XIIth 2023-24
Date : 23/10/2023

Chemistry Theory Round -02

Max.Marks :- 35
Time 90 Minutes.

General Instructions : The question paper is divided into four sections.
(1) Section A : Q.No.1 contains Five Multiple choice type of question carrying **One** mark each.
Q.No.2 contains Five very short answer type of questions carrying **One** mark each.
(2) Section B : Q.No.3 to Q.9 are short answer type of question carrying **Two** marks each.
(3) Section C : Q.No.10 to Q. No.14 are short answer type of questions carrying **Three** marks each
(4) Section D: Q.No.15 to Q.No.18 are long answer type of questions carrying **Four** marks each.
(5) Figures to the right indicate full marks

MODEL ANSWER KEY

Section -A [05]

Q.1 Select and write the correct answers for the following multiple choice type of questions.

(i) _____ element of group 17 is liquid at room temperature.

(a) Cl (b) I
(c) Br (d) F

(ii) The product of the following reaction is

$CH_3 - CH = CH - CH_2 - CHO \xrightarrow[(ii)\ H_3O^+]{(i)\ LiAlH_4}$ -------?

(a) $CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - OH$ (b) **$CH_3 - CH = CH - CH_2 - CH_2 - OH$**
(c) $CH_3 - CH_2 - CH_2 - CH_2 - COOH$ (d) $CH_3 - CH = CH - CH_2 - COOH$

(iii) Ozonolysis of 2, 3 dimethyl but - 2-ene followed by reduction with Zn dust and water gives _____

(a) acetaldehyde (b) propionaldehyde and acetone
(c) acetone (d) acetaldehyde and butyraldehyde

(iv) Acetone on treatment with Grignard reagent produces _____

(a) acetic acid (b) secondary alcohol
(c) primary alcohol **(d) tertiary alcohol**

(v) The value of $[H_3O^+]$ in mol lit^{-1} of 0.00 M acetic acid solution ($K_a = 1.8 \times 10^{-5}$) is

(a) 1.34×10^{-1} (b) 1.34×10^{-2}
(c) 1.34×10^{-3} **(d) 1.34×10^{-4}**

Q.2 Answer the following questions. **[05]**

(i) Write the name of the product formed by the action of $LiAlH_4$/ether on acetamide.

Ans : The name of the product formed by the action of $LiAlH_4$/ether on acetamide is ethanamine.

$$CH_3-\overset{O}{\overset{\|}{C}}-NH_2 + 2\,[H] \xrightarrow[Ether]{LiAlH_4} CH_2-CH_2-NH_2$$

(Acetamide) (Acetamine)

(ii) Write the chemical composition of cryolite

Ans : The chemical composition of cryolite is $NaAlF_6$

(iii) Calculate the molar conductivity for 0.5 M $BaCl_2$ if its conductivity at 298 K is 0.01 Ω^{-1} cm^{-1}

Ans : Conductivity K = 1×10^{-2} Ω^{-1} cm^{-1}

Molar concentration C = 0.5 = 5 × 10–1

Conductivity Am = ?

$$Am = \frac{1000K}{C}$$

$$= \frac{10^3 \times 1 \times 10^{-2}}{5 \times 10^{-1}}$$

$\therefore$ Am = 20 Ω^{-1} mol^{-1}

(iv) Write the name of the product formed when acetone is treated with 2, 4-dinitrophenyl hydrazine

Ans : 2, 4 dinitrophenyl hydrozone.

(v) Identify the molecularity of the following elementary reaction.

$$NO_{(g)} + O_{3(g)} \longrightarrow NO_{3(g)} + O_{(g)}$$

Ans : Molecularity is the no. of reactant molecules taking part in an elementary reaction. In above reaction, there are two reactant molecules. Hence molecularity is 2.

Section -B : Attempt any -4 (Q. 3 to 9) [08]

Answer the following questions :

Q.3 Explain pseudo-first order reaction with suitable example.

Ans : Pseudo-first order reaction:-

Reactions that are expected to be higher order by rate law but follow first order are called pseudo first order reactions.

Example:-

$CH_3COOCH_3 + H_2O \rightarrow CH_3COOH + CH_3OH.$

Hydrolysis of methyl acetate is supposed to be second order but it is found that reaction obeys order kinetics.

The reaction is taht solvent water is present in such large excess that the change in its concentration is negligible compared to initial are or is concentration remains constant. another example is hydrolysis of sucrose.

Q.4 Explain the trends in the following atomic properties of group 16 elements

i) Atomic radii ii) Ionization enthalpy

iii) Electronegativity iv) Electron gain enthalpy

Ans : Trends in properties of group 16 elements.

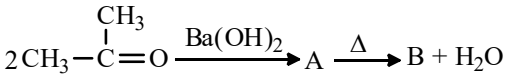
(i) Atomic radii :– increase down the group.

(ii) ionisation enthalpy :– decrease down the group

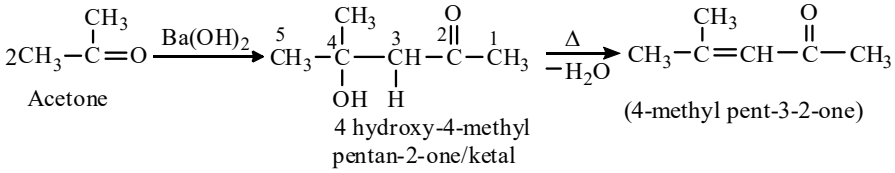
(iii) Electronegativity :– Decreases down the group

(iv) electron gain enthalpy :– Decomes down less the negativity group

Q.5 Identify A and B from the following reaction.



Ans :



Acetone

4 hydroxy-4-methyl pentan-2-one/ketal

(4-methyl pent-3-2-one)

(A) (B)

Q.6 How many moles of electrons are required for reduction of 2 moles of Zn^{2+} to Zn ? How many faraday of electricity will be required ?

Ans : $Zn^{2+}_{(aq)} + 2e^- \rightarrow Zn(aq)$

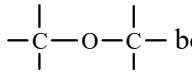
$\therefore$ 1 mole of Zn^{2+} is reduced by 2 moles of electrons.

Hence for 2 moles of Zn^{2+} is reduced by 4 moles of electrons

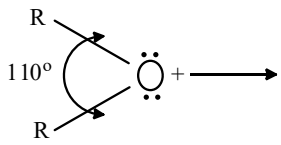
1 mole of e^- = 1 faraday electricity

$\therefore$ 4 mole of e^- = 4 faraday electricity.

Q.7 Why ethers possess a small net dipole moment ?

Ans : Since  bond angle in ether is 110oand not 180o, the bond dipole moments of two C–O bonds do not cancel each other.

Therefore ethers possess a small net dipole moment.

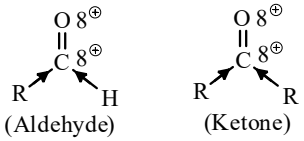


Q.8 Aldehydes are more reactive than ketone. Explain.

Ans : Aldehydes have only one electron donating group (+1) but ketones have two electron donating groups bonded to carbonyl carbon. Hence aldehydes are more electrophilic.

Also two bulky alkyl groups of ketone obstruct nucleophilic attack (steric hinderane) aldehyde are less crowded.

Thus aldehyde is more easily attacked by nucleophites. Hence they are more reactive.



(Aldehyde) (Ketone)

Q.9 Define interhalogen compounds. Write any two characteristics of interhalogen compounds.

Ans : An interhalogen compounds is a compound formed by a combination of atoms of different halogens.

eg. ClF_1 BrF_3.

Section -C : Attempt any -3 (Q.10 to 14) [09]

Q.10 Covert the following.

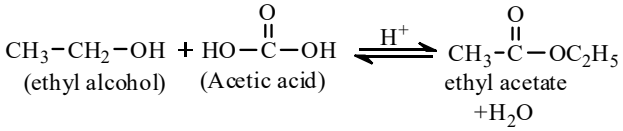
(i) Ethyl alcohol into ethyl acetate

(ii) Phenol into benzene

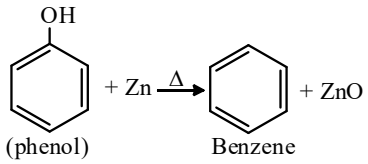
(iii) Diethyl ether into ethyl chloride.

Ans : Organic conversions :-

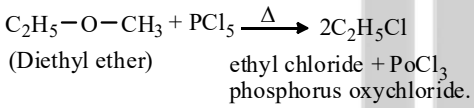
(i) Ethyl alcohol into ethyl acetate :-



(ii) Phenol into benzene



(iii) Diethyl ether into ethyl chloride



Q.11 Draw labelled diagram of H_2– O_2 fuel cell. Write two applications of fuel cell.

Ans :

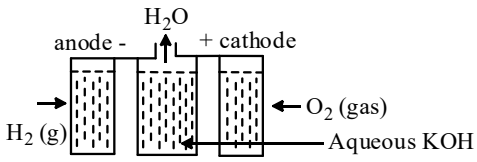


fig. H_2-O_2-fuel cell

Applications of fuel cells

(i) They are non-polluting cells

(ii) Efficiency is about 70%

Q.12 Explain anomalous behaviour of oxygen in group 16 with respect to

(i) atomicity (ii) magnetic property (iii) oxidation state.

Ans : Anomalous behaviours of oxygen.

(i) Atomicity:- oxygen in diatomic other membranes of the group 16 are poly atomic.

(ii) Magnetic property :- O_2 is paramagentic other member of the group 16 are diamagnetic.

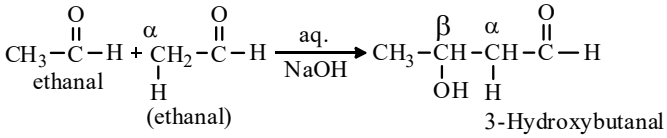
(iii) Oxidation state:- Oxidation state for oxygen is –2, –1, and +2 while oxidation state of other members of the group 16 are –2, +2, +4, +6

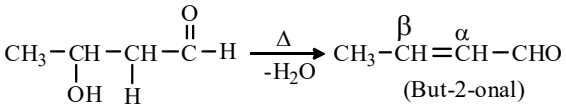
Q.13 Explain Aldol condensation of ethanal.

Ans : Adol condensation:- Aldehydes containing atleast one α-hydrogen atom undergo a reaction in presence of dilute alkali (NaOH/KOH) to form β-hydroxy aldehydes (adol).

This reaction is known as adol reaction formation of adol is an addition reaction adol formed undergoes subsequent elimination of water molecule on warming giving rise to $\alpha-\beta$-unsaturated aldehyde.

* Adol condensation of ethanol.





Q.14 Define half life of first order reaction. Obtain the expression for half life and rate constant of the first order reaction.

Ans : Half life period:-

It is the lime required for the reactant concentraction of fall of its initial value.

Expression for half-life period:-

For first order reaction, integrated law is given by.

$$k = \frac{2.303}{t}\log_{10}\frac{[A]_o}{[A]_t}$$

where,

$[A]_o$ = Initial concentration of reactant at and $[A]_t$ = concentration at lime, t = t

At time $t = t_1/2$, $[A]_t = \frac{[A]_o}{2}$

$$\therefore \quad K = \frac{2.303}{t_{1/2}}\log 10\frac{[A]_o}{[A]_{o/2}}$$

$$= \frac{2.303 \times 0.3010}{t_{1/2}}$$

$$= \frac{0.693}{t_{1/2}}$$

$$\therefore \quad t_{1/2} = \frac{0.693}{K}$$

Section -D : Attempt any 2 (Q.15 to 18) [08]

Q.15 Show that the time required for 99.9% completion of first order reaction is three times the time required for 90% completion. Write a note on haloform reaction. What is reference electrode.

Ans : Proof :

We have for first order reaction

$$K = \frac{2.303}{t} \log 10 \frac{[A]_o}{[A]_t}$$

or $$t = \frac{2.303}{K} \log_{10} \frac{[A]_o}{[A]_t}$$

Where,

$[A]_o$ = Initial concentration ot time, $t = 0$

$[A]_t$ = Concentration of time $t = t$

For 90% disintegration

$$t_{90\%} = \frac{2.303}{K} \times \log_{10} \frac{100}{10}$$

$$\therefore \quad t_{90\%} = \frac{2.303 \times 1}{K} \qquad (\because \log_{10} 10 - 1)$$

$$\therefore \quad t_{90\%} = \frac{2.303}{K}$$

For 99.9% disintegration

$$t_{99.9\%} = \frac{2.303}{K} \times \log_{10} \frac{100}{0.1}$$

$$= \frac{2.303}{K} \times \log_{10} \times 10^3$$

$$\therefore \quad t_{99.9\%} = \frac{2.303 \times 3}{K}$$

$$\therefore \quad t_{99.9\%} = 3\ t90\%$$

Hence, time required for 99.9% completion of a first order reaction is three times the time required for 90% completion.

Electronic configuration of Gd (Z = 64)

Gd [Z = 64] = [Xe] $4f^7\ 5d^1\ 6s^2$

Nano material

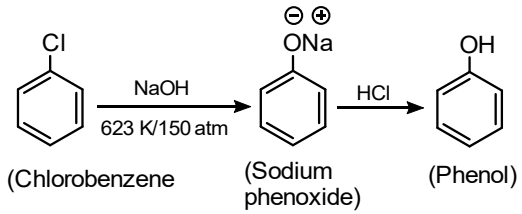
Carbon block is used in car tyres to increase the life of tyres.

Q.16 Write Dow process for preparation of phenol. What is the action of bromine water on phenol ?

Give reason : Group 16th elements have lower ionization enthalpy compared to group 15th elements. Write two uses of dioxygen.

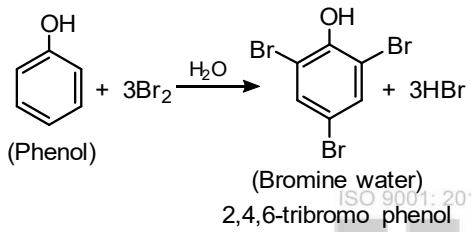
Ans : Dow process for preparation of phenol :

Chlorobenzene is fused with NaOH at high temperature and pressure (623 K and 150 atm) followed by treatement with dilute HCl to obtain phenol.



Action of bromine water on phenol.

Phenol reacts with aqueous solution of bromine to give 1,4,6-tribromo phenol.



Stability of group 15 and 16 elements :

The outermost electronic configuration of group 16 is $ns^2 np^4$ whereas that of group 15 is $ns^2 np^3$.

Group 15 have half filled p-orbital.

Hence they have extra stability due to half filled p-orbital than group 16. hence, group 15 elements have higher ionisation potential then group 16 elements.

Uses of Dioxygen :

i) Dioxygen (O_2) is important for respiration.

ii) It is necessary for combustion of fuels.

Q.17 Find out reaction intermediate and molecularity of following reactions.

$$NO_{(g)} + Cl_{2\,(g)} \longrightarrow NOCl_{2\,(g)}$$

$$NOCl_{2\,(g)} + NO_{(g)} \longrightarrow 2NOCl_{(g)}$$

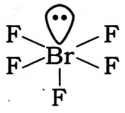
Draw structure of BrF_5 and HOCl.

Ans : Reaction intermediate = $NOCl_2$ (g)

Molecularity of the reaction = 2

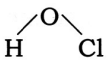
Structure :

Bromine pentafluoride (BrF_5)



(Square pyramidal)

Hypochlorous acid (HOCl)

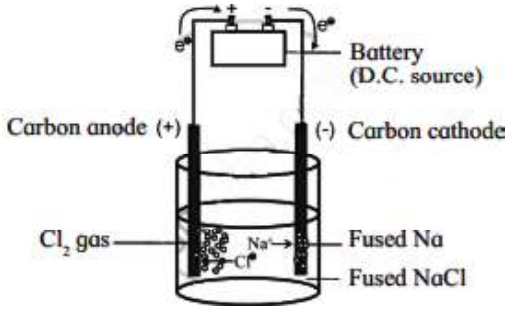


(Angular or 'V' shaped)

Q.18 Explain electrolysis of molten NaCl. Write two uses of salt bridge.

Ans : Electrolysis of Molten NaCl

Electrolysis of NaCl in molten or fused state is carried out in electrolytic cell made up of two graphite electrodes immersed in molten NaCl.



Reaction : When current is passed Cl^- ions migrate to anode.

$2Cl^- \rightarrow 3Cl_2(g) + 2e^-$ (Reduction)

Battery suck electrons and push them to cathode through wire in external circuit at cathode.

$2Na^+(aq) + 2e^- \rightarrow 2Na(s)$

Net cell reaction,

$2Na^+(aq) + 2Cl^-(s) \rightarrow 2Na(s) + Cl_2(g)$

Hence pale yellow $Cl_2(g)$ is released at anode

Silver-white sodium is formed at cathode.

Uses of connects two half cells.

1) It connects two half cells.

2) It provides electrical contract between two electrolyes.