2023

(May/June)

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 the simple and mixed organometallic compounds? Give one example each. Write down one method of preparation of organometallic compound of lithium. 2+1=3

(b) What is the difference between interhalogen compounds and polyhalide ions? Give one method of preparation of polyhalide of iodine. 2+1=3

(c) Write down one method of preparation of cyanogen and one reaction to show the resemblance in chemical properties between CN^- and Cl^- ions. 1½+1½=3

OR

2. (a) What are inorganic polymers? Indicate the manner in which they differ from organic polymers. 3

(b) How are the linear and cross-linked silicones prepared? Draw their structures. 3

(c) What are pi-bonded organometallic compounds? Name one compound and indicate the hapticity of the ligand. 2+1=3

3. (a) On the basis of Werner's theory, explain why cobalt amine complex $CoCl_3 \cdot 3NH_3$ does not give white precipitate of AgCl with $AgNO_3$. 3

(b) What type of isomerism is exhibited by the following compounds? 1+1=2

(i) $[PtCl_2(NH_3)_2]$

(ii) $[Cr(C_2O_4)_3]^{3-}$

(c) Give the IUPAC names of the following coordination compounds : 1+1=2

(i) $(NH_4)_2\,[Pt(SCN)_6]$

(ii) $[Cu(NH_3)_4]SO_4$

(d) What are chelating ligands and chelates? Give one example. 2

OR

4. (a) Give the number of unpaired electrons in a strong and weak octahedral field for Cr^{2+}. Draw their crystal field energy-level diagram. 3

(b) Calculate the effective atomic number of Fe in $[Fe(CN)_6]^{3-}$. Does it fulfill the effective atomic number rule? Give reasons for your answer. 3

(c) Name the type of isomerism exhibited by the following pairs of compounds : 1

$[Cr(H_2O)_6]Cl_3$ and $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$

(d) On the basis of valence bond theory, predict the magnetic behaviour of $[MnCl_4]^{2-}$. 2

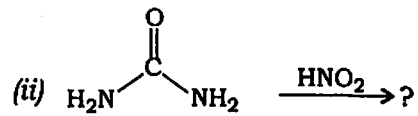
SECTION—II

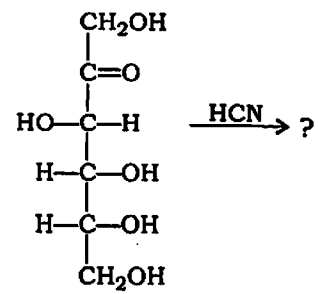
(Organic)

(*Marks* : 19)

5. (a) Complete the following reactions : 1×3=3

(i) Maltose $\xrightarrow{Br_2/H_2O}$?

(ii) 

(iii) 

(b) Explain the term 'epimerisation' citing a suitable example. 1½

(c) How can you prepare urea by Wohler's method? 1

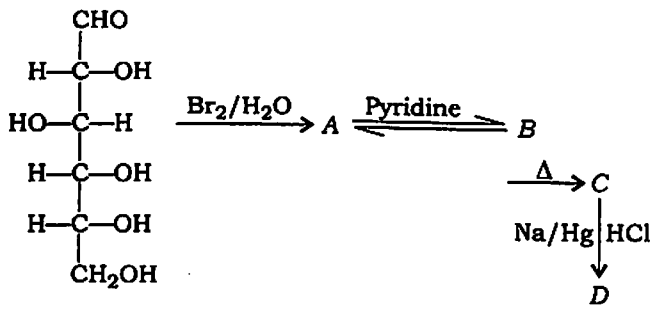
(d) What are the essential amino acids? Draw the structures of any two essential amino acids. 1+1=2

(e) What are antibiotics and antibacterial drugs? Give one example for each. 2

OR

6. *(a)* Identify the products in the following reactions : 2×2=4

(i)



(ii) Sucrose $\xrightarrow[{}^{\ominus}OH]{(CH_3)_2SO_4} E \xrightarrow{H_2O/H^{\oplus}} F + G$

(b) How can you synthesize glutamic acid by Gabriel method? 2

(c) How does urea react with the following? 1+1=2

(i) H_2O

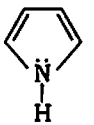
(ii) CH_3COCl

(d) Give a method of preparation for each of the following : 1+½=1½

(i) Paracetamol

(ii) Barbituric acid

7. *(a)* Complete the following reactions (with mechanisms) : 2×2=4

(i)  + $CHCl_3 \xrightarrow{KOH}$?

(ii)  + $KNO_3 \xrightarrow[\Delta]{H_2SO_4}$?

(b) Define iodine value of oils and mention its significance. 1½

(c) "Detergents are superior to soaps." Explain. 1

(d) What are chromophores and auxochromes? Illustrate by giving suitable examples. 2

(e) Draw the structure of malachite green. 1

OR

8. *(a)* Explain why furan is less reactive than pyrrole towards electrophilic substitution. 1

(b) Complete the following reactions (with mechanisms) : 1½×2=3

(i)  $\xrightarrow[\text{Catalyst}]{NH_3,\ H_2O}$?

(ii)  $\xrightarrow[100\ °C]{NaNH_2,\ liq.NH_3}$?

(c) Draw the structure of Bismark brown indicating the auxochromic and chromophoric groups in it. 2

(d) What are the characteristics of a good dye? 1½

(e) Write short notes on the following : 1+1=2

(i) RM value

(ii) Drying oils

SECTION—III

(Physical)

(*Marks* : 19)

9. *(a)* Define hydrolysis of a salt. Why is an aqueous solution of sodium acetate basic? Derive an expression for the hydrolysis constant of this solution. 1+1+2=4

(b) Draw and explain the conductometric titration curve obtained when a strong acid is titrated against a weak base. 1+2=3

(c) Calculate the pH of a mixture containing 0·01 *M* acetic acid and 0·03 *M* sodium acetate solutions. ($K_a = 1 \cdot 8 \times 10^{-5}$ at 25 °C) 2½

OR

10. *(a)* Discuss with the help of graphs the variation of equivalent conductance with concentration of strong and weak electrolytes. 2+2=4

(b) Derive the Ostwald's dilution law and mention its uses. 2+1=3

(c) The molar conductivities at infinite dilution of NaOH, NaCl and $BaCl_2$ are

248×10^4 S m^2 mol^{-1},

127×10^{-4} S m^2 mol^{-1}

280×10^{-4} S m^2 mol^{-1}

respectively. Calculate the molar conductivity of $Ba(OH)_2$ at infinite dilution. 2½

11. (a) What are the main points of difference between an electrochemical cell and an electrolytic cell (at least four points)? 2

(b) Draw a labelled phase diagram of the sulphur system and describe the important points, lines and areas in the diagram. 4

(c) Write the cell reaction for the following electrochemical cell :

$Fe, Fe^{2+}(0 \cdot 1\ M) \| Cd^{2+}(0 \cdot 001\ M), Cd$

Calculate the e.m.f. of the cell at 25 °C, if

$E^\circ_{Fe^{2+}, Fe} = -0 \cdot 44$ V and $E^\circ_{Cd^{2+}, Cd} = -0 \cdot 40$ V

1+2½=3½

(Continued)

OR

12. (a) Calculate the number of phases, components and degrees of freedom in the following systems : 1½+1½=3

(i) A mixture of ice, water and water vapour at equilibrium

(ii) $MgCO_3(s) \rightleftharpoons MgO(s) + CO_2(g)$

(b) What is an incongruent melting point? Describe the phase diagram of a two-component system involving an incongruent melting point, taking the example of NaCl-H_2O system. 1+2½=3½

(c) Define the following with one example for each : 1½+1½=3

(i) Half-cells

(ii) Azeotropes

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