ISC Solved Paper 2022 Semester-2

Chemistry

Class-XII

(Maximum Marks : 40)

(Time allowed : One and a half hours)

*Candidates are allowed an additional **15 minutes** for **only** reading the paper.*
*They must **NOT** start writing during this time.*

All questions are compulsory
Question 1 is of 20 marks having four sub parts, all of which are compulsory.
Question numbers 2 to 8 carry 2 marks each, with two questions having internal choice.
Question numbers 9 to 15 carry 3 marks each, with two questions having an internal choice.
Question numbers 16 to 18 carry 5 marks each, with an internal choice.
All working, including rough work, should be done on the same sheet as, and adjacent to the rest of the answer.
The intended marks for questions or parts of questions are given in brackets [ ].
Balanced equations must be given wherever possible and diagrams where they are helpful.
When solving numerical problems, all essential working must be shown.
In working out problems, use the following data:
Gas constant R = 1.987 cal deg–1 mol–1 = 8.314 JK–1 mol–1 = 0.0821 dm3 atm K–1mol–1
1 l atm = 1 dm3 atm = 101.3 J. 1 Faraday = 96500 coulombs.
Avogadro's number = 6.023 × 1023.

SECTION-A [7 Marks]

1. Fill in the blanks by choosing the appropriate word(s) from those given in the brackets:

(colourless, first, paired, dependent, second, independent, coloured, unpaired, electrophilic, ortho and para, meta, nucleophilic)

(i) The half-life period of _____ order reaction is _____ of the initial concentration of the reactant. **[1]**

(ii) Paramagnetic compounds are generally _____ and contain _____ electrons. **[1]**

(iii) Benzaldehyde undergoes _____ substitution at _____ position. **[1]**

Ans. (i) First, independent

(ii) Coloured, unpaired

(iii) Electrophilic, meta

2. Select and write the correct alternative from the choices given below.

(i) The coordination number and oxidation state of the element 'E' in the complex $[E(NH_3)_4Cl_2]NO_3$ are respectively: **[1]**

(a) 6 and 3 **(b)** 6 and 2

(c) 4 and 2 **(d)** 4 and 3

(ii) Benzaldehyde when heated with alcoholic solution of potassium cyandide gives: **[1]**

(a) $C_6H_5CH(OH)CN$

(b) $C_6H_5(OH)COC_6H_5$

(c) $C_6H_5CH(OH)COOH$

(d) $C_6H_5CH(OH)CH(OH)C_6H_5$

(iii) Ethylamine ($C_2H_5NH_2$) reacts with nitrous acid (HNO_2) to form : **[1]**

(a) Methyl alcohol **(b)** Ethyl alcohol

(c) Ethane **(d)** Ethyl nitrite

***(iv) Assertion :** Colloidal solutions are stable but colloidal particles do not settle down. **[1]**

Reason : Brownian movement counters the force of gravity actively on colloidal particles.

(a) Both assertion and reason are true and reason is the correct explanation for assertion.

(b) Both assertion and reason are true but reason is not the correct explanation for assertion.

(c) Assertion is true but reason is false.

(d) Assertion is false but reason is true.

2. **(i) (a)** 6 and 3

Oxidation state of E = $x + (0 \times 4) + (-1 \times 2) + (-1) = 0$

$$x = +3$$

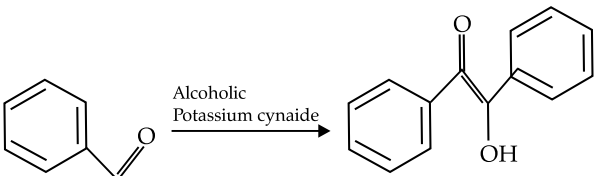
Coordination number of E is 6 as four molecules of ammonia and two molecules of chlorine atoms.

All are monodentate.

So, coordination number= $(4 \times 1) + (2 \times 1) = 6$

(ii) (b) $C_6H_5CH(OH)COC_6H_5$

***Out of Syllabus**



(iii) (b) Ethyl alcohol

$$C_2H_5NH_2 \xrightarrow{HNO_2} C_2H_5OH$$

Ethyl Amine — Ethyl alcohol

SECTION-B [12 Marks]

3. Write the IUPAC names of the following compounds: [2]

(i) $[Co(NH_3)_4Cl_2]Cl$

(ii) $K_3[Al(C_2O_4)_3]$

Ans. (i) $[Co(NH_3)_4Cl_2]Cl$: Tetraamine dichloro cobalt(III) chloride

(ii) $K_3[Al(C_2O_4)_3]$: Potassium trioxalato aluminate(III)

4. Write the chemical equations to illustrate each of the following name reactions: [2]

(a) Aldol condensation

(b) HVZ reaction

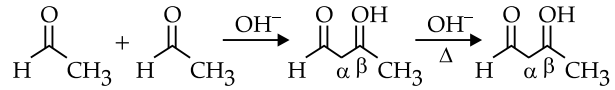
OR

How will the following be converted? (Give chemical equation)

(a) Acetone to iodoform

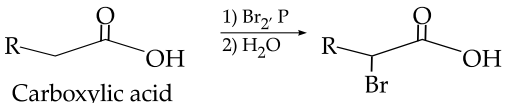
(b) Acetic acid to methane

Ans. (a) Aldol condensation : Aldehydes which hydrogen can undergo self-condensation on warming with dilute or mild base to form hydroxy aldehydes or aldols (alcohol + aldehyde). Such reaction is called Aldol Condensation.



acetaldeyde — acetaldeyde — 3-hydroxybutanal (aldchyde + alcohol) aldol) — but-2-enal

(b) Hell – Volhard Zelinsky Reaction – Those reactions which occurs in presence of Cl Red Phosphorous and converts carboxylic acid into an halo acid are called HVZ reactions.



Carboxylic acid — α-Bromo carboxylic acid

OR

(ii) (a) Acetone to iodoform : When acetone is treated with iodine solution and sodium carbonate gives triiodo acetone which on further treatment with sodium hydroxide gives iodoform.

$$CH_3—COCH_3 \xrightarrow{I_2/Na_2CO_3} I_3COOCH_3$$

Acetone — Triodo acetone

$$\xrightarrow{NaOH} CH_3COONa + CHI_3$$

Sodium acetate — Iodoform

(b) Acetic acid to methane : When acetic acid reacts with sodium hydroxide forms sodium acetate which on further distillation with soda lime gives methane.

$$CH_3COOH \xrightarrow{NaOH} CH_3COONa$$

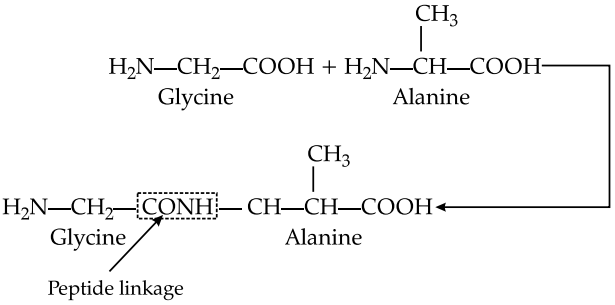
$$\xrightarrow[\Delta]{NaOH + CaO} CH_4 + Na_2CO_3$$

(Methane)

5. What is a peptide bond ? Illustrate its formation with an example. [2]

Ans. The bonds formed between the amine group ($–NH_2$) of one of the amino acids and the carboxylic group (–COOH) of another amino acid results in the formation of an amide group (–CO-NH–) by losing a molecule of water are called peptide bonds.

For example, peptide bond is formed in between the two amino acid that are Glycine and Alanine forming Glycylalanine



Glycylalanine (Gly - Ala)

6. $CH_3NH_2 + CHCl_3 + 3KOH(alc.) \xrightarrow{heat}$ _____ $+ 3KCl + 3H_2O$ [2]

(a) Complete the reaction given above.

(b) Name the reaction given above.

Ans. (a) $CH_3NH_2 + CHCl_3 + 3KOH \xrightarrow{\Delta}$

methylamine — (alc)

$CH_3NC + 3KCl + 3H_2O$

methylcarbylamine

(b) This reaction is known as the Carbylamine reaction. It is also used to detect primary amines. This, is also an example of the Isocyanide test.

7. Answer the following questions. [2]

(i) Name the chemical compound which can be used as an antiseptic as well as a disinfectant.

(ii) What are artificial sweetening agents? Give one example.

Ans. (i) Phenol and its derivatives are used as both an antiseptic as well as a disinfectant. 0.2% solution of phenol is used as an antiseptic while 1% of its solution is used as a disinfectant.

(ii) Those chemicals which are used to sweeten the food are called artificial sweetening agents. They don't harm our body as they do not add calories to our body. For example, Aspartame, Saccharin, Alitame, etc.

8. A first order reaction is 50% complete in 30 minutes at 27°C and the same reaction is again 50% complete in 10 minutes at 47°C. Calculate the activation energy of the reaction (R = 8.314JK^{-1}mol^{-1})

Ans. According to Arrhenius Equation,

$$\log\left(\frac{k_2}{k_1}\right) = \frac{E_a}{2.303R}\left(\frac{T_2 - T_1}{T_1T_2}\right)$$

k_1 at 27°C or 300 K $= \frac{0.693}{30\,\text{min}} = 0.0231\ \text{min}^{-1}$

k_2 at 47°C or 320 K $= \frac{0.693}{10\,\text{min}} = 0.0693\ \text{min}^{-1}$

$$R = 8.314\ \text{JK}^{-1}\ \text{mol}^{-1}$$

By placing the values in the equation

$$\log\left(\frac{0.0693}{0.0231}\right) = \frac{E_a}{2.303 \times 8.314}\left(\frac{20}{320 \times 300}\right)$$

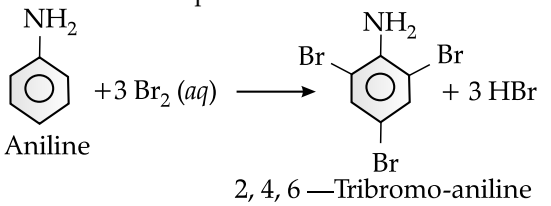
$$E_a = 43.85\ \text{kJ mol}^{-1}$$

9. Give balanced chemical equation for each of the following :

(i) Aniline and bromine water

(ii) Ethyl amine and ethyl bromide

Ans. (i) When aniline treated with bromine water, the bromine water gets decolourised and formation of white precipitate takes place. This reaction results in the formation of 2,4,6-tribromo phenylamine. This reaction is an example of bromination.



(ii) When the reaction between primary amine and alkyl halide take place, it is known as alkylation of amine. In this reaction, nucleophile attacks on the bromine atom and substitute it by ethyl group and thus form secondary amine.

$CH_3CH_2NH_3 + CH_3CH_2Br \longrightarrow CH_3CH_2\text{-}NH\text{-}CH_2CH_3$

Ethyl amine Ethyl Bromide 2° Amine or N-ethyl ethanamine

10. Give one chemical test to distinugish between each of the following pairs of compounds:

(i) Formaldehyde and acetaldehyde

(ii) Benzaldehyde and acetic acid

Ans. (i) Formaldehyde and acetaldehyde can be distinguished by Iodoform test.

When acetaldehyde and formaldehyde are treated with iodine in presence of alkali, acetaldehyde will give yellow precipitate of iodoform whereas formaldehyde do not react.

$CH_3CHO + 4NaOH + 3I_2 \longrightarrow CH_3I +$ Yellow ppt.
$HCOONa + 3NaI + 3H_2O$

$HCHO + 4NaOH + 3I_2 \longrightarrow$ No reaction

(ii) Benzaldehyde and Acetic acid can be distinguished by sodium bicarbonate Test

When acetic acid and benzaldehyde is treated with sodium bicarbonate, evolution carbon dioxide gas with brisk of effervescence comes out in case of acetic acid whereas no effervescence comes in case of benzaldehyde.

$CH_3COOH + Na_2CO_3/NaHCO_3 \rightarrow CH_3COONa + CO_2\uparrow + H_2O$

Brisk effervescence

$C_6H_5CHO + Na_2CO_3/NaHCO_3 \longrightarrow$ No reaction

SECTION-C [12 Marks]

11. (i) Answer the following questions. [3]

(a) A first order reaction takes 100 minutes for completion of 60% of the reaction. Find the time required when 90% of the reaction will be completed.

(b) In a reaction, mA + nB $\longrightarrow$ Products, when the concentration of A is doubled, the rate of reaction is also doubled. When the concentration of B is doubled, the rate of reaction becomes four times. Find the overall order of reaction.

OR

(ii) Answer the following questions

(a) Mention any two factors that influence the rate of a chemical reaction.

(b) In a first order reaction, 20% of a reaction is consumed in 30 minutes. Calculate the following:

(1) The half-life period of the reaction.

(2) The time required for completing 93.75% of the reaction.

Ans. (i) (a) According to the first order reaction

$$k = \frac{2.303}{t}\log\frac{a}{a-x}$$

t = 100 min

Initial concentration (a) = 100

If the reaction is 60% completed in 100 min

Final concentration $(a - x)$ = 100 – 60 = 40

Putting the values in equation

$$k = \frac{2.303}{100}\log\frac{100}{40}$$

$$k = 0.00916\ s^{-1}$$

If the reaction is 90% completed in time t min

Final concentration $(a - x)$ = 100 – 90 = 10

$$t = \frac{2.303}{0.00916}\log\frac{100}{40}\ t = 251.4\ min$$

(b) $mA + nB \longrightarrow$ Products

In the above reaction the rate of reaction is expressed as

$$r = k\,[A]^{\underline{m}}\,[B]^{\underline{n}} \qquad \ldots 1$$

If concentration of A is double, rate of reaction also doubles the concentration of B is double, rate of reaction becomes four times.

$$2r = k\,[2A]^m\,[B]^n \qquad \ldots 2$$

$$4r = k\,[A]^m\,[2B]^n \qquad \ldots 3$$

On dividing Eq. 2 by Eq. 1

$$\frac{2r = k[2A]^m[B]^n}{r = k[A]^m[B]^n}$$

$$2^1 = 2^m$$

On dividing Eq. 3 by Eq. 1

$$\frac{4r = k[A]^m[2B]^n}{r = k[A]^m[B]^n}$$

$$4^1 = 2^n$$

Thus, $m = 1$, $n = 2$

Place the values of m and n in Eq. 1

Therefore, $r = k\,[A]^1\,[B]^2$

Order of the reaction = 1+2 = 3

Thus, the order of the given equation is 3rd order reaction.

OR

(ii) (a) The two factors that affect the rate of a chemical reaction are

1. **Concentration of reactant:** Increase in the concentration of reactant increases the rate of reaction
2. **Temperature:** As the temperature increases, the rate of chemical reaction also increases.

(b) (1) According to the first order reaction

$$k = \frac{2.303}{t}\log\frac{a}{a-x}$$

t = 30 min

Initial concentration (a) = 100

If the reaction is 20% completed in 30 min

Final concentration $(a - x)$ = 100 – 20 = 80

Putting the values in equation

$$k = \frac{2.303}{30}\log\frac{100}{80}$$

$$k = 0.145\ s^{-1}$$

Half-life, $t_{1/2} = \frac{0.693}{k}$

$$t_{1/2} = \frac{0.693}{0.145} = 4.77\text{min}$$

(2) Initial concentration (a) = 100

If the reaction is 93.75% completed in time t min

Final concentration $(a - x)$ = 100 – 93.75 = 6.25

$$t = \frac{2.303}{0.145}\log\frac{100}{6.25}$$

= 19.12 min

Time required to complete 93.75 % is 19.12 min.

12. (i) The size of the trivalent cations in the lanthanoid series decreases steadily as the atomic number increases. What is this phenomenon called ? **[3]**

(ii) Why are the compounds of transition elements coloured ?

Ans. (i) The size of trivalent lanthanoid cation decreases with an increase in the atomic number because the differentiating electron enter is added in the inner 4f orbital. The shielding of one 4*f* electron by another from the increasing nuclear charge is very much imperfect due to the peculiar shape of 4*f* orbitals. This phenomenon is known as Lanthanoid Contraction.

(ii) When visible light falls on any transition metal compound or ion, the unpaired electrons present in the lower energy of the d-orbital excited to high energy d-orbitals, due to the absorption of visible light. This is called d-d transition. Transition metal ions generally possess one or more unpaired electrons. However, the energy involved in d-d transition is quantised, only a definite wavelength gets absorbed, remaining wavelengths present in the visible region got transmitted. Thus, transmitted light shows colour complementary to the absorbed colour.

13. (i) $[Fe(CN)_6]^{4-}$ is a coordination complex ion: **[3]**

(a) Is the complex ion diamagnetic or paramagnetic ?

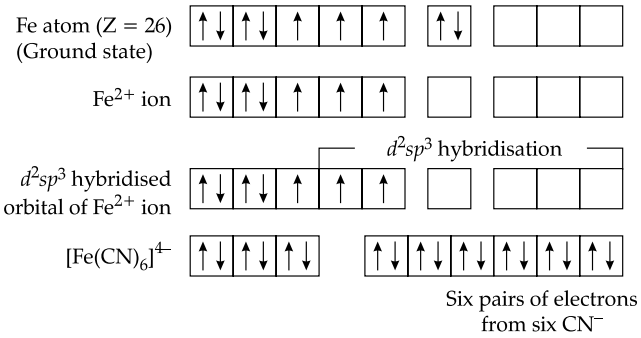
(b) What is the hybridisation state of the central metal atom ?

(ii) Name the type of isomerism shown by the following pair of coordination compounds:

$[Co(NH_3)_5SO_4]$ Br and $[Co(NH_3)_5Br]SO_4]$

Ans. **(i)** (a) The complex $[Fe(CN)_6]^{4-}$ is diamagnetic in nature because of the absence of unpaired electrons as all electrons are paired.

(b) The hybridisation of Fe in the complex is d^2sp^3



(ii) The type of isomerism present in the complex $[Co(NH_3)_5SO_4]Br$ and $[Co(NH_3)_5Br]SO_4$ is Ionisation Isomerism.

***14.** Answer the following questions. **[3]**

(i) Which aqueous solution of concentration 0.01 M salt i.e., KCl, $MgCl_2$ and $AlCl_3$ would be most effective in coagulating a negatively charged colloidal solution of As_2S_3?

(ii) Bleeding caused by a nick from a razor during shaving can be stopped by rubbing alum. Give reason.

(iii) Muddy water can be purified by adding potash alum to it. Give reason.

■■