{H_2N\text{-}OH} \text{'B'}$

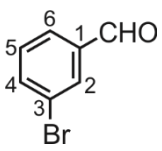
(ii) Write IUPAC name of the following compound:



(iii) Write chemical test to distinguish between the following compounds:

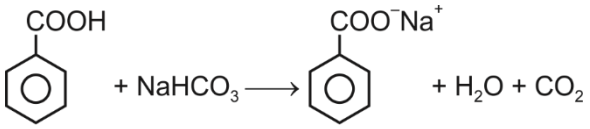
Phenol and Benzoic acid

Sol. (a) (i) $CH_3CN \xrightarrow[2.\ H_2O]{1.\ AlH(i\text{-}Bu)_2} \underset{(A)}{CH_3CHO} \xrightarrow[H^+]{NH_2\text{-}OH} \underset{(B)}{CH_3CH=N-OH}$ [½+½]

(ii) 

IUPAC name: 3-Bromobenzaldehyde [1]

(iii) Phenol and benzoic acid can be distinguished by treating each with aqueous sodium bicarbonate solution. Effervescence of CO_2 will be observed on reaction with benzoic acid but with phenol, no characteristic change will be observed. [½]



[½]

OR

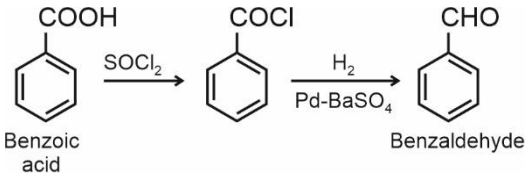
(b) Convert the following : [1×3=3]

(i) Benzoic acid to Benzaldehyde

(ii) Propan-1-ol to 2-Bromopropanoic acid

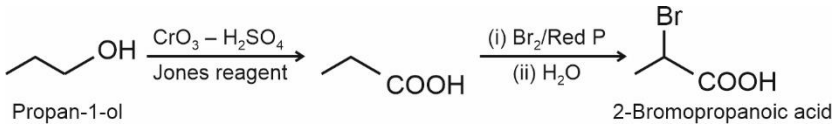
(iii) Acetaldehyde to But-2-enal

Sol. (b) (i)



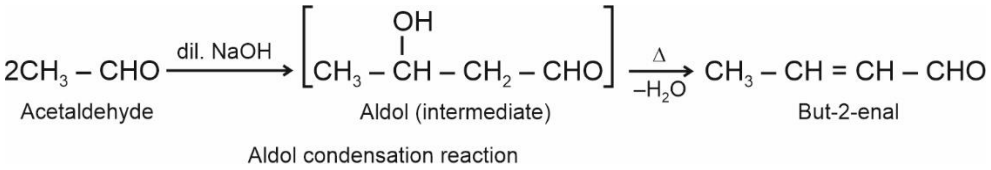
[½+½]

(ii)



[½+½]

(iii)



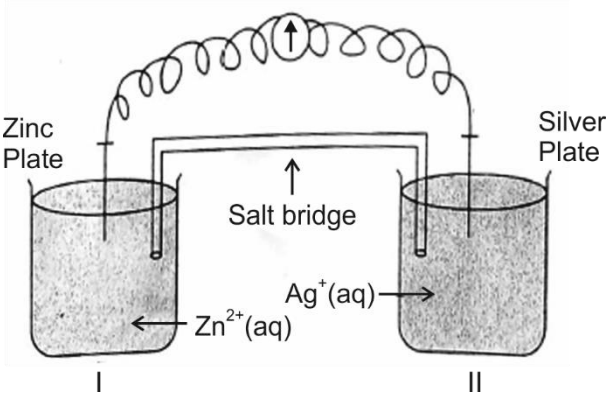
[½+½]

SECTION-C

12. **Read the passage given below and answer the question that follow:** [1+1+1+2=5]

Oxidation-reduction reactions are commonly known as redox reactions. They involve transfer of electrons from one species to another. In a spontaneous reaction, energy is released which can be used to do useful work. The reaction is split into two half reactions. Two different containers are used and a wire is used to drive the electrons from one side to the other and a Voltaic/Galvanic cell is created. It is an electrochemical cell that uses spontaneous redox reactions to generate electricity. A salt bridge also connects to the half cells. The reading of the voltmeter gives the cell voltage or cell potential or electromotive force. If E°_{cell} is positive the reaction is spontaneous and if it is negative the reaction is non-spontaneous and is referred to as electrolytic cell. Electrolysis refers to the decomposition of a substance by an electric current. One mole of electric charge when passed through a cell will discharge half a mole of divalent metal ion such as Cu^{2+}. This was first formulated by Faraday in the form of laws of electrolysis.

The conductance of material is the property of materials due to which a material allows the follow of ions through itself and thus conducts electricity. Conductivity is represented by κ and it depends upon nature and concentration of electrolyte, temperature etc. A more common term molar conductivity of a solution at a given concentration is conductance of the volume of solution containing one mole of electrolyte kept between two electrodes with the unit area of cross-section and distance of unit length. Limiting molar conductivity of weak electrolytes cannot be obtained graphically.



(a) Is silver plate the anode or cathode? [1]

(b) What will happen if the salt bridge is removed? [1]

(c) When does electrochemical cell behaves like an electrolytic cell? [1]

(d) (i) What will happen to the concentration of Zn^{2+} and Ag^+ when $E_{cell} = 0$. [1×2=2]

(ii) Why does conductivity of a solution decreases with dilution?

OR

(d) The molar conductivity of a 1.5 M solution of an electrolyte is found to be 138.9 S cm^2 mol^{-1}. Calculate the conductivity of this solution. [2]

Sol. (a) Silver plate is used as cathode in the given Galvanic cell. [1]

(b) If we remove salt bridge, Galvanic cell will stop working as the flow of electrons from one half cell to another stops. [1]

(c) If E°_{cell} is negative or cell reaction is non-spontaneous then electrochemical cell will behave like electrolytic cell. [1]

(d) (i) At $E_{cell} = 0$, reaction will be at equilibrium and concentrations of Zn^{2+} and Ag^+ become constant. [1]

(ii) Conductivity of solution decreases with dilutions as the concentration of ions decreases. [1]

OR

(d) $\Lambda_m = \frac{1000}{M}\kappa$

or

$\kappa = \frac{\Lambda_m \cdot M}{1000}$ [1]

$= \frac{138.9 \times 1.5}{1000}$ [½]

= 0.20 S cm^{-1} [½]

❑ ❑ ❑