2 0 1 7

(April)

CHEMISTRY

(Elective/Honours)

(General Chemistry—IV)

(Inorganic, Organic and Physical)

(Chem–EH–401)

Marks : 56

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

SECTION—I

(Inorganic)

(*Marks* : 18)

1. *(a)* What are meant by pi-bonded organo-metallic compounds? Give one example. Write down one method of its preparation. 2+1=3

(2)

(b) What are silicones? Write down the action of water on $(CH_3)_2SiCl_2$.   1+1=2

(c) Give one method of preparation of BrF_5. Discuss the structure of BrF_5 and also mention the hybridization involved.   1+2=3

(d) Write down one method of preparation of triphosphonitrilic chloride and one use of phosphonitrilic halides.   2

OR

2. (a) Write down any one method of preparation and one use of organometallic compound of lithium.   2

(b) Mention any three points of difference between inorganic and organic polymers.   3

(c) What are polyhalides? Give one example of polyhalide of iodine and one method of its preparation.   3

(d) Explain why interhalogen compounds are more reactive than the halogens.   2

3. (a) What is smog? What are the harmful effects of smog?   1+1=2

(b) What is the aim of the tertiary treatment process for depollution of domestic wastewater? Discuss the process of electrodialysis of wastewater.   1+2=3

(3)

(c) What is radioactive waste? Write down one method of disposal of radioactive waste from nuclear reactors.   1+2=3

OR

4. (a) Write down the chemical equations for the formation of nitric acid rain. How does it affect the environment?   2+1=3

(b) Discuss solid-waste disposal by anaerobic digestion of biological waste.   3

(c) Write a short note on e-pollution.   2

SECTION—II

(Organic)

(Marks : 19)

5. (a) Giving appropriate equations, show how you would bring about the following conversions :   1½×2=3

(i) D-glucose to D-fructose

(ii) D-glucose to D-mannose

(b) Explain briefly the utility of HIO_4 in determining the size of the ring in glucose.   2

(4)

(c) Complete the following reactions : 1×3=3

(i) Glucose reacts with conc. HNO_3

(ii) Urea reacts with diethylmalonate

(iii) Fructose reacts with phenylhydrazine

(d) What are epimers? Explain giving suitable example. 1½

OR
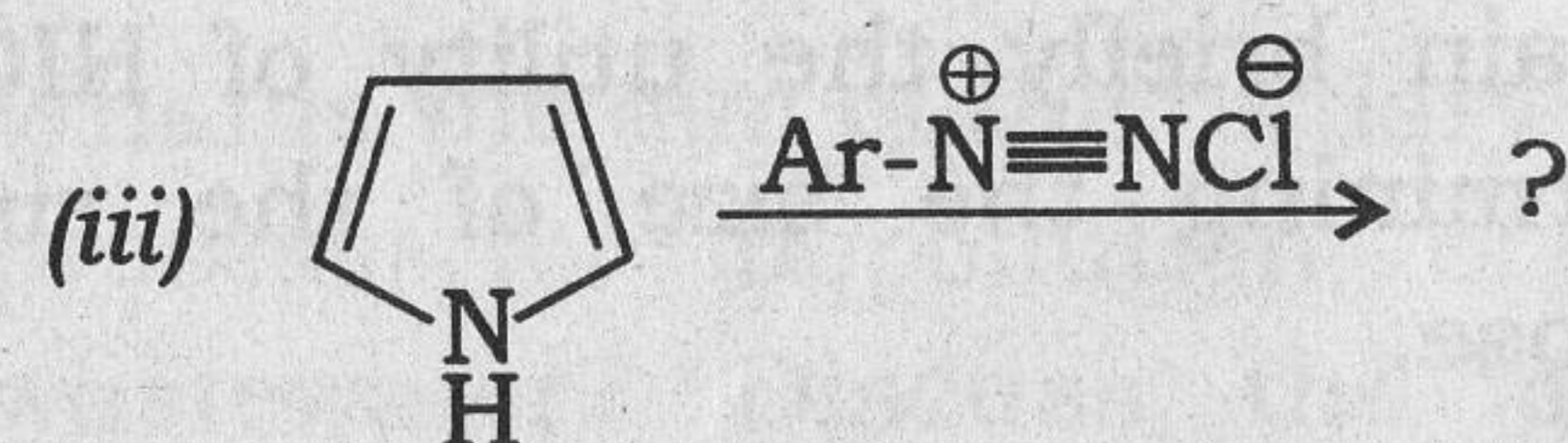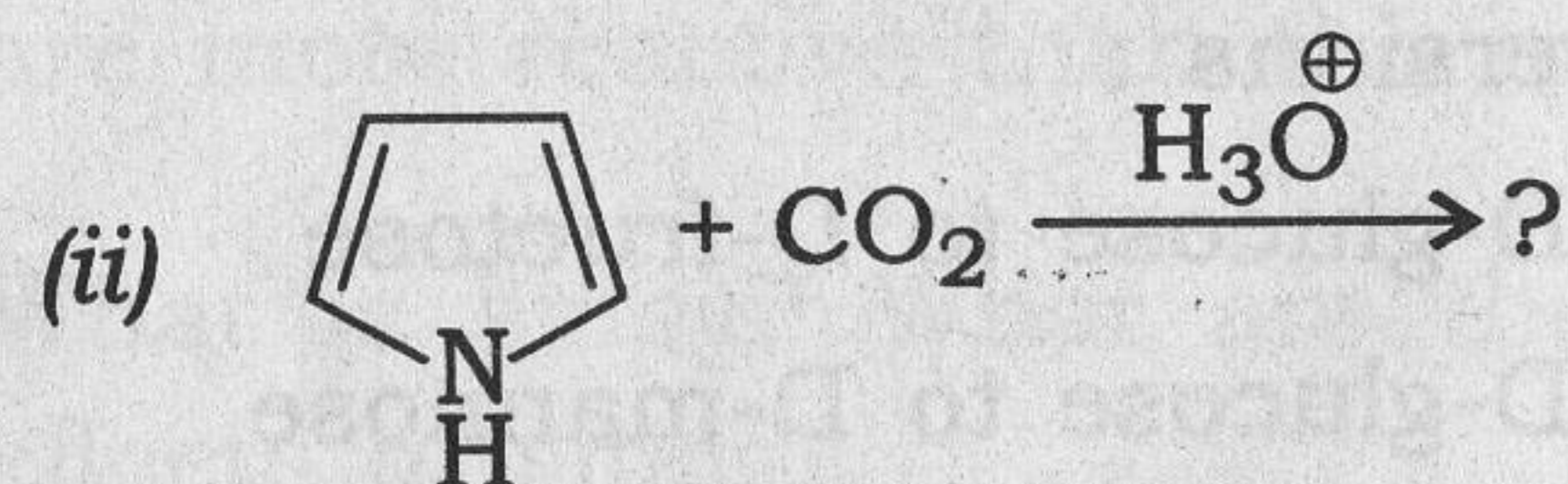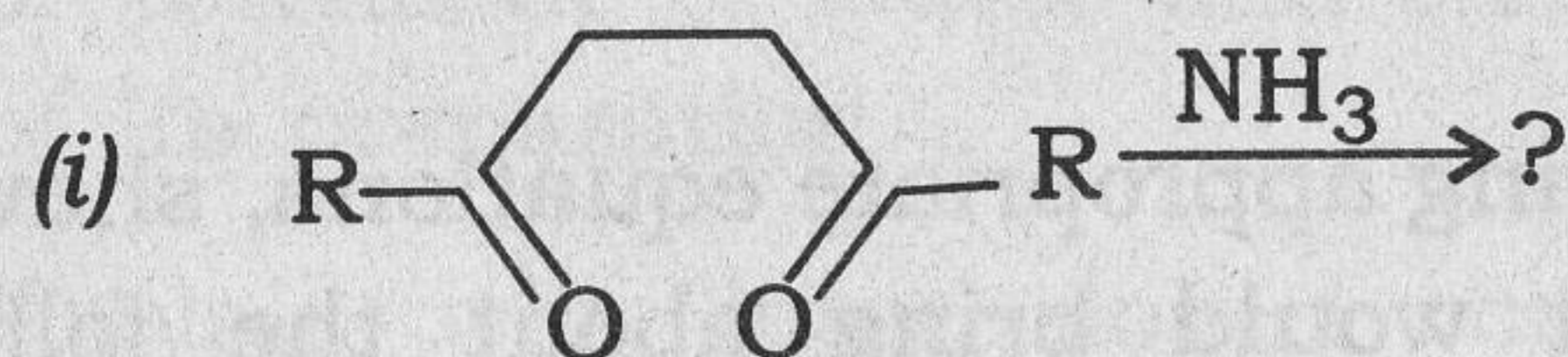
6. (a) What are peptides? Write the structures of all the possible dipeptides obtainable from glycine and phenylalanine. 2

(b) Describe the Wohler's synthesis of urea. 2

(c) Electrophilic substitution in pyrrole takes place at 2-position, whereas in pyridine it is at 3-position. Explain. 2½

(d) Complete the following reactions : 1×3=3
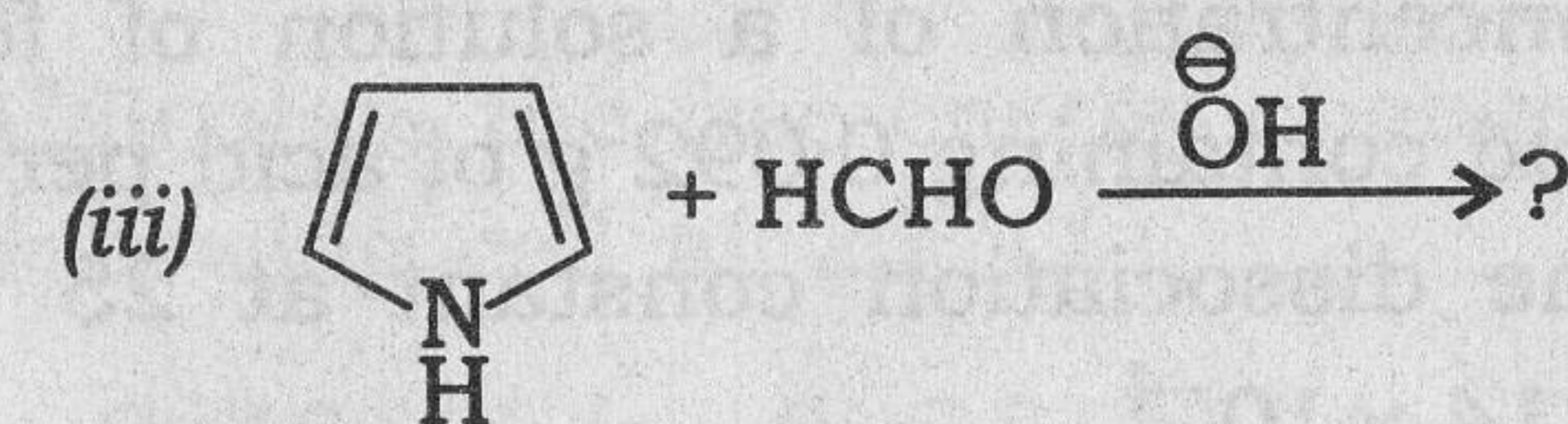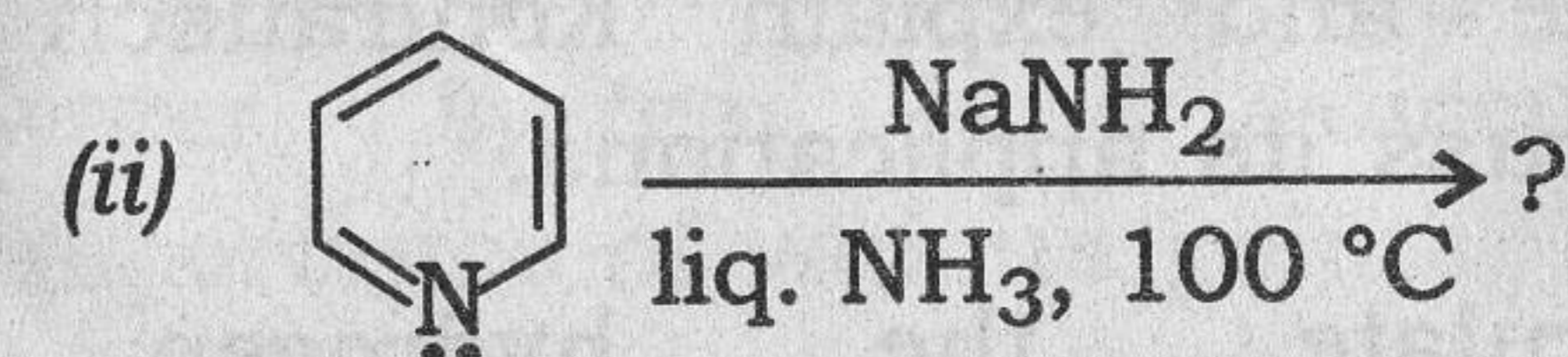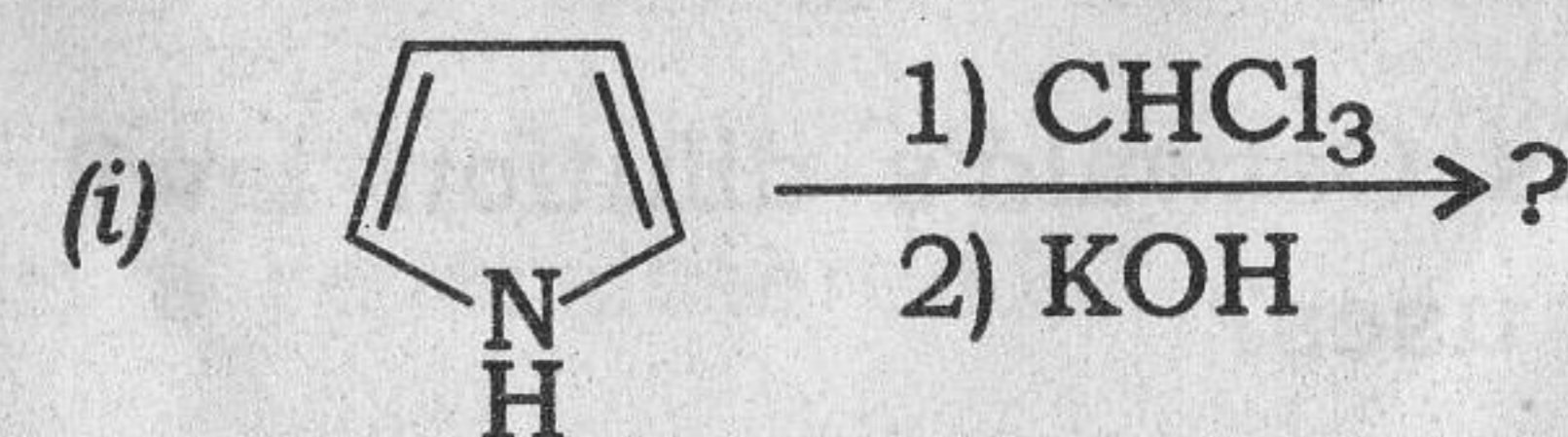
(i)

(ii)

(iii)

(5)

7. (a) Why are animal fats solid and vegetable oils liquid? 2

(b) Write the structure of Bismarck brown indicating the auxochromic and chromophoric groups in it. 2½

(c) Why is furan less reactive than pyrrole towards electrophilic substitution reaction? 2

(d) Give the products of the following reactions with mechanisms (any *two*) : 1½×2=3

(i)

(ii)

(iii)

OR

8. (a) What are antipyretic-analgesic drugs? Write its classification with appropriate examples. 2½

(b) What are the characteristics of a good dye? 2

(c) Define the following terms : 3

   (i) Isoelectric point

   (ii) Zwitterion

   (iii) Saponification value

(d) Compare the basicities of pyridine and piperidine. 2

SECTION—III

(Physical)

(Marks : 19)

9. (a) What is Ostwald's dilution law? What are its uses? 4

(b) State and explain Kohlrausch law. Discuss its applications. $2+1\frac{1}{2}=3\frac{1}{2}$

(c) Calculate the hydrogen ion concentration of a solution of formic acid containing 0·092 g of acid per litre. The dissociation constant at 25 °C is $2 \cdot 14 \times 10^{-4}$. 2

OR

10. (a) Discuss the curves obtained by conductometric titration of—

   (i) a weak acid with a strong base;

   (ii) a strong acid with a weak base. $2+2=4$

(Continued)

(b) Describe Hittorf's method for the determination of transport number. What are the factors that influence the transport number of ions? $2+1\frac{1}{2}=3\frac{1}{2}$

(c) Determine the pH of a solution obtained by mixing equal volumes of a 0·10 N ammonium nitrate and 0·02 N ammonium hydroxide. K_b for NH_4OH is $1 \cdot 8 \times 10^{-5}$. 2

11. (a) Explain how Gibbs-Helmholtz equation can be utilized for calculating the enthalpy change of a reaction occurring in a reversible cell. $3\frac{1}{2}$

(b) Give the labelled phase diagram of the water system and discuss the importance of various points, lines and areas. 4

(c) Calculate the free energy change of the following cell at 25 °C : 2

$$Sn\,|\,Sn^{++}\,(a = 0 \cdot 6)\,||\,Pb^{++}\,(a = 0 \cdot 3)\,|\,Pb$$
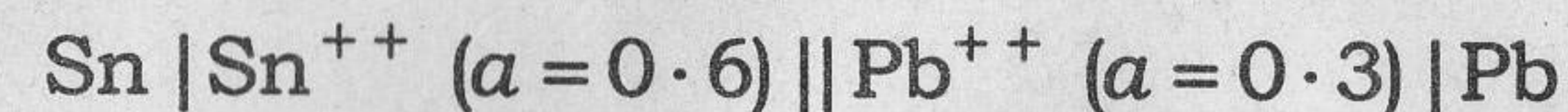
The standard EMF of the cell is 0·014 volt.

OR

12. (a) (i) Derive Nernst equation for measuring the EMF of a cell.

(Turn Over)

(ii) What is electro-chemical series?

$$2\frac{1}{2}+2=4\frac{1}{2}$$

(b) Draw a labelled phase diagram of $KI\text{-}H_2O$ system and describe the main features.   3

(c) Calculate the equivalent conductivity at 20 °C of NH_4OH at infinite dilution. Given :   2

$$\lambda_0\,(NH_4Cl) = 1\cdot30\ S\,m^2\,mol^{-1}$$

$$\lambda_0\,(OH^-) = 174\ S\,m^2\,mol^{-1}$$

$$\lambda_0\,(Cl^-) = 66\ S\,m^2\,mol^{-1}$$

★★★

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SECTION—I

(Inorganic)

(*Marks* : 18)

1. (a) What is glass transition temperature of a polymer? Discuss the structure and properties of tetrasulphur-tetranitride polymers. 3

   (b) Explain the following : 3

      (i) NaC_5H_5 is more stable than NaC_5H_{11}.

      (ii) NaC_6H_5 is more reactive than $NaCH_2C_6H_5$.

(*Turn Over*)

(c) What happens when ClF_5 and IF_7 are hydrolyzed? Draw the structure and mention the number of bond pairs and lone pairs in ClF_5 and IF_7 molecules.   4

OR

2. (a) Write down the general properties of inorganic polymers. Discuss various structural aspects of silicones polymers.   3

(b) Define hapticity of a ligand. Write down the IUPAC name and discuss the structural aspects of $Li(CH_3)_4$ and $Fe(C_5H_5)_2$ organometallic compounds.   4

(c) What are pseudohalogens? Why are they so called? Describe the important characteristics of pseudohalogens.   3

3. (a) What is the function of ozone present in the troposphere? Explain how fluorocarbons tend to deplete the ozone layer. What is the effect of this depletion?   4

(b) "Industrial wastewater is polluted differently depending upon the industry from which it is obtained." Illustrate on this statement with suitable examples.   2

    (Continued)

(c) Give a brief account on the method of disposal of radioactive wastes.   2

OR

4. (a) Discuss the various methods of discarding solid wastes. What do you mean by anaerobic digestion of biological wastes?   3

(b) What do you mean by reverse osmosis? How can it be used in the treatment of depollution of domestic wastewater?   2
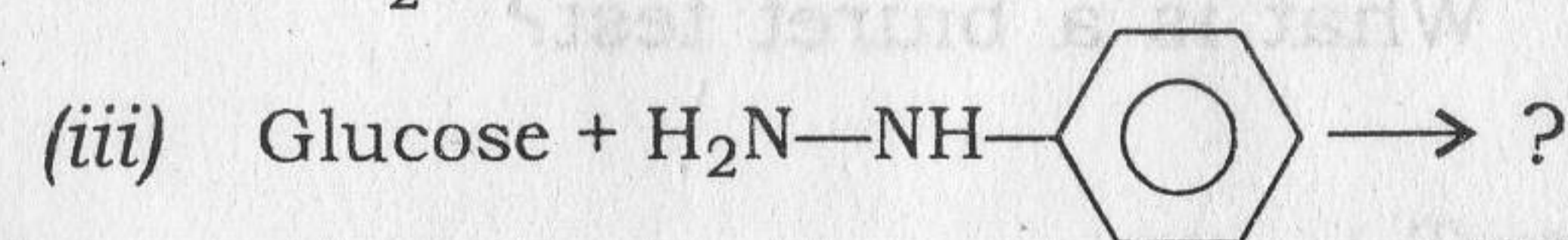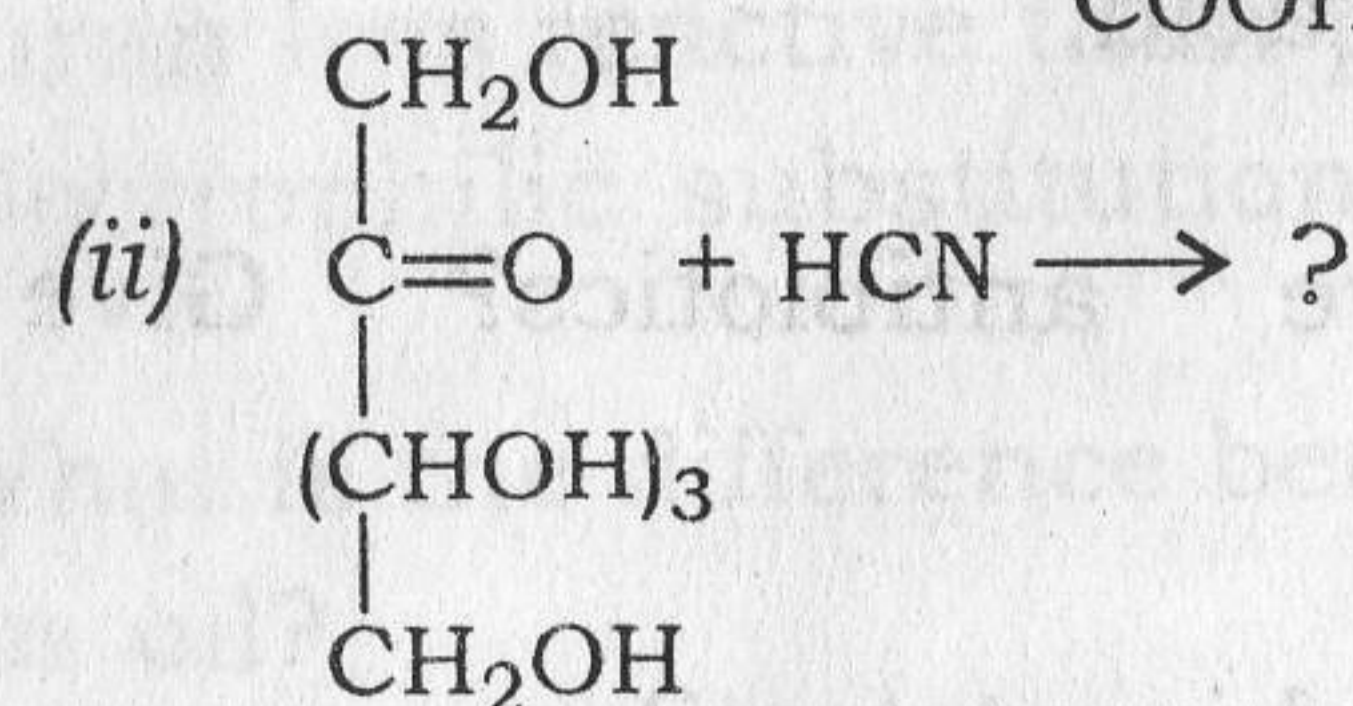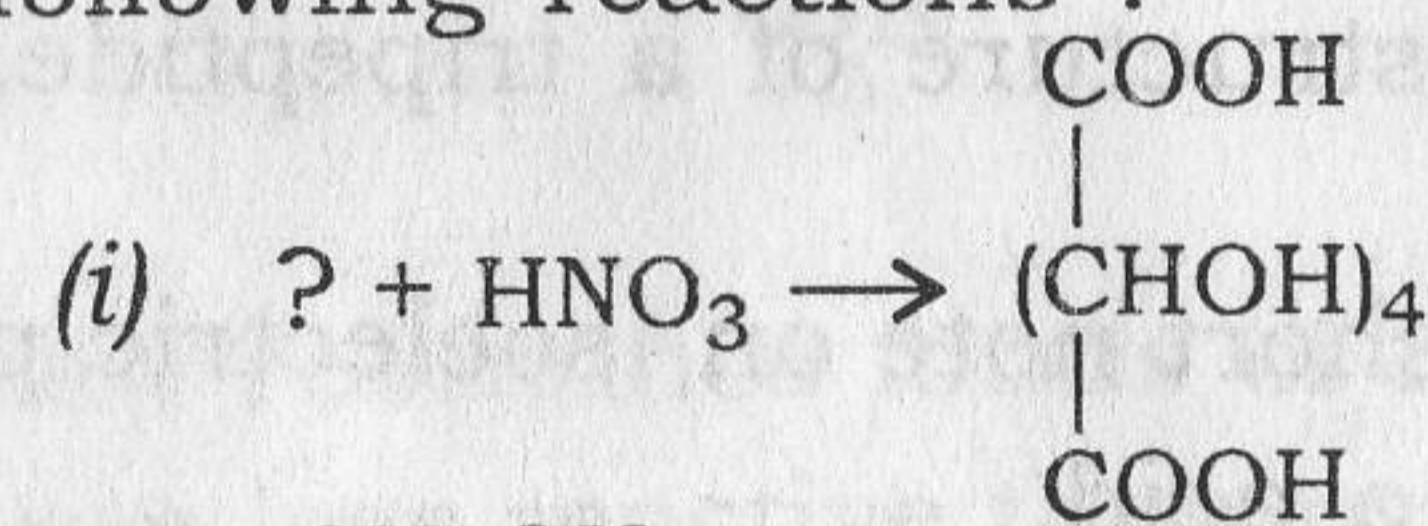
(c) Outline the various schemes and guidelines of wastewater treatment.   3

SECTION—II

(Organic)

(Marks : 19)

5. (a) Identify the reactants/products in the following reactions : $1 \times 3 = 3$

(i) $? + HNO_3 \rightarrow$
$$\begin{array}{c} COOH \\ | \\ (CHOH)_4 \\ | \\ COOH \end{array}$$

(ii)
$$\begin{array}{c} CH_2OH \\ | \\ C=O \\ | \\ (CHOH)_3 \\ | \\ CH_2OH \end{array} + HCN \rightarrow ?$$

(iii) Glucose + $H_2N-NH-\langle \bigcirc \rangle \rightarrow ?$

    (Turn Over)

(4)

(b) Draw the Haworth projection formulae of α-D-furctose and β-D-fructose. ½+½=1

(c) What is epimerization? How will you convert D-glucose to D-mannose? Give reactions. 1+1½=2½

(d) Discuss the classification of α-amino acids with suitable examples. 2

(e) Give one example each for the following : ½×2=1
 (i) Tranquilizers
  (ii) Sulpha drugs

OR

6. (a) How is glucose converted to fructose? 2

(b) Give a method for the synthesis of phenylalanine. 1½

(c) What is peptide linkage? Write the general structure of a tripeptide. 1½

(d) Write a short note on isoelectric point of an amino acid. 1½

(e) What are antibiotics? Give two examples. 2

(f) What is a biuret test? 1

(5)

7. (a) Complete the following reactions and give mechanisms (any two) : 1½×2=3

  (i)

  (ii)

  (iii)
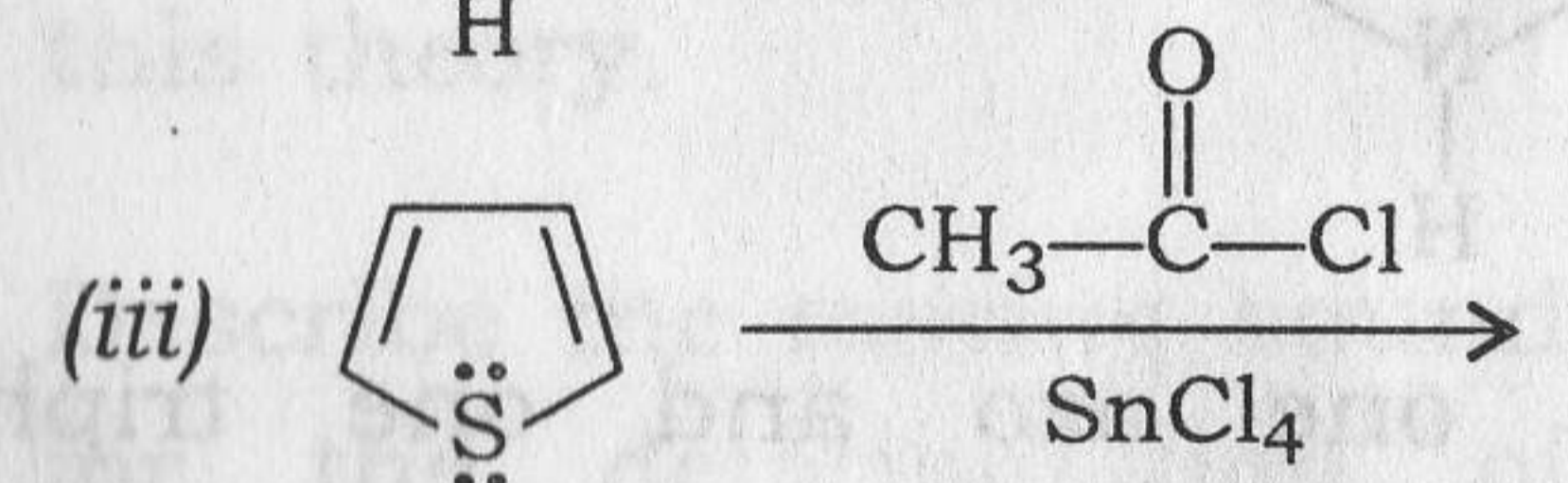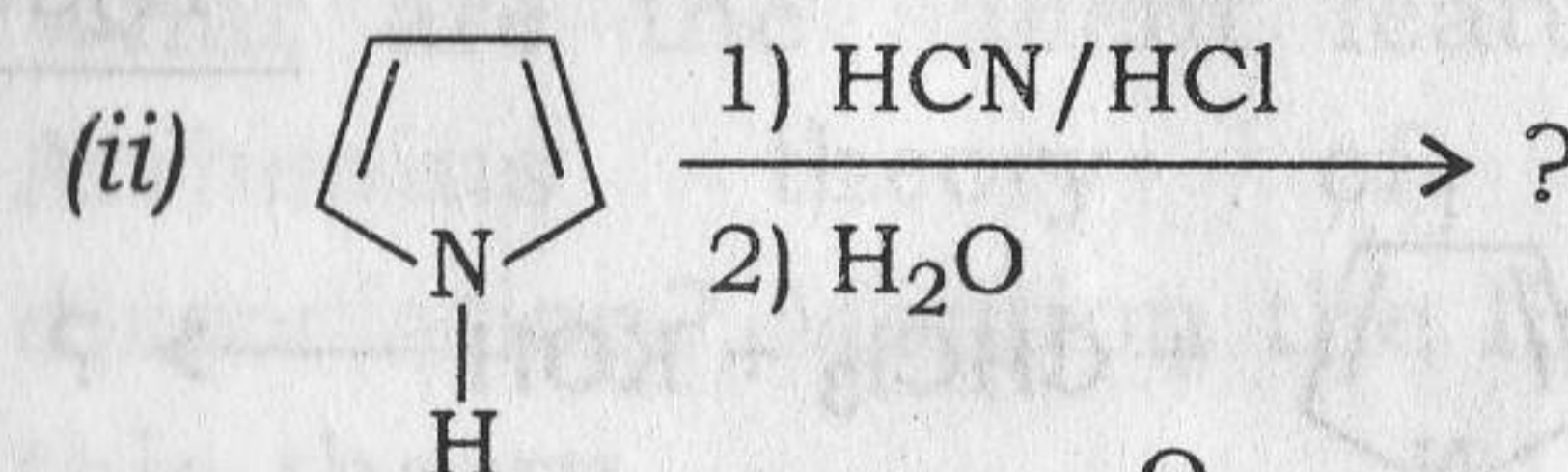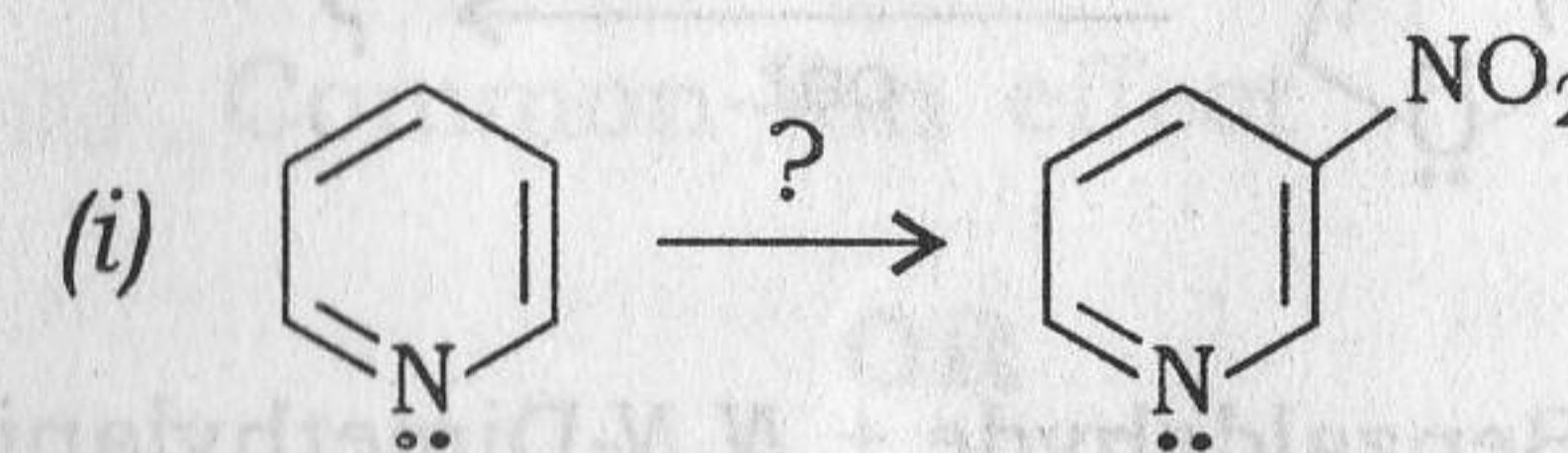
(b) Describe Witt's theory of colour and constitution. 2

(c) Give the synthesis of methyl orange. 1½

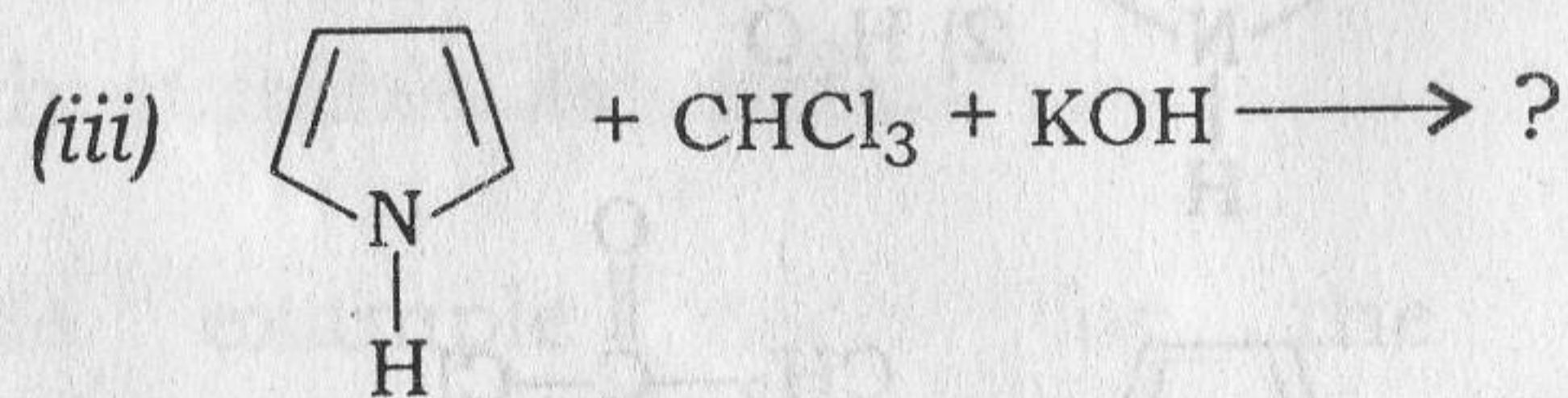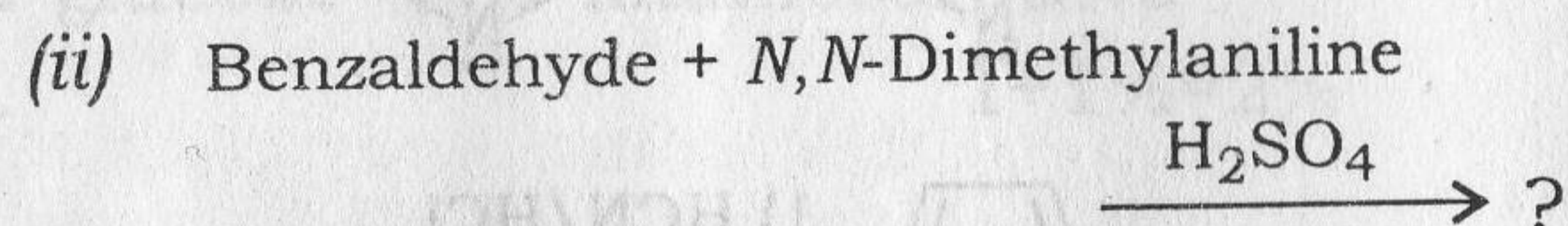(d) Write notes on the following : 1½×2=3
  (i) RM value
  (ii) Iodine value

OR
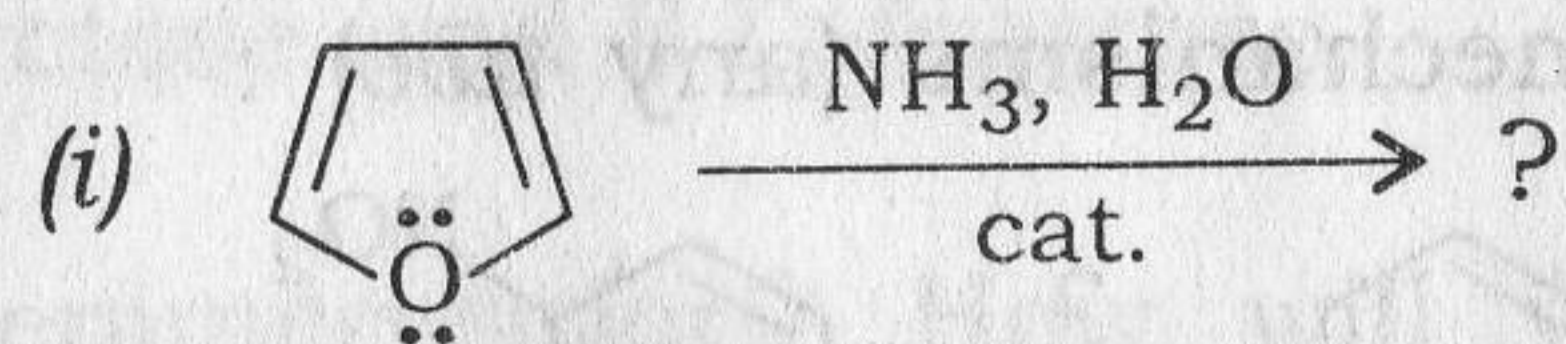
8. (a) Draw resonance forms of furan. Why is furan less reactive than pyrrole towards electrophilic substitution reactions? 2½

(b) What is the difference between a fat and an oil? 1

(c) Complete the following reactions : 1×3=3

(i) $\xrightarrow[\text{cat.}]{\text{NH}_3,\ \text{H}_2\text{O}}$?

(ii) Benzaldehyde + *N,N*-Dimethylaniline

$\xrightarrow{\text{H}_2\text{SO}_4}$?

(iii) + CHCl$_3$ + KOH $\longrightarrow$?

(d) Name one azo and one triphenyl-methane dyes. Draw their structures and also mark the chromophore and auxochrome in them. 1+1+1=3

SECTION—III

(Physical)

(*Marks* : 19)

9. (a) What is hydrolysis? Derive an expression for the hydrolysis constant of a salt of a weak acid and strong base in terms of dissociation constant of a weak acid and ionic product of water. 3½

(b) Explain how equivalent conductance and specific conductance vary with dilution. 3

(c) Explain the following terms : 1½×2=3

(i) Buffer solution

(ii) Common ion effect

OR

10. (a) What are the salient features of the Arrhenius theory of electrolytic dissociation? Mention the limitations of this theory. 3½

(b) Describe the moving boundary method for the determination of transport number of ions. 3

(c) What is meant by pH of a solution? Calculate the pH of—

(i) 10^{-4} *N* aqueous HCl solution;

(ii) 10^{-6} *N* aqueous NaOH solution. 1+1+1=3

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11. (a) Give a schematic representation of an electrochemical cell, mentioning important sign conventions, taking suitable example of Zn-Cu cell. 3½

(b) Differentiate between electrochemical cell and electrolytic cell: 2

(c) What are meant by congruent melting point and azeotropes? Give examples. 2+2=4

OR

12. (a) What is upper critical solution temperature? Explain the phase diagram of phenol-water system. 3
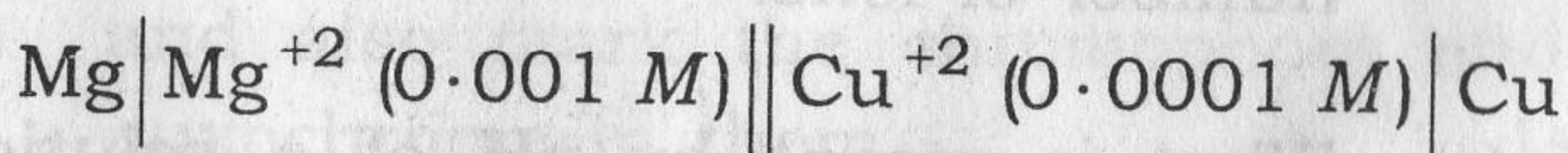
(b) Explain the following terms : 3

(i) Phase

(ii) Degrees of freedom

(iii) Components

(c) Write the Nernst equation and calculate the EMF of the following cell at 25 °C :

$$Mg \,|\, Mg^{+2} \,(0 \cdot 001\ M) \,\|\, Cu^{+2} \,(0 \cdot 0001\ M) \,|\, Cu$$

Given, $E^{\circ}_{Mg^{+2}|\,Mg} = -2 \cdot 37\ V$ and

$E^{\circ}_{Cu^{+2}|\,Cu} = +0 \cdot 34\ V.$ 3½

★ ★ ★