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### Part: I

Question: 1 ..... ii-iv

### Part: II

Section: A

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**Part I** (Answer all questions)

**Question: 1**

- a. Correct the following statements by changing the underlined part of the sentence. (Do not change the whole sentence): [5]

i. Water boils below  $100^{\circ}\text{C}$  by the addition of NaCl.

**Answer:** Water boils above  $100^{\circ}\text{C}$  by the addition of NaCl.

ii. The rate of constant of a first order reaction is proportional to the concentration of the reactant.

**Answer:** The rate of a first order reaction is proportional to the concentration of the reactant.

iii. Acetone gives a white precipitate on treatment with sodium chloride.

**Answer:** Acetone gives a white precipitate on treatment with sodium hydroxide.

iv. Acetaldehyde undergoes Cannizzaro's reaction on treatment with dilute alkali.

**Answer:** Acetaldehyde undergoes Aldol condensation on treatment with dilute alkali.

v. The formation of chlorobenzene from benzene is a  $\text{SN}^2$  reaction. \*\*

- b. Complete the following statements by selecting the correct alternative from the choices given: [5]

1. Mesotartaric acid is optically inactive because:

- It has no chiral carbon atom
- It has a double bond
- Of internal compensation
- Of external compensation

**Answer: c**

2. The reaction between X and Y is first order with respect to X and second order with respect to Y. If the concentration of X is halved and the concentration of Y is doubled, the rate of the reaction will be:

- Same as the initial value
- Three times the initial value
- Double the initial value
- Half the initial value

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**Answer: d**

3. The fibre obtained by the condensation of hexamethylene diamine and adipic acid is"

- a. Nylon-66
- b. Teflon
- c. Dacron
- d. Polyester

**Answer: a**

4. The solubility of a gas varies directly with pressure of the gas, is based upon:

- a. Raoult's Law
- b. Henry's Law
- c. Nernst's Distribution Law
- d. None of these.

**Answer: b**

5. When zinc granule is dipped into copper sulphate solution, copper is precipitated because:

- a. Both, copper and zinc have a positive reduction potential.
- b. Reduction potential of copper is higher than that of zinc.
- c. Reduction potential of zinc is higher than that of copper
- d. Both zinc and copper have a negative reduction potential.

**Answer: b**

c. Fill in the blanks from the word / words given in brackets: [5]

(Formaldehyde, acetaldehyde, cyanohydrin, first, second, independent, proton, tartaric acid, acetone, depends, cathode, anode, neutron fission, fusion, lactic acid, methyl cyanide, tartaric acid, yellow, phenol, helium, white, acetoxime.)

1. The half of a period of a \_\_\_\_\_ order reaction is \_\_\_\_\_ on the concentration of the reactant.

**Answer: Second, dependent.**

2. In a galvanic cell, the movement of electrons in the external circuit is from \_\_\_\_\_ to \_\_\_\_\_ .

**Answer: Anode, cathode.**

3. Acetaldehyde reacts with HCN to give \_\_\_\_\_ which on hydrolysis gives \_\_\_\_\_ .

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**Answer: Acetaldehyde cyanohydrin, Lactic acid.**

4. A \_\_\_\_\_ precipitate is obtained on adding iodine and sodium hydroxide to \_\_\_\_\_.

**Answer: Yellow, Acetone.**

5. The type of reaction considered to be the principal source of energy in stars is \_\_\_\_\_ when hydrogen is converted to \_\_\_\_\_ \*\*

d. Match the following:

i. Urea	a. Aldol
ii. Acetaldehyde	b. Free Radicals
iii. Homolytic Fission	c. Ostwald's Dilution Law
iv. Tollen's Reagent	d. Wohler's Synthesis
v. Weak Electrolyte	e. Ammoniacal AgNO <sub>3</sub>

**Answer: i. d**  
**ii. a**  
**iii. e**  
**iv. c**  
**v. b**

**Part II** (Answer six questions choosing two from section A, two from section B. And two from section C)

**Section A** (Answer any two questions)

**Question: 2**

- a.
1. If the molality of an aqueous solution of cane sugar is 0.4445, what is the mole fraction of cane sugar. [4]

**Answer: The mole fraction of cane sugar solution**

$$\frac{\frac{w}{m}}{\frac{w}{m} + \frac{W}{M}} = \frac{0.4445}{0.4445 + \frac{1000}{8}} = \frac{0.4445}{0.4445 + 55.55}$$
$$= \frac{0.4445}{56}$$

**Mole fraction = 0.0079**

2. Albumins are the most abundant proteins in blood. At 25°C, 3.5 g of albumin in 100 ml of water produces an osmotic pressure of 0.014 atm. What is the molecular weight of albumin? [3]

**Answer:**  $m = \frac{wRT}{\pi V}$

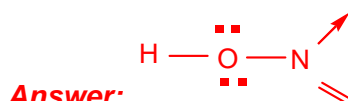
$W = 3.5 \text{ g}$ ,  $R = 0.0821 \text{ atm mol}^{-1} \text{ K}^{-1}$ ,  $T = 273 + 25 = 298 \text{ K}$   
 $\pi = 0.014 \text{ atm}$ ,  $V = 100 \text{ ml} = 100 \times 10^{-3} \text{ litre}$

$m = \frac{3.5 \times 0.0821 \times 298}{0.014 \times 100 \times 10^{-3}}$

$= \frac{3.5 \times 821 \times 298}{140}$

$m = 61164.5$

b. Draw the electron dot or any suitable diagram of nitric acid. [3]

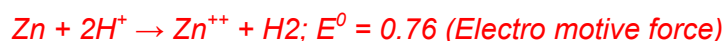
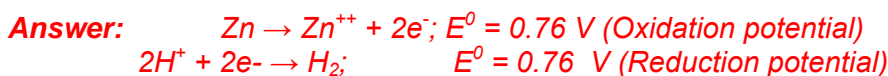


c. Schematically represent the temperature composition curve for the vapour in equilibrium with an ideal mixture of two completely miscible liquids of different boiling points. Explain with the aid of this diagram how fractional distillation of is done. \*\* [3]

### Question: 3

a. Explain the following: [3]

i. Zinc displaces hydrogen from acid solution. [ $E^\circ_{\text{Zn}^{+2}/\text{Zn}} = -0.76 \text{ volts}$ ]



*It is clear from the above example that zinc displaces hydrogen from acid solution because the elements having positive oxidation potential can replace hydrogen from acids due to zero electrode potential of hydrogen.*

*Electromotive force ( $E^\circ$ ) of the complete reaction will be positive in this case.*

ii. The hydride of sulphur is a gas but the hydride of oxygen is a liquid.

**Answer:** *The molecules linked by hydrogen bond, associate with one another, to form associated units, each of which may contain 2 or more molecules. Strong association between the molecules brings them close enough to form a liquid.*

*Thus hydride of oxygen ( $\text{H}_2\text{O}$ ) is a liquid and hydride of sulphur ( $\text{H}_2\text{S}$ ) is a gas.*

b. Complete the following nuclear equations: \*\* [1]



c. Water acts as a Bronsted Acid as well as a Bronsted Base. Give one example each to illustrate this. [3]

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**Answer:** Water behaves like both acid and base. Water can donate or accept proton, hence it is called amphiprotic solvent e.g  $\text{NH}_3 + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4^+ + \text{OH}^-$

In this reaction, water acts as an acid;  $\text{HCl} + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{Cl}^-$

In this reaction water acts as base so we can write the behaviour of water in the following manner:  $\text{H}_2\text{O} + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{OH}^-$  acid<sub>1</sub> base<sub>2</sub> acid<sub>2</sub> base<sub>1</sub>  $\text{pH} = -\log [\text{H}^+]$

d. Find the pH of 0.05 M  $\text{H}_2\text{SO}_4$  solution.

**Answer:**  $\text{H}_2\text{SO}_4 \rightleftharpoons \text{SO}_4^{2-}$   
 $= -\log [0.05] = -\log [2 \times 0.05]$   
 $= -\log [0.10] = -\log [1 \times 10^{-1}]$   
 $= -\log 1 + 1 \log 10$   
 $= 0 + 1$   
 $\text{pH} = 1$

**Question: 4**

a. A 0.05 M NaOH solution offered a resistance of 31.6 ohms in a conductivity cell. If the cell constant of the conductivity cell is  $0.378 \text{ cm}^{-1}$ , determine the molar conductivity of sodium hydroxide solution at this temperature. [3]

**Answer:**  $\lambda_m = K \times \frac{1000}{M} = \frac{1}{31.6} \times 0.378 \times \frac{1000}{0.05}$

b. Give reasons for the following:

i. The number of hydrogen ions in an aqueous solution of acetic acid increase considerably with dilution while this is not the case with an aqueous solution of hydrogen chloride.

**Answer:** Acetic acid is a weak acid. It ionizes feebly in an aqueous solution, which increases with dilution according to Ostwald's dilution law. When the degree of ionization is increased, more and more hydrogen ions are formed in the aqueous solution, it is completely ionized.

As such there is no effect of dilution of ionization of an aqueous solution of hydrogen chloride.

ii. A mixture of  $\text{NH}_4\text{Cl}$  and  $\text{NH}_4\text{OH}$  is used to precipitate the metallic hydroxides of group H.

**Answer:** A mixture of  $\text{NH}_4\text{Cl}$  and  $\text{NH}_4\text{OH}$  is used to precipitate the metallic hydroxides of group (III).  $\text{NH}_4\text{OH}$  is a weak base and the concentration of  $\text{OH}^-$  ions is low.  $\text{NH}_4\text{Cl}$  provides more  $\text{NH}_4^+$  ions which shifts the equilibrium to the left due to common ion effect.



Thus some  $\text{OH}^-$  ions are converted to undissociated  $\text{NH}_4\text{OH}$ . So the concentration of  $\text{OH}^-$  ions becomes extremely low. But the ionic product, is greater than the solubility product values for the hydroxides of (III) group metallic ions which precipitate out.

- c. i. For diamond, state the element present at the lattice sites, the number of nearest neighbours for each atom and the type of cell. State the hybridization of the carbon atom in diamond. [2]

**Answer:** Carbon is present in lattice sites, one carbon atom is linked with other four carbon atoms i.e tetrahedral units. Diamond have covalent network crystals. It has  $sp^3$  hybridisation.

- ii. The rate constant of a first order reaction is  $4.5 \times 10^{-2} \text{ sec}^{-1}$ , what will be the time required for the initial concentration of 0.4 M of the reactant to be reduced to 0.2 M? [1]

**Answer:**  $t_{1/2} = \frac{0.693}{k} = \frac{0.693}{4.5 \times 10^{-2}}$

### Section B (Answer any two questions)

#### Question: 5

- a. i. Calculate the maximum work done when 64 g of oxygen gas occupying a volume of 7 litres is expanded isothermally and reversibly to 14 litres at  $27^\circ\text{C}$  [  $R = 1.987 \text{ cal deg}^{-1} \text{ mol}^{-1}$ ] [3]

**Answer:**  $W = 2.303nRT \log \frac{V_2}{V_1}$

$N = \frac{64}{32} = 2 \text{ mole (M wt. Of } O_2 - 32)$

$T = 273 + 27 = 300 \text{ K}$

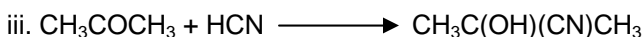
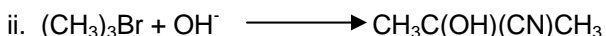
$W = 2303 \times 2 \times 1.987 \times 300 \times \log \frac{14}{7}$   
 $= 826.5 \text{ cal}$

- ii. Diethyl ether boils at  $35^\circ\text{C}$  at 1 atmosphere pressure. If its heat of vapourisation is 6.5 Kcal, calculate its entropy at boiling point. [3]

**Answer:**  $\Delta S = \frac{VH_{vap}}{T}$

$VS = \frac{6.5}{308} = 0.0211 \text{ Jk}^{-1} \text{ mol}^{-1}$

- b. Classify the following based on the type of reagent and type of reaction: \*\* [3]



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**Question: 6 \*\***

- a. Name the chief ore of tin. Describe the extraction of tin from the concentrated ore  
b. Arrange the following in increase order of acidity and explain your order: Phenol, Methanol, Water. [5]

**Answer:**  $\text{CH}_3\text{OH} < \text{HOH} < \text{C}_6\text{H}_5\text{OH}$

*The above increasing order of acidic strengths can be explained as follow:*

*Acidity depends how easily  $\text{H}^+$  ions are deliberated. Electron releasing substituents decreases the acidic character. Water is more acidic than alcohol as H of water is substituted by  $(\text{CH}_3)$  methyl group which have electron releasing nature.*

$\text{CH}_3\text{OH} < \text{HOH}$

*Further phenols are more acidic than alcohol and water because phenoxide ion left after the release of a proton is stabilized by resonance but the methoxide ion and hydroxide ion is not.  $\text{PKa}$  values further support the answer as  $\text{pKa}$  of phenol is  $1.1 \times 10^{-10}$  while that of water is  $1.0 \times 10^{-14}$ .*

- c.  
i. Name the acid that can be prepared from bone ash.  
ii. What do you observe when this acid is treated with silver nitrate solution?  
iii. Write the balanced equation for this reaction. [2]

**Answer:**

**Question 7**

- a. How is Silicon Carbide manufactured? \*\* [4]  
b. Write balanced equations for each of the following re actions:  
i. Silver Sulphide and Sodium Cyanide.

**Answer:**  $\text{Ag}_2\text{S} + 4\text{NaCN} \rightarrow 2\text{Na}[\text{Ag}(\text{CN})_2] + \text{Na}_2\text{S}$   
Sod ARgentocyanide

- ii. Water is added to aluminium chloride. \*\*  
iii. Bromine water and sodium sulphite.

**Answer:**  $\text{Na}_2\text{SO}_3 + \text{Br}_2 + \text{H}_2\text{O} \rightarrow \text{Na}_2\text{SO}_4 + 2\text{HBr}$

- iv. Phosphorous is boiled with a solution of sodium hydroxide. \*\*



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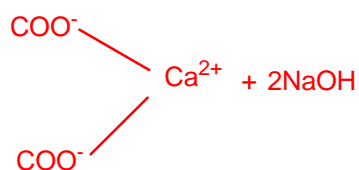
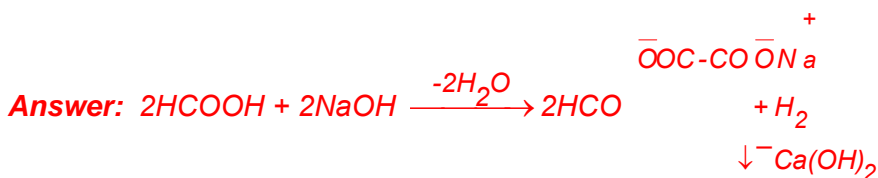
**Section C** (Answer any two questions)

**Question: 8**

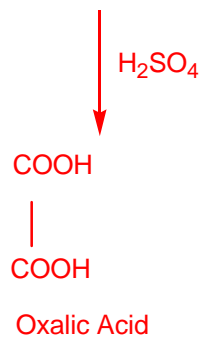
a. How will you carry out the following conversions:

i. Chloroacetic acid to Glycine. \*\* [2]

ii. Formic acid to Oxalic acid [1]

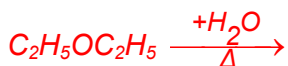


Calcium oxalate



iii. Diethyl ether to ethanol [2]

**Answer:** Ethers heated with  $\text{H}_2\text{SO}_4$



b. Draw the resonating structure of Chlorobenzene.

**Question: 9**

a. State the reagents for the following conversions: \*\* [3]

Benzene  $\xrightarrow{\text{A}}$  Nitrobenzene  $\xrightarrow{\text{B}}$  Aniline  $\xrightarrow{\text{C}}$  Aniline Hydrochloride  $\xrightarrow{\text{D}}$  Benzene Diazonium Chloride.

b. Give one example each of the following: \*\* [3]

- i. Hoffmann's Degradation
  - ii. Cannizzaro's Reaction
  - iii. Benzoin Condensation
  - iv. Friedel Craft's Reaction
- c. Write the names and structures of three isomers which have the same molecular formulae  $C_3H_8O$ . \*\* [3]

**Question: 10**

- a.
- i. To 2ml of aqueous solution of Glucose added 2ml of Tollen's reagent – a silver mirror is obtained while sucrose do not give this test. To 2ml of aqueous solution of the sucrose added a trace of resorcinol, a deep wine red colour or precipitate is obtained sucrose is confirmed.

**Answer:** To 2ml of aqueous solution of Glucose added 2ml of Tollen's reagent – a silver mirror is obtained while sucrose do not give this test. To 2ml of aqueous solution of the sucrose added a trace of resorcinol, a deep wine red colour or precipitate is obtained sucrose is confirmed.

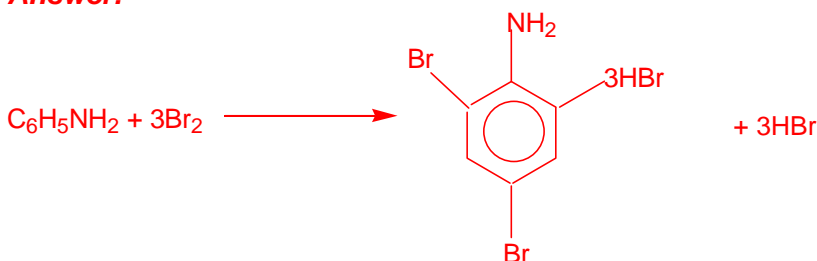
- ii. Ethanol give red colour with ceric ammonium nitrate while phenol will not. Phenol with Ferric chloride will give violet colour.

**Answer:** Ethanol give red colour with ceric ammonium nitrate while phenol will not. Phenol with Ferric chloride will give violet colour.

- b. Write the balanced equations of the following reactions:

(i) Aniline and Bromine water

**Answer:**



(ii) Ethylamine and Nitrous Acid



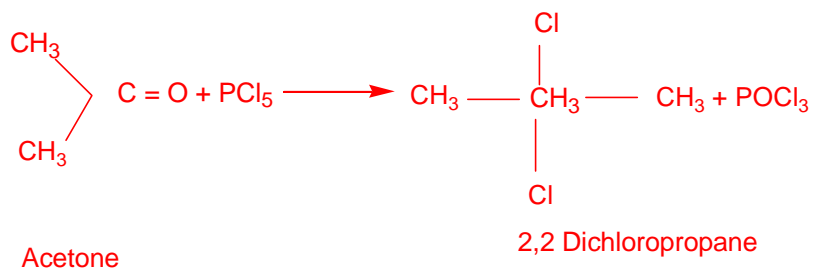
(iii) Acetic Anhydride and Ammonia

**Answer:**



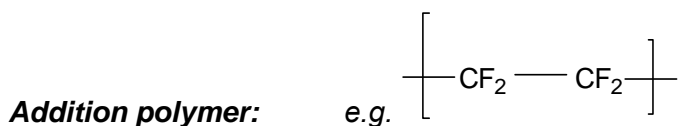
(iv) Acetone and Phosphorous Pentachloride

**Answer:**

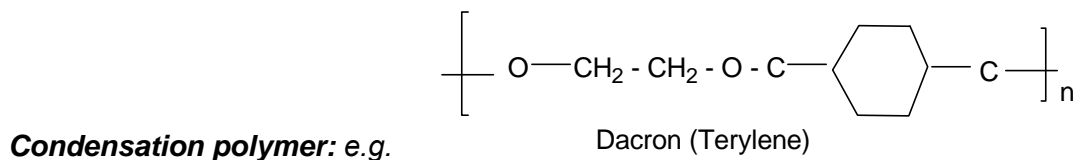


- c. Give one example each of addition and condensation polymer. Name the monomers in each case. [2]

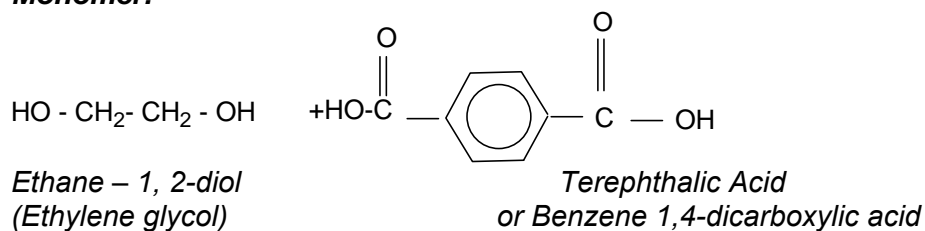
\*\*



**Monomer :**  $\text{CF}_2 - \text{CF}_2$  (Tetrafluoroethylene)



**Monomer:**



**Answer:**

\*\* Out of syllabus. Answer should be provided up on request