

[This question paper contains 6 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 6481

HC

Unique Paper Code : 32171101

Name of the Paper : Inorganic Chemistry

Name of the Course : B.Sc. (II) Chemistry

Semester : 1

Duration : 3 Hours

Maximum Marks : 75

**Instructions for Candidates**

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **six** questions in all.
3. Question No. **1** is compulsory.
4. The questions should be numbered in accordance with the number in the question paper.
5. Calculators and log tables may be used.

1. Explain any **five** of the following :

- (i) The first ionization enthalpy of Al is less than that of Mg but reverse is true for the second ionization enthalpy of Al. Explain.

P.T.O.

- (ii) Half-filled and fully - filled orbitals are associated with extra stability.
- (iii) 's' orbitals are spherically symmetrical.
- (iv) Water has maximum density at 4°C.
- (v) Bond length in  $N_2^+$  is greater than in  $N_2$ , while the bond length in  $NO^+$  is less than  $NO$ .
- (vi)  $NO_2$  is bent whereas  $CO_2$  is linear.

(3×5)

2. (i) Write the Schrodinger wave equation for an electron in H atom and give the significance of the various terms involved.
- (ii) Draw neatly labelled diagrams for radial probability distribution curves for 2s and 2p orbitals.
- (iii) Calculate the ionic radii of  $K^+$  and  $Cl^-$  using Pauling's method if the inter-nuclear distance between these ions is 314 pm.

(4×3)

3. (i) State the Heisenberg's Uncertainty Principle. Give its importance on micro and macro scales.



- (ii) What are degenerate orbitals? Comment upon the degeneracy of the 3s, 3p and 3d orbitals for the hydrogen atom and multi electron systems.
- (iii) What do you understand by resonance? Write resonating structures for  $N_2O$  and  $N_3^-$ . (4×3)
4. (i) State the Pauli Exclusion Principle. How can this principle be used to fix the maximum capacity of the various energy levels in an atom?
- (ii) If an electron shifts from  $n=6$  to  $n=1$  and  $n=5$  to  $n=2$  levels, in which portion of the electromagnetic spectrum would these lines lie? Name the corresponding spectral series.
- (iii) On which law is the Born-Haber Cycle based? Set up a Born-Haber Cycle for the formation of MgO from Magnesium metal and Oxygen, i.e.  $Mg(s) + 1/2 O_2(g) \rightarrow MgO(s)$ . (4×3)
5. (i) Draw neatly labelled molecular orbital diagrams of  $N_2$  (with s-p mixing) and  $F_2$ . Predict the bond order in each case.

- (ii) What are the basic principles of VSEPR theory? Using this theory, predict the shape of the following:  $I_3^-$  and  $SF_6$ .
- (iii) What are Slater rules? Calculate the screening constant and the effective nuclear charge for the Valence electrons in gallium ( $Z = 31$ ). (4×3)
6. (i) Select from each group of species the one having the smallest size. Justify your answer.
- (a)  $O$ ,  $O^-$ ,  $O^{2-}$ . (b)  $K^+$ ,  $Sr^{2+}$ ,  $Al^{3+}$ . And
- (ii) Which of the elements Na, Mg, Si & P will have the greatest difference between the first and second ionisation enthalpy? Explain.
- (iii) Calculate the per cent ionic character in the Cs-F bond in CsF. The electronegativity values for Cs and F are 0.7 and 4.0 respectively. Predict the nature of the bonding in CsF. (4×3)
7. (i) Identify the example, which best suits the property mentioned. Giving reasons for your choice:
- (a) Higher dipole moment:  $NH_3$  or  $NF_3$



(b) Higher boiling point: ortho- nitrophenol or para- nitrophenol.

(ii) The bond angles in  $\text{CH}_2\text{F}_2$  are  $\text{HCH} = 112.3^\circ$  and  $\text{FCF} = 108.3^\circ$ . Calculate the  $s$  character used by the carbon atom in the orbital directed to the hydrogen and fluorine atoms. Discuss the result in terms of Bent's rule.

(iii) Calculate the limiting radius ratio of cation to that of anion when co-ordination number is four (tetrahedral geometry). What is the co-ordination number of cation in the crystal, when  $r_{\text{M}^+} = 97 \text{ pm}$  and  $r_{\text{X}^-} = 221 \text{ pm}$ ? (4×3)

8. (i) Using Band theory explain how Na and Be metals act as conductors.

(ii) How is percent ionic character related to electronegativity difference and dipole moment? The dipole moment of HI is 0.384 D and bond distance is 1.60 pm. What will be the % of ionic character of HI?

- (iii) What do you understand by equivalent and non-equivalent hybrid orbitals? Give one example each. (4×3)



[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 6482 HC  
Unique Paper Code : 32171102  
Name of the Paper : Physical Chemistry I  
Name of the Course : B.Sc. (Honours) Chemistry  
Semester : I  
Duration : 3 Hours Maximum Marks : 75

### Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **six** questions.
3. First question is compulsory.
4. Use of scientific calculators and log tables is allowed.

1. Explain any **five** :

- (a) pH of neutral water at  $110^{\circ}\text{C}$  is less than 7 but it is not acidic in nature.
- (b) Solubility of  $\text{AgCl}$  will decrease if some  $\text{AgNO}_3$  is added to its saturated solution.
- (c) Addition of acetic acid to water decreases its surface tension, whereas addition of sodium chloride increases it.

P.T.O.

- (d) At room temperature the distribution of molecular velocities of hydrogen and helium is same.
- (e) Heat capacity of a polyatomic gas is greater than that of a monoatomic gas.
- (f)  $K^+$  and  $Cl^-$  are indistinguishable by X ray diffraction method. (3×5=15)
2. (a) Derive the van der Waals equation of state for gases. How does it take into account the deviation from ideality?
- (b) Draw, label and explain the Andrews isotherms for a real gas.
- (c) Find the temperature at which 3 moles of  $SO_2$  will occupy a volume of  $20 \text{ dm}^3$  at a pressure of  $1.5 \text{ MPa}$   
 a) using ideal gas equation b) using the van der Waals equation ( $a = 678.88 \text{ dm}^6 \text{ KPa mole}^{-2}$  and  $b = 5.6 \times 10^{-2} \text{ dm}^3 \text{ mol}^{-1}$ ,  $R = 8.314 \text{ K Pa dm}^3$ ). (4,4,4)
3. (a) Derive the expressions for the pH of the solutions for the titration of strong acid with strong base – (i) before the equivalent point (ii) at the equivalent point (iii) after the equivalent point.
- (b) Define buffer Index. Derive an expression for it.
- (c) Calculate the solubility product of  $Ag_2CrO_4$  if its solubility is  $8 \times 10^{-5} \text{ mol per liter}$ . What is the solubility of  $Ag_2CrO_4$  in a solution containing  $0.01 \text{ mol per liter}$  of  $K_2CrO_4$ ? (4,4,4)



4. (a) What is the coefficient of viscosity of a liquid? What are its SI units? Describe a method for determining the coefficient of viscosity in the lab.
- (b) How do the detergents help in cleaning?
- (c) Describe phenomenon of capillary action?
- (d) What is the radius of the drop of liquid falling from a capillary tube 1mm in diameter at 300 K. (Surface tension of liquid =  $65 \times 10^{-3} \text{ Nm}^{-1}$ , density =  $1.3 \text{ gcm}^{-3}$ ).  
(4,2,2,4)
5. (a) Describe all the symmetry elements of a cube.
- (b) Write the Millar indices for the planes with the following intercepts (i) a,  $1/3b$ ,  $1/4c$  (ii)  $0a$ ,  $1b$ ,  $2c$  (iii)  $3a$ ,  $2b$ ,  $4c$  (iv)  $1/2a$ ,  $1/4b$ ,  $\infty c$
- (c) X ray powder for molybdenum has reflections at  $\theta$  values  $20.25^\circ$   $29.30^\circ$   $36.82^\circ$   $43.81^\circ$   $50.69^\circ$   $58.80^\circ$   $66.30^\circ$  and other larger angles, when  $K_\alpha$  X rays from Cu are used ( $\lambda = 154 \text{ pm}$ )
- (i) What is the type of crystal of molybdenum lattice?
- (ii) What is the length of side of the unit cell?  
(4,4,4)
- (a) Derive Bragg's law. How is it used to determine the crystal structure?

- (b) Derive an expression for the viscosity of a gas.
- (c) Calculate the pH of the following solutions
- (i) 0.11 N Sodium acetate (ii) a solution formed by mixing 20 ml, 0.1 M Acetic acid and 10 ml 0.1 M Sodium acetate. ( $K_a$  of Acetic Acid is  $1.74 \times 10^{-5}$ ) (4,4,4)
7. (a) Derive expressions for hydrolysis constant and pH of the solution of salt of a strong acid and a weak base.
- (b) Derive the expressions for the heat capacities of linear and non linear polyatomic molecules on the basis of equipartition of energy.
- (c) (i) Define mean free path in a gas assembly.
- (ii) Calculate the number of bimolecular collisions per  $\text{sec cm}^{-3}$  in Argon at a pressure of 101.325 KPa and a temperature of  $90^\circ\text{C}$  if the collision diameter is 350 pm. ( $k=1.38 \times 10^{-23} \text{ J K}^{-1}$ ). (4,4,4)
8. Write short note on any **three** of the following :
- (a) Experimental determination of critical constants of a gas
- (b) Buffer Action
- (c) Theory of acid-base indicators
- (d) Laws of crystallography (4,4,4)



[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 8588

HC

Unique Paper Code : 32173911

Name of the Paper : Pesticide Chemistry

Name of the Course : B.A. (H) Chemistry

Semester : V

Duration : 3 Hours

Maximum Marks : 38

**Instructions for Candidates**

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **five** questions only.
3. Question No. **1** is for **10** marks.

1. Answer the following : (10)

- (i) Define pesticide with example.
- (ii) Write the structural formula of physostigmine.
- (iii) What is a leaving group? Explain with example.

P.T.O.

(iv) Write the structural formula of the toxic isomer of HCH.

(v) Write the structural formula of Malaoxon.

2. Answer the following :

(2+2+2+1)

(i) What are fungicides? Give an example.

(ii) Discuss systemic fungicides.

(iii) Discuss pre-emergence herbicides.

(iv) Write structural formula of any soil acting herbicide.

3. Answer the following :

(2+2+2+1)

(i) Write the structural formula of DDT.

(ii) Write the structural formula of Isomalathion.

(iii) Write the structural formula of Alachlor.

(iv) Define Insecticide.

4. Answer the following :

(2+2+2+1)

(i) Which is more preferred organo chlorine or organo phosphorous insecticide? Explain.



- (ii) Write chemical equation for the preparation of DDT.
- (iii) Write chemical equation for the preparation of Parathion.
- (iv) Write the structural formula of Carbaryl.

5. Answer the following : (2+2+2+1)

- (i) Write the decreasing order of toxicity for, o o, p p, m m, and o m isomers of DDT.
- (ii) What happens when HCH is hydrolyzed with alcoh. NaOH? Write chemical equation.
- (iii) Write chemical equation for the reduction of Parathion.
- (iv) Write the structural formula of chloranil.

Discuss the following : (4+3)

- (i) Mode of action of organochlorine insecticides.
  - (ii) Mode of action of carbamates.
- (a) Write the structural formula of the following : (2+2)
- (i) Acetylcholine

(ii) Malathion

(b) Discuss the mode of action of organo phosphorous compounds.

(3)



[This question paper contains 6 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5043

H

Unique Paper Code : 217161

Name of the Paper : CHPT-101 : CHEMISTRY - I

Name of the Course : B.Sc. (Prog.) Physical Sci. / Life  
Sci. / Applied Sci.

Semester : I

Duration : 3 Hours

Maximum Marks : 75

**Instructions for Candidates**

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **Three** questions from **Section-A** and **Section-B** respectively.

**SECTION - A**

1. (a) Write the Schrodinger's wave equation. Explain the terms involved in it.  
(b) Plot the radial distribution curves for 3p, 3d orbitals.  
(c) Why half-filled and fully filled orbital systems are more stable?

P.T.O.

- (d) Write the values of three quantum number's ( $n, m, l$ ) for electron in 4f and 3d orbitals.
- (e) Draw the shape of d orbitals. Indicating the sign of wave function.  
(2,2,2½,3,3)
2. (a)  $\text{BeCl}_2$  has zero dipole moment while  $\text{H}_2\text{S}$  has some value.
- (b) Write Born lande's equation for calculating lattice energy. Explain all the terms in it.
- (c) Calculate the % ionic character of Si-H bond in  $\text{SiH}_4$ . Pauling electronegativity of Si and H are 1.4 and 2.1, respectively.
- (d) Discuss the lattice energy.
- (e) Which cation will exert a greater polarizing power in the following cases? Explain.
- (i)  $\text{Na}^+$  or  $\text{Mg}^{2+}$     (ii)  $\text{Cu}^{2+}$  or  $\text{Ca}^{2+}$     (2½,2½,2½,2,3)
3. (a) Discuss the hybridization of the central atom and geometry of the following molecules/ions.
- $\text{XeF}_4$ ,     $\text{SO}_4^{2-}$ ,     $\text{NH}_3$ ,     $\text{I}_3^-$
- (b) Draw the resonance structure of  $\text{CO}_3^{2-}$ .



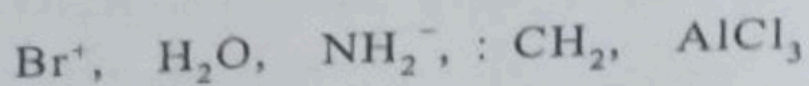
- (c) State the fundamental rules of VSEPR theory.
- (d) Explain the diamagnetic behaviour of  $N_2$  molecule with the help of M.O. diagram. (4,2½,3,3)
4. (a) Explain the Born Haber Cycle with suitable example. (3½)
- (b) Write short notes on any **three** of the following :
- (i) Hybridization
  - (ii) Fajan's Rule
  - (iii) Dipole moment
  - (iv) Solvation energy (3,3,3)

**SECTION - B**

5. (a) Explain the following :
- (i) Benzyl free radical is more stable than methyl free radical.
  - (ii) Boat conformation of cyclohexane is less stable than chair conformation of cyclohexane.

(iii) Ethylamine is more basic than aniline.

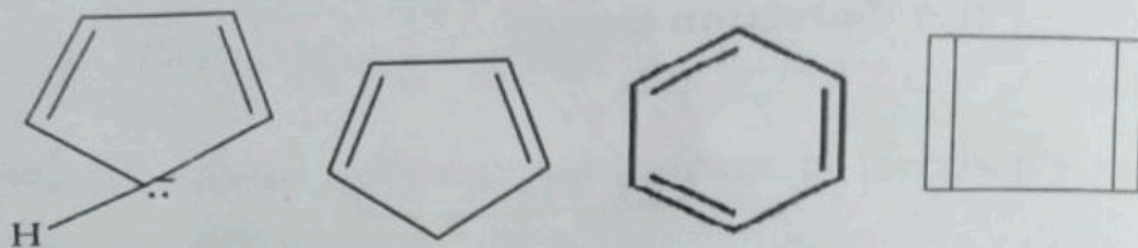
(b) Classify the following as electrophiles and nucleophiles:



(c) How many stereoisomers are possible for 2, 3 - dibromobutane? Write their structures and give their relationship with each other. (6, 2½, 4)

6. (a) Give a chemical test to distinguish between but-1-yne and but-2-yne.

(b) Explain which of the following are aromatic in nature :

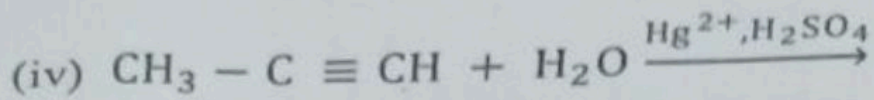
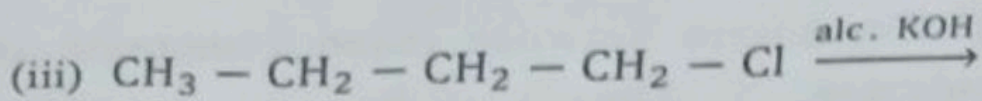
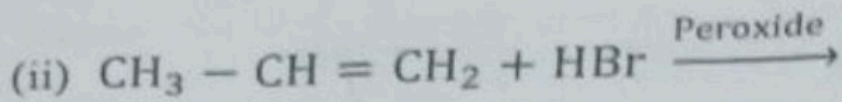
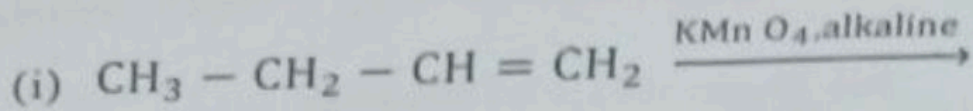


(c) Draw Newmann projection for different conformations of n-butane. Which of the conformation is most stable and why? (1½, 6, 5)

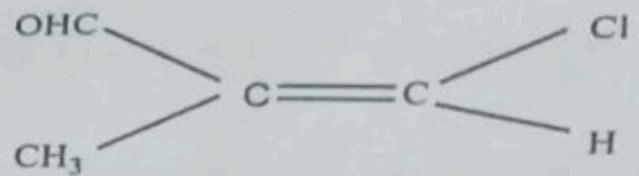
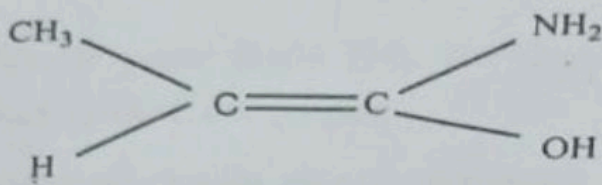
7. (a) Methane and chlorine react in presence of light to give chloromethane. Give mechanism for this reaction.



(b) Complete the following reactions :

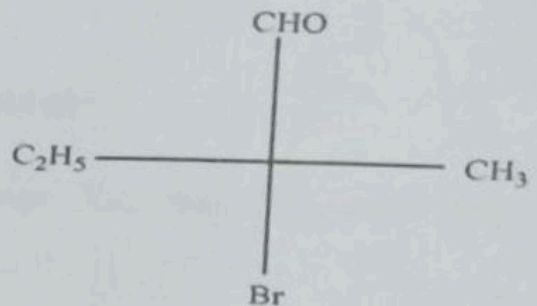
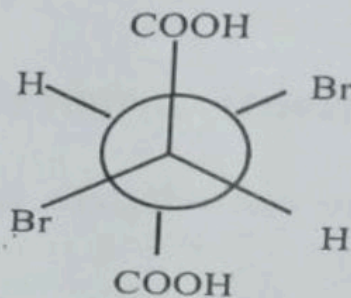
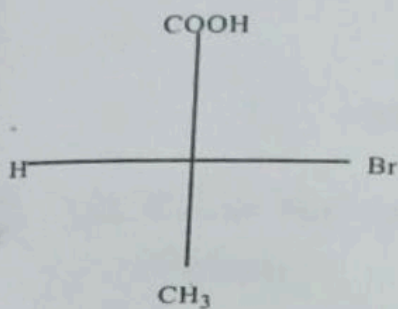


(c) Giving priority, assign E-/ Z- to the following :



(2½, 6, 4)

8. (a) Assign R-/S- configuration to each of the following :



P.T.O.

(b) Write short notes on any **two** of the following :

- (i) Wurtz reaction
- (ii) Ozonolysis of alkenes
- (iii) Geometrical isomerism

(c) Differentiate between meso compound and racemic mixture.  
(6,5,1½)



[This question paper contains 6 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 6861

HC

Unique Paper Code : 42171103

Name of the Paper : Atomic structure, bonding, General Organic Chemistry and Aliphatic hydrocarbons

Name of the Course : B.Sc. (Prog.)

Semester : I

Duration : 3 Hours

Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Answer **three** questions each from Section-A and Section-B.
3. **All** questions are compulsory.
4. Attempt Section **A** and **B** in separate portions of the same answer sheet.

**SECTION-A (Inorganic)**

1. (a) Draw the radial distribution curves for 3s, 3p, and 3d orbitals.

P.T.O.

(b) Explain the following

(i) Why is orbital spherical in shape?

(ii) Why is shape of  $dz^2$  different from that of  $dx^2-y^2$ ?

(c) Write Schrodinger's wave equation for a one electron system and explain various terms involved in it.

(4,4,4.5)

2. (a) Write the electronic configuration of La (At. No. 57) and Co (At. No. 27).

(b) Write short notes on-

(i) Pauli Exclusion Principle.

(ii) Hund's Rule.

(c) Why are the half-filled and full-filled orbital systems more stable?

(4,4,4.5)

3. (a) Draw the Molecule Orbital diagram of  $O_2$  molecule and calculate its bond order.

(b) Explain on the basis of Molecule orbital theory,  $N_2$  is diamagnetic while  $O_2$  is paramagnetic.

(c) The bond angle in  $NH_3$  is  $107^\circ$  while it is  $104^\circ$  in  $H_2O$ , explain it briefly.

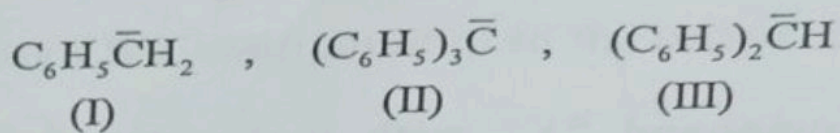
(4,4,4.5)



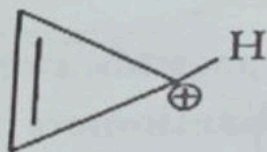
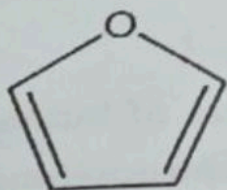
- (a) Write short notes on-
- Resonance.
  - Born-Haber Cycle.
- (b) Differentiate between the following:
- Bonding and Antibonding Molecular orbitals.
  - Valence bond theory and Molecular orbital theory.
- (c) Write main postulates of Valence Bond Theory. (4,4,4.5)

### SECTION-B (Organic)

- (a) Giving reasons arrange the following carbanions in increasing order of stability.



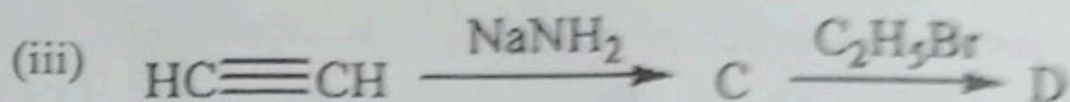
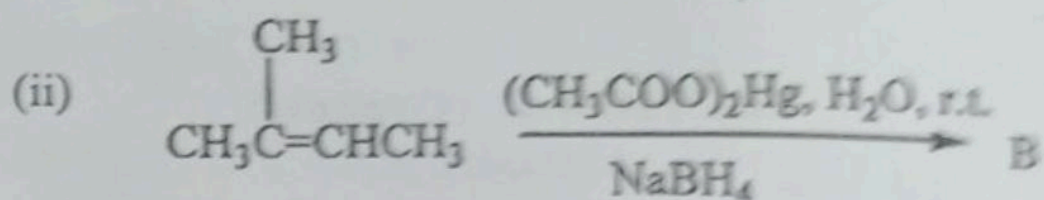
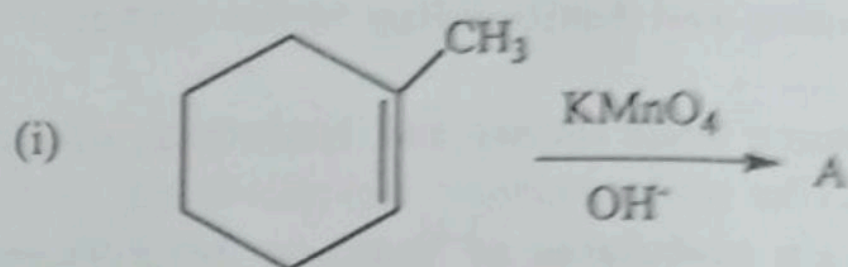
- (b) Write down Huckel's rule. Which of the following compound/s is/ are aromatic? Justify your answer in each case.



P.T.O.

- (c) Define conformations. Write down all possible conformations of n-butane when it is rotated about  $C_2-C_3$  bond. Which among these is most stable and why? (4,4,5)

6. (a) Complete the following reactions:



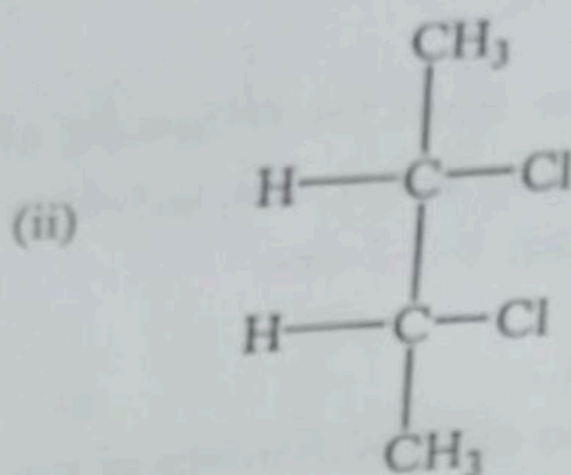
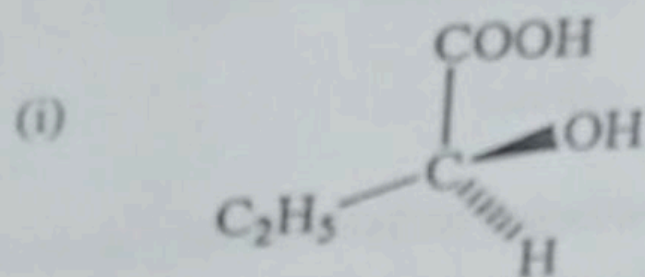
- (b) A compound "Y" with molecular formula  $C_6H_{10}$  decolorizes bromine solution in  $CCl_4$ , on catalytic hydrogenation yields 2-methylpentane. Ozonolysis of "Y" yields acetaldehyde and 2-methylpropanal. Write down the name and structure of "Y". Write down all the equations.
- (c) Write down all possible stereoisomers of butane-2,3-diol. Pair them as enantiomers and diastereoisomers.

(4,4, 4.5)





(c) Assign the R/S configuration for the following:



(4,4,4,5)



[This question paper contains 6 printed pages.]

Your Roll No.....

Se. No. of Question Paper : 6864 HC  
Unique Paper Code : 42161101  
Name of the Paper : Biodiversity (Microbes, Algae,  
Fungi & Archegoniatae)  
Name of the Course : B.Sc. (Prog.)  
Semester : 1  
Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
  2. Attempt five questions in all.
  3. Question Nos. 1 & 6 are compulsory.
  4. All parts of a question must be answered together.
  5. Draw well-labelled diagrams wherever necessary.
1. (a) Give an appropriate term for each of the following definitions (any five):
- (i) Maturation of antheridia before the maturation of archegonia in a monoecious gametophyte.

P.T.O.

- (ii) A small granular structure present at the base of the flagellum.
- (iii) Phenomenon of frequent appearance of mushrooms in circles on ground.
- (iv) Long, cylindrical, unbranched and leafless structures arising from the lower side of stem at the point of dichotomy in *Selaginella*.
- (v) Cluster of leaves surrounding the group of archegonia on archegonial branch.
- (vi) Specialized apogeotropic roots in *Cycas* which are fleshy, short, dichotomously branched and grow on the surface of soil.
- (vii) Phenomenon of occurrence of two morphologically different types of Spores. (1×5=5)

(b) Fill in the blanks (any five):

- (i) *Nostoc* occurs as an endophyte in \_\_\_\_\_
- (ii) \_\_\_\_\_ is the extrachromosomal DNA found in bacterium.
- (iii) In *Penicillium* the conidia are arranged in \_\_\_\_\_ manner.



- (iv) In *Marchantia*, specialized branch bearing female sex organ is called \_\_\_\_\_ .
- (v) Heterospory expresses \_\_\_\_\_ determining capability of the plant.
- (vi) The upper sterile portion of the microsporophyll of *Cycas* is called \_\_\_\_\_.
- (vii) Members of archegoniatae possess \_\_\_\_\_ for protection of sex Organs. (1×5=5)

(c) Match the following:

- |                                    |                          |
|------------------------------------|--------------------------|
| (i) Bacteria                       | (a) Stolon               |
| (ii) Coenocytic thallus            | (b) <i>Pteris</i>        |
| (iii) Accessory transfusion tissue | (c) <i>Vaucheria</i>     |
| (iv) Coenosorus                    | (d) Peptidoglycan        |
| (v) <i>Rhizopus</i>                | (e) <i>Cycas</i> leaflet |

(1×5=5)

Differentiate between any **three** of the following:

- (a) Lytic and (Lysogenic cycle)

(b) Isogamy and Oogamy

(c) Bryophytes and pteridophytes

(d) Sporophyte of *Marchantia* and *Funaria*

(e) Male cone of *Cycas* and *Pinus*

(5×3=15)

3. Draw well labelled diagrams of **any five** of the following:

(a) Tobacco Mosaic Virus (TMV) model

(b) L.S. Female Conceptacle in *Fucus*

(c) V.S. Leaf passing through teleutosorus of *Puccinia*

(d) V.S. Thallus passing through gemma cup of *Marchantia*

(e) L.S. Strobilus of *Equisetum*

(f) L.S. Female cone of *Pinus*

(3×5=15)

4. Write short notes on **any three** of the following:

(a) Conjugation in bacteria

(b) External features of *Fucus* thallus

(c) Morphological types of lichens



(d) Transition to land habit

(e) Characteristic features of gymnosperms (5×3=15)

5. Explain **any three** of the following with suitable illustrations.

(a) Life cycle of *Marchantia*

(b) Reproduction in *Equisetu*?

(c) Life cycle of *Alternaria*

(d) Life cycle of *Cycas*

(e) Life cycle of *Polysiphonia* (5×3=15)

6. Attempt **any five**.

(a) 'Bacteria help in increasing soil fertility'. Comment on this statement with the help of appropriate examples.

(b) Discuss the role of algae in filtration industry.

(c) 'Fungi are not only foes but friends also'. Discuss this statement giving suitable examples.

(d) Why are lichens considered to be good bio-indicators of air pollution? Give suitable examples of lichens to explain.

(e) Discuss the ecological importance of bryophytes.

(f) Name any three pteridophytes of economic importance.  
Also mention their uses.

(3×5=15)

This question paper contains 6 printed pages.

002092

Your Roll No. ....

Sl. No. of Ques. Paper : 5065  
Unique Paper Code : 217361  
Name of Paper : CHPT-303 (Solutions,  
Conductance, Electrochemistry  
and Functional Group Organic  
Chemistry - II)  
Name of Course : B.Sc. Life Sc. / Phy Sc. / Industrial  
Chem. / Analytical Chem.  
Semester : III  
Duration : 3 hours  
Maximum Marks : 75

(Write your Roll No. on the top immediately  
on receipt of this question paper.)

Answer six questions in all, three questions from each Section.

Use of scientific calculator is allowed.

Use separate answer sheets for Section A and Section B.

#### SECTION A

Attempt three questions in all.

Question No. 1 is compulsory.

All questions carry equal marks.

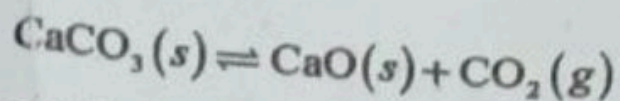
1. Attempt any five questions:

- (a) Explain why a eutectic mixture has a definite composition and sharp melting point yet it is not a compound.

Turn over



- (b) What are the electrochemical reactions that take place at calomel electrode?
- (c) The ionic molar conductivity of hydrogen ion is much greater than any other ion. Give reason.
- (d) How will you explain the presence of both lower and upper CST for certain systems?
- (e) Give and justify the number of components in the system:



- (f) Usually a saturated solution of KCl or  $\text{NH}_4\text{NO}_3$  is used in the salt bridge. Explain.
- (g) Explain why enthalpy and volume of mixing for the formation of ideal binary solution is zero.
- (h) State and explain Kohlrausch's law of independent migration of ions.

$$2\frac{1}{2} \times 5 = 12\frac{1}{2}$$

2. (a) What is meant by the process-solvent extraction? Explain why the process of extraction is more efficient if the solvent is used in a number of small portions rather than in one whole lot.
- (b) Why do binary solutions deviate from ideality? The vapour pressure of pure benzene and toluene at  $40^\circ\text{C}$  are 184.0 torr and 59.0 torr, respectively. Calculate the partial pressures of benzene and toluene, the total vapour pressure of the

solution and the mole fraction of benzene in the vapour above the solution that has 0.40 mol fraction of benzene. Assume that the solution is ideal.

(c) Differentiate between congruent and incongruent melting points. 4,6,2½

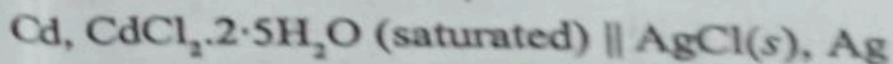
(a) Define specific conductance, molar conductance and equivalent conductance. What are their S.I. units?

(b) The molar conductances of sodium acetate, hydrochloric acid and sodium chloride at infinite dilution are  $91.0 \times 10^{-4}$ ,  $426.16 \times 10^{-4}$  and  $126.45 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}$ , respectively at  $25^\circ\text{C}$ . Calculate the molar conductance at infinite dilution for acetic acid. Is transport number of ions related to molar conductivity at infinite dilution? Give reason for your answer.

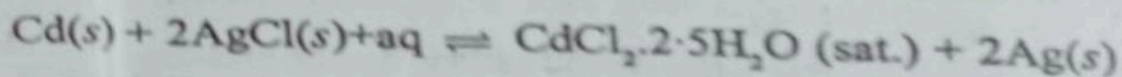
(c) Draw and explain the conductometric titration of a weak acid with a strong base. 4½,4,4

4. (a) Differentiate between concentration cell with and without transference.

(b) The emf of the cell



in which the cell reaction



is 0.6753 volt at  $25^\circ\text{C}$  and 0.6915 volt at  $0^\circ\text{C}$ . Calculate the free energy change ( $\Delta G$ ), enthalpy change ( $\Delta H$ ) and entropy change ( $\Delta S$ ) of the cell reaction at  $25^\circ\text{C}$ .



- (e) How is the pH of a solution determined using (i) hydrogen electrode and (ii) quinhydrone electrode? 4, 4½, 4

5. Write short notes on:

- (a) Moving Boundary Method  
 (b) Phase Diagram of Sulphur  
 (c) Lever Rule or Glass Electrode.

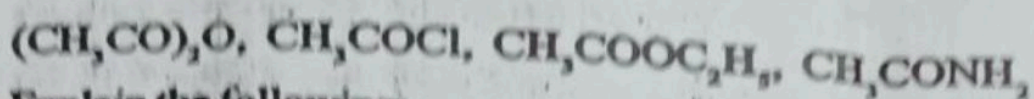
4½, 4, 4

### SECTION B

*Attempt three questions in all.*

*All questions carry equal marks.*

6. (a) Arrange the following acid derivatives in decreasing order of reactivity towards nucleophilic substitution and give reason:

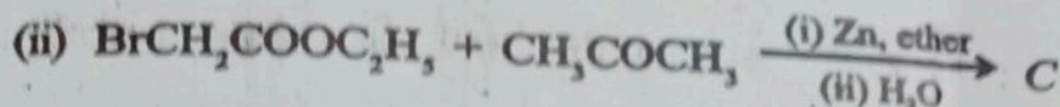
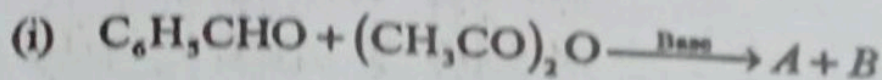


- (b) Explain the following:

- (i) Acetyl chloride is hydrolysed more readily than benzoyl chloride.  
 (ii) Benzoic acid is stronger acid than acetic acid.  
 (iii) *p*-hydroxy benzoic acid is weaker acid than *m*-hydroxy benzoic acid.

- (c) Discuss Hell-Volhard-Zelinsky reaction with mechanism.

- (d) Complete the following reactions:



2, 4½, 3, 3



7. (a) Write short notes on the following (any two):
- Gabriel's Phthalimide Synthesis
  - Hofmann Bromamide Reaction
  - Schotten-Baumann Reaction.
- (b) How will you chemically differentiate between aniline and N-methyl aniline?
- (c) Complete the reactions:
- $\text{ArNH}_2 + \text{CHCl}_3 + 3\text{KOH} \rightarrow A$
  - $\text{ArNH}_2 + \text{Br}_2 \xrightarrow{\text{CS}_2} B$
  - $\text{ArN}_2^+\text{Cl}^- + \text{H}_2\text{O}/\text{H}^+ \xrightarrow{\Delta} C$
- (d) Give a detailed account of Hofmann elimination and compare it with Saytzeff elimination. 5,2,2,3½
8. (a) How will you convert D-arabinose to D-glucose and D-mannose by Killiani-Fischer synthesis?
- (b) How will you convert D-glucose to D-fructose?
- (c) Draw the Haworth projection for  $\alpha$ -D-glucopyranose and  $\beta$ -D-fructofuranose.
- (d) Write short notes on the following:
- Mutarotation
  - Ruffs Degradation. 2½,3,2,5
9. (a) Give the name and mechanism of the reaction involved in the synthesis of ethyl acetoacetate from ethyl acetate.
- (b) What is tautomerism? Give the structures of keto and enol form of ethyl acetoacetate.

(c) How can the following compounds be obtained from ethyl acetoacetate:

- (i) 2-Pentanone
- (ii) Butanoic acid
- (iii) Succinic acid?

5,3,4%

[This question paper contains 4 printed pages.]

Your Roll Number

Sr. No. of Question Paper : 6878 HC  
Unique Paper Code : 42234301  
Name of the Paper : Physiology and Biochemistry  
Name of the Course : B.Sc. (Prog.)  
Semester : III  
Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt five questions in all, two each from Section A and Section B. Q. No. 1 is compulsory.
3. Use separate sheets for Section A and Section B.

1. (a) Define the following terms:

- (i) Hemopoiesis
- (ii) Glycogenesis
- (iii) Peristalsis
- (iv) Saltatory conduction

P.T.O.



(v) Rate constant

(b) Differentiate between the following pairs of terms:

(i) IPSP and EPSP

(ii) Glycolysis and gluconeogenesis

(iii) Tidal Volume and Vital Capacity

(iv) Transketolase and Transaldolase

(v) Tropic and Trophic Hormone

(c) Expand the following terms:

(i) ACP

(ii) hCG

(iii) FAD

(iv) JGA

(d) Give the location and function of the following:

(i) Schwann cells

(ii) Pyruvate dehydrogenase complex

(iii) Carnitine acyltransferase II

(iv) Transverse tubules

**SECTION-A**

*(Attempt any two questions)*

2. (a) Discuss the sliding filament theory of muscle contraction in detail.
- (b) Write briefly about the hormonal control of blood calcium levels. (9+3)
3. (a) Write in detail about the cardiac cycle.
- (b) Explain the Oxygen dissociation curves (7+5)
4. Write short notes on any **three** of the following:
- (i) Phases of an Action potential
- (ii) Counter current exchanger
- (iii) Carbohydrate and protein digestion
- (iv) Hormonal Control of Menstrual cycle (4+4+4)

**SECTION B**

*(Attempt any two questions)*

5. (a) Elucidate the metabolic pathway of biosynthesis of palmitic acid.

- (b) Diagrammatically represent the Urea Cycle. (8+4)
6. (a) Discuss the process of glycogenolysis. How is it regulated?
- (b) Give an account of the Citric Acid Cycle. (6+6)
7. Write short notes on any **three** of the following:
- (i) Fatty Acid Synthases
  - (ii) Pentose phosphate pathway
  - (iii) Oxidative phosphorylation
  - (iv) Allosteric enzymes (4+4+4)



[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 6879

HC

Unique Paper Code : 42164301

Name of the Paper : Plant Anatomy and Embryology

Name of the Course : B.Sc. (Programme)

Semester : III

Duration : 3 Hours

Maximum Marks : 75

**Instructions for Candidates**

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **Five** questions in all including Question No. 1 which is compulsory.
3. **All** questions carry equal marks.
4. Attempt **all** parts of a question together.
5. Draw **well-labelled** diagrams whenever necessary.

1. (a) Fill in the blanks: (8×1=8)

(i) \_\_\_\_\_ present in endodermis blocks the apoplasmic transport in the root.

(ii) Vascular bundles developed in the pith region are called \_\_\_\_\_.

P.T.O.

- (iii) *Polygonum* and \_\_\_\_\_ are examples of monosporic type of embryo sac.
- (iv) \_\_\_\_\_ discovered double fertilization in *Fritillaria*.
- (v) Composite endosperm is present in \_\_\_\_\_
- (vi) Occurrence of more than four spores in a tetrad is called \_\_\_\_\_
- (vii) A vascular bundle which has strands of xylem and phloem on same radius is called \_\_\_\_\_ .
- (viii) \_\_\_\_\_ type of parenchyma is present in the stem of *Hydrilla* which provides buoyancy.

(b) Define the following:

(7×1=7)

- (i) Meristem
- (ii) Phellogen
- (iii) Open vascular bundle
- (iv) X-bodies
- (v) Circinotropus ovule
- (vi) Pollenkitt
- (vii) Ari



2. Differentiate between any five of the following: ( $5 \times 3 = 15$ )
- (i) Collenchyma and sclerenchyma
  - (ii) Dicot and monocot embryo
  - (iii) Heartwood and sapwood
  - (iv) Amoeboid and glandular tapetum
  - (v) Structure of dicot and monocot stem
  - (vi) Ephydrophily and hyphydrophily
  - (vii) Periderm and bark
3. (i) Define stomata. Describe different types of stomata according to Metcalf and Chalk classification with the help of suitable examples and diagrams. (8)
- (ii) What is endosperm? Briefly explain different types of endosperms with suitable examples and diagrams. (7)
4. Write short notes on any **five** of the following: ( $5 \times 3 = 15$ )
- (i) Role of trichomes in plant defense
  - (ii) Cleavage polyembryony
  - (iii) Theories of shoot apical meristem



- (iv) Practical applications of apomixis
  - (v) Anatomical adaptations in xerophytes
  - (vi) Male Germ Unit (MGU)
5. (i) Describe briefly the mechanisms that favour cross pollination. (8)
- (ii) Describe secondary growth in dicotyledonous stem with the help of suitable examples. (7)
6. (i) What is tapetum? Enumerate the various functions performed by tapetum. (5)
- (ii) Define agamospermy? Briefly mention its different types. (5)
- (iii) What do you understand by seasonal activity of cambium? (5)
7. (i) Explain the ultrastructure of mature embryo sac with the help of suitable diagram. (7)
- (ii) Describe the structure of seed. Briefly discuss various seed dispersal mechanisms. (5)
- (iii) Write a short note on quiescent centre. (3)

[This question paper contains 6 printed pages.]

Your Roll No. ....

Sr. No. of Question Paper : 6885

HC

Unique Paper Code : 42174304

Name of the Paper : C-VIII, DSC-2C-Solutions, Phase Equilibria, Conductance Electrochemistry and Functional Group Organic Chemistry-II

Name of the Course : B.Sc. (Prog.)

Semester : III

Duration : 3 Hours

Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Answer six questions in all, three questions from each section.
3. Use of scientific calculator is allowed.

SECTION A

*Attempt 3 questions in all.*

*Question No. 1 is compulsory.*

*All questions carry equal marks.*

P.T.O.



1. Explain any five:

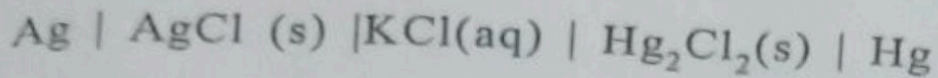
- (a) A eutectic mixture has a definite composition and sharp melting point yet it is not a compound.
- (b) Equivalent conductance of a solution of electrolyte increases on dilution whereas the specific conductance decreases.
- (c) Addition of succinic acid in water phenol system decreases Critical Solution Temperature (CST)
- (d) All feasible electrochemical cells should have positive EMF values.
- (e) In phase diagram of water the fusion curve is inclined towards pressure axis.
- (f) Triple point is an invariant point.
- (g) Limitation of standard hydrogen electrode.
- (h) Difference between congruent and incongruent melting point.  $(2\frac{1}{2} \times 5 = 12\frac{1}{2})$

2. (a) Derive expression for EMF of concentration cell without transference.

(b) Explain any two reference electrodes.

(c) The EMF of the cell:





is 0.0455V at 298K and the temperature coefficient is  $3.38 \times 10^{-4} \text{ VK}^{-1}$ . What is the reaction taking place in the cell and calculate free energy, enthalpy and entropy changes at 298 K.

(4, 4, 4½)

3. (a) Derive Gibbs phase rule.
- (b) Draw and discuss the well labelled phase diagram of lead-silver system or sulphur.
- (c) In water-phenol system, determine Phase, Component and Degree of Freedom:
- (i) inside the solubility curve
  - (ii) outside the solubility curve
  - (iii) at CST
- (4,4,4½)
4. (a) Define transference number and explain any one method to determine it.
- (b) Write short note on any two:
- (i) Ionic Mobility
  - (ii) Nernst distribution Law

- (iii) Conductometric Titration
- (iv) Liquid junction potential
- (c) If the molar conductance at infinite dilution of NaCl, HCl and  $\text{CH}_3\text{COONa}$  are 126, 420 and 91  $\text{Scm}^2\text{mol}^{-1}$  respectively, calculate molar conductance of acetic acid at infinite dilution. (4, 4, 4½)

### SECTION B

*Attempt three questions in all.*

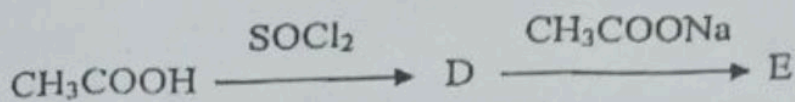
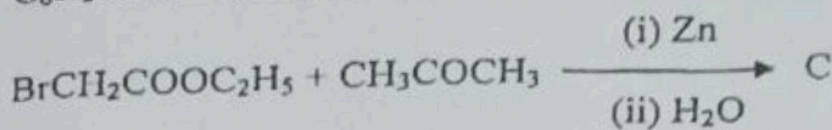
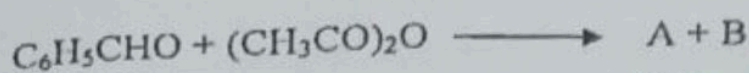
*All questions carry equal marks.*

5. (a) Arrange the following acid derivatives in increasing order of their reactivity toward nucleophilic substitution reaction and support your order by suitable explanation:



- (b) Explain Hell-Volhard-Zelinsky reaction and give its synthetic applications?
- (c) The alkaline hydrolysis of an ester is preferred than acidic hydrolysis to prepare carboxylic acid. Justify.
- (d) Complete the following reactions and predict the structure of compounds A, B, C, D and E





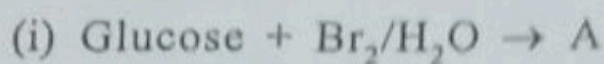
(3,3,1½,5)

- (a) Give a detailed account of Hofmann elimination and compare it with Saytzeff elimination.
- (b) Compare the basicity of aniline and ammonia.
- (c) Write the reactions of primary aliphatic and aromatic amines with  $\text{HNO}_2$ .
- (d) How benzene diazonium chloride can be converted to:
- Benzene
  - Phenol
- (e) Outline the chemistry of Hinsberg test? (3½,2,2,2,3)
- (a) Explain Edman degradation method for the determination of N-terminal amino acid of peptide.
- (b) Give the preparation of Glycine using Gabriel Phthalimide synthesis.
- (c) What is DCC? Explain its usage in peptide synthesis with mechanism. (6, 3½,3)

P.T.O.



8. (a) Write the structures of products in the following reactions:



(b) Write short notes on the following:

(i) Mutarotation

(ii) Ruff's Degradation

(c) How will you convert D-arabinose to D-glucose and D-mannose?

(d) Draw the Haworth projection for:  $\alpha$ -D-glucopyranose and  $\beta$ -D-fructofuranose. (3,5,2½,2)

*This question paper contains 6 printed pages.*

*Your Roll No. ....*

*Sl. No. of Ques. Paper* : 5071 **H**  
*Unique Paper Code* : 217561  
*Name of Paper* : CHPT-505 : Chemistry – V  
Chemistry of d Block Elements,  
Quantum Chemistry and  
Spectroscopy  
*Name of Course* : B.Sc. Programme Life Science /  
Physical Science / Applied Life  
Science (Agrochemical & Pest  
Management) / Applied Physical  
Science (Analytical Chemistry /  
Industrial Chemistry)  
*Semester* : V  
*Duration* : 3 hours  
*Maximum Marks* : 75

*(Write your Roll No. on the top immediately  
on receipt of this question paper.)*

*Attempt three questions from Section A and three questions  
from Section B. Sections A and B are to be attempted  
in separate portions of the same answer sheet.*

*Please indicate the Section you are attempting at the  
appropriate place and do not intermix the Sections. The  
questions should be numbered in accordance to the number  
in the question paper.*

*Calculators and log tables may be used.*

#### SECTION A

*Attempt any three questions.*

*Turn over*

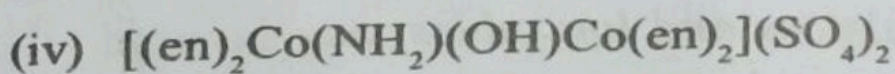
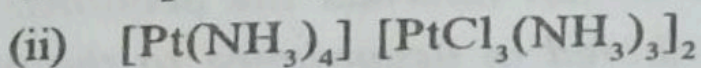
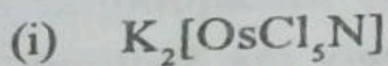


1. (a) Give brief reasons for any *three* of the following:
- Cu(II) compounds are coloured while Cu(I) compounds are colourless.
  - Zinc, cadmium and mercury are softer than the transition metals.
  - Octahedral complexes of Co(III) may be of inner and outer orbital types but those of Cr(III) are only inner orbital.
  - Many transition metals and their compounds act as catalysts.
  - The atomic radii of zirconium and hafnium are very similar.

(b) Define, using *two* examples, an ambidentate ligand. What specific type of isomerism is displayed in complexes containing such ligands? How does an ambidentate ligand differ from a bidentate ligand? 9,3½)

2. (a) Explain why a  $d^9$  octahedral complex with six identical ligands is not expected to have identical bond lengths. Give the appropriate splitting diagram of such a case where the axial bonds are longer than the equatorial bonds.

(b) Give the IUPAC names of any *three* of the following:



(c) The magnetic moments of  $[Fe(H_2O)_6]^{3+}$  and  $[Fe(CN)_6]^{3-}$  are 5.9 BM and 1.8 BM respectively. Explain on basis of



VBT. Indicate which of these is an inner orbital complex and which is an outer orbital complex. 5,4½,3

3. (a) Write the formulae of any *three* of the following:

- (i) Barium tetrafluorobromate(III)
- (ii) Diamminesilver(I) tetraacetatoaurate(III)
- (iii) Aquatris (triphenylphosphine) palladium(0)
- (iv) Bis (ethylenediamine) copper(II) tetrahydroxocuprate(II)

(b) Calculate the CFSE in terms of  $\Delta_t$  of the  $\text{Co}^{2+}$  ion placed in a tetrahedral field. Draw the splitting diagram and explain why the splitting pattern differs in tetrahedral and octahedral fields.

(c) Indicate the type of isomerism and one test to distinguish between the following:

- (i)  $[\text{CoI}(\text{NH}_3)_5]\text{SO}_4$  and  $[\text{CoSO}_4(\text{NH}_3)_5]\text{I}$
- (ii)  $[\text{CrCl}(\text{H}_2\text{O})_5]\text{Cl}_2$  and  $[\text{CrCl}_2(\text{H}_2\text{O})_4]\text{Cl} \cdot \text{H}_2\text{O}$  - 4½,4,4

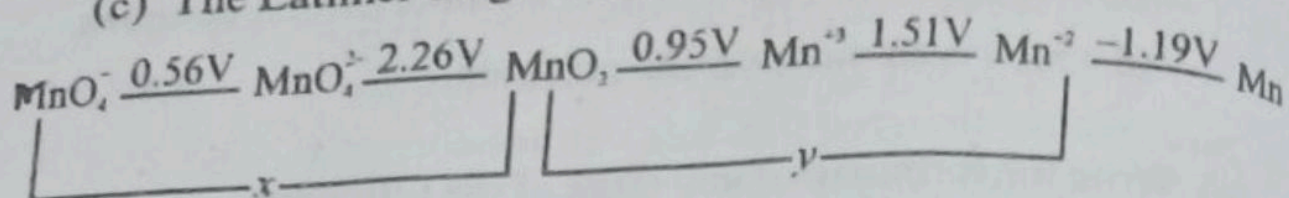
4. (a) Explain using CFT why an octahedral complex may be high spin or low spin but a tetrahedral complex is generally high spin.

(b) Indicate the appropriate choice and give brief reasons:

- (i) Greater value of  $\Delta_o$   $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$  or  $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$
- (ii) Good reducing agent  $\text{Sm}(\text{II})$  or  $\text{Ce}(\text{IV})$
- (iii) Optically active  $\text{cis}$  or  $\text{trans} [\text{CrCl}_2(\text{en})_2]^+$



(c) The Latimer diagram of manganese is given below:



Calculate  $x$  and  $y$  and indicate by showing necessary calculations which species will be disproportionate.

Or

(c) Write short notes on any *two* of the following:

- (i) Separation of lanthanides by ion exchange
- (ii) Spectrochemical series
- (iii) Variable oxidation states of  $3d$  elements.

3,4½,5

### SECTION B

Attempt any three questions.

#### Physical Constants

Planck's constant =  $6.626 \times 10^{-34}$  J s

Velocity of light =  $3 \times 10^8$  m s<sup>-1</sup>

Avogadro's number =  $6.023 \times 10^{23}$  mol<sup>-1</sup>

Atomic mass unit =  $1.661 \times 10^{-27}$  kg

Mass of electron =  $9.109 \times 10^{-31}$  kg

$\pi = 3.142$

- (a) Write the mathematical expressions for the position operator  $x$  and the linear momentum operator  $p_x$ .
- (b) Prove that the momentum and position operators do not commute with each other.
- (c) Examine which of the following are acceptable wave functions:

(i)  $\psi = x^2$

(ii)  $\psi = e^x$

(iii)  $\psi = e^{-x}$

(iv)  $\psi = A \sin x$



- (d) Prove that the wave functions of a particle in one-dimensional box are normalized. 2,2½,4,4
6. (a) The fundamental vibration frequency of  $N^{14}O^{16}$  is observed at  $1870\text{ cm}^{-1}$ . Evaluate the zero point energy and the force constant of the molecule.
- (b) A molecule AB is undergoing rotational motion under the rigid rotator approximation. What is this approximation? Write the mathematical expression for the Hamiltonian, Schrodinger's equation and the rotational energy  $E_{rot}$  associated with this system.
- (c) Which of the following molecules can exhibit a pure microwave spectrum:  $Cl_2$ ,  $NH_3$ ,  $CO$ ,  $C_2H_2$ ? Explain briefly. 4,4½,4
7. (a) Explain the terms degeneracy and node using the particle in a box problem as an example.
- (b) Predict the wave number of the lowest energy absorption band in the conjugated octatetraene molecule given that the average carbon-carbon bond distance is  $0.141\text{ nm}$ .
- (c) For a photochemical reaction,  $A \rightarrow B$ ,  $1.08 \times 10^{-5}$  moles of B are formed on absorption of  $5.89\text{ J}$  at  $360\text{ nm}$ . Calculate the quantum efficiency of the reaction. Explain why the quantum yield is quite high for certain reactions. 4,4,4½

8. (a) Write a short notes on any *three* of the following:
- (i) Fluorescence and Phosphorescence
  - (ii) Beer-Lambert's Law
  - (iii) Bathochromic and Hypsochromic shift
  - (iv) Bohr's correspondence principle.
- (b) Define eigenfunction and eigenvalue.

3 1/2



This question paper contains 3 printed pages]

Roll No.

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S. No. of Question Paper : 6984

Unique Paper Code : 32173909

HC

Name of the Paper : Pharmaceutical Chemistry

Name of the Course : B.Sc. (Hons.) Chemistry/B.Sc. (Prog.) :  
SEC

Semester : III

Duration : 2 Hours

Maximum Marks : 37½

(Write your Roll No. on the top immediately on receipt of this question paper.)

Answer any *three* questions.

Each question carries equal marks.

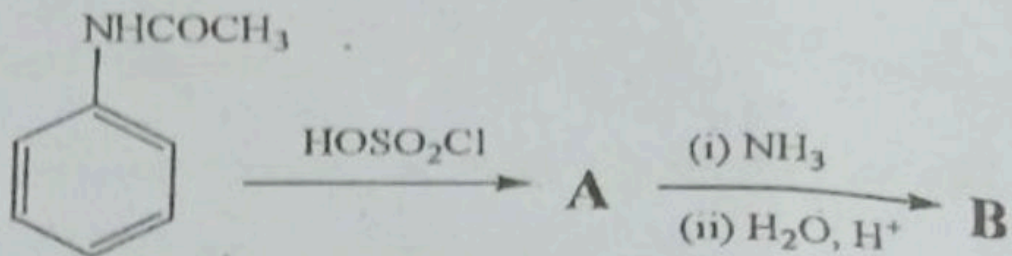
1. Do any *five* : 2.5×5

- (i) What is a 'lead' in drug discovery ?
- (ii) What is a 'pharmacophore' ?
- (iii) Give method of preparation of paracetamol.
- (iv) What are antibiotics ? Give *one* example.
- (v) Give structure of trimethoprim.

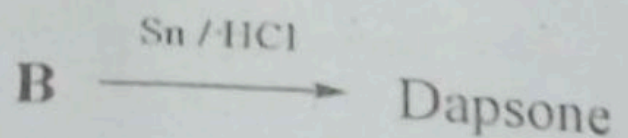
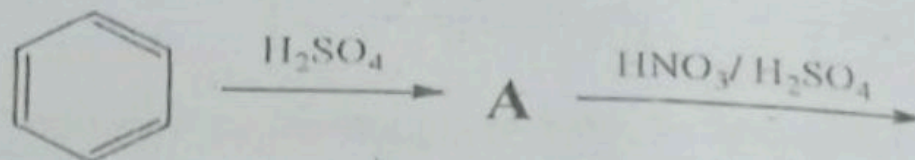
P.T.O.

- (v) What is antilaprosyl agent ? Give *one* example.
- (vi) Describe production of ethyl alcohol by fermentation process.

2. (i) What is structure-activity relationship (SAR) ? How can it be optimized ?
- (ii) What are antipyretic agents ? Give *two* examples.
- (iii) Complete the following :



3. (i) What are barbiturates ? What type of activity do they show ?
- (ii) Complete the following :





- (iii) (a) What is anaerobic fermentation ?
- (b) How is the fermentation process used for industrial production of antibiotics ? Explain using suitable examples.

6.5

4. (i) Write short notes on any *two* of the following : 5.5

(a) Drug discovery from natural products and microbes.

(b) Non-steroidal anti-inflammatory drugs (NSAID).

(c) Target specificity and selectivity within body.

(ii) What is the meaning of 'high therapeutics index' ? 2.5

[This question paper contains 7 printed pages]

Your Roll No. : .....

Sl. No. of Q. Paper : 7275 HC

Unique Paper Code : 32175901

Name of the Course : **Generic Elective for  
Honours : Chemistry**

Name of the Paper : Atomic Structure,  
Bonding, General  
Organic Chemistry &  
Aliphatic Hydrocarbons

Semester : I/III

**Time : 3 Hours**                      **Maximum Marks : 75**

**Instructions for Candidates :**

- (a) Write your Roll No. on the top immediately on the receipt of the paper.
- (b) Use of Calculator is permitted.

**Section - A**

$37\frac{1}{2}$

**(Inorganic Chemistry)**

**Note :** Attempt any **three** questions. Question No. 1 is Compulsory.

P.T.O.



1. (a) Electronic Configuration of Cu is  $3d^{10} 4s^1$  and not  $3d^9 4s^2$ . Explain.  $2\frac{1}{2}$
- (b) What are some special properties which must be fulfilled by the acceptable solution of the wave equation?  $2\frac{1}{2}$
- (c) Though the radii of  $Ag^+$  is comparable with the radii of  $K^+$ , the melting point of  $AgCl$  is much lower than that of  $KCl$ . Explain.  $2\frac{1}{2}$
- (d) How Born Haber's Cycle can explain the stability of ionic compounds?  $2\frac{1}{2}$
- (e) Explain why  $PCl_5$  is more reactive than  $SF_6$  Molecule.  $2\frac{1}{2}$
2. (a) Write time independent Schrodinger wave equation for an electron in Hydrogen atom. Explain the various terms. Name the three quantum numbers obtained from this equation.  $4\frac{1}{2}$

(b) What are Polar Coordinates ? Derive a relationship between the Cartesian coordinates and polar coordinates.

4

(c) Write a short note on the following :

4

(i) Radial probability Distribution Curves.

(ii) Physical Significance of  $\Psi$  and  $\Psi^2$ .

3. (a) Calculate the Heat of formation, of  $\text{MgF}_2$  from its elements using the Born Haber's Cycle from the following thermo-chemical data: Sublimation energy of  $\text{Mg(s)} = 146.4 \text{ kJmol}^{-1}$ , Dissociation energy of  $\text{F}_2(\text{g}) = 158.9 \text{ kJmol}^{-1}$ , Ionization energy of  $\text{Mg(g)} / \text{Mg(g)}^{2+} = 2184 \text{ kJmol}^{-1}$ , Electron affinity of  $\text{F(g)} / \text{F}^-(\text{g}) = -334.7 \text{ kJmol}^{-1}$ , lattice energy of  $\text{MgF}_2(\text{s}) = -2922.5 \text{ kJmol}^{-1}$ .

4  $\frac{1}{2}$ 

(b) Explain Fajan's Rules and on the basis of these rules compare the covalent character in following compounds :

4

(i)  $\text{NaCl}$  and  $\text{CuCl}$

(ii)  $\text{AgCl}$  and  $\text{AgI}$



(c) Define Lattice and Solvation energy. What is the role of these terms in deciding the solubility of ionic solids ?

4. (a) How does Molecular Orbital Theory account for the following ? 4  $\frac{1}{2}$

(i) Monoatomic nature of Helium

(ii) Paramagnetic character in  $O_2$  molecule

(b) Using VSEPR Theory justify that  $ClF_3$  is T-shaped while  $XeF_4$  is a square planar molecule. 4

(c) Give the hybridization of the central atom and shape of the following molecules :

$NO_3^-$ ,  $CO_3^{2-}$ ,  $SF_4$  and  $ClO_4^-$  4

### Section - B

37  $\frac{1}{2}$

**Note :** Attempt any **three** questions.

5. (a) What is electrometric effect ? How does it differ from inductive effect ? 3

(b) What is Huckel's rule of aromaticity ?  
Explain with at least two examples. 3

(c) Explain the following:

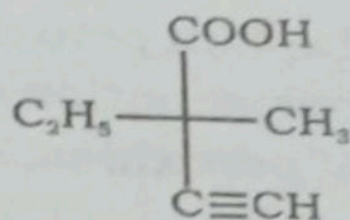
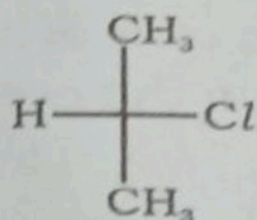
(i)  ${}^{\cdot}\text{CH}_3$  is planar while  ${}^{-}\text{CH}_3$  is pyramidal.

(ii) Benzyl free radical is more stable than methyl free radical. 1.5, 1.5

(d) O-Hydroxybenzoic acid is more acidic than benzoic acid while p-hydroxybenzoic acid is less. Why ? 3.5

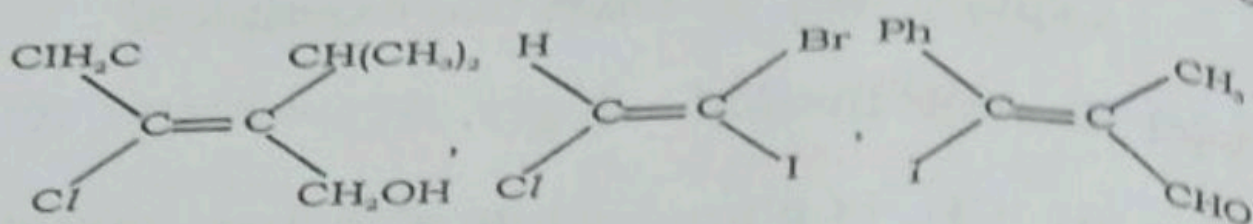
6. (a) Write down all the possible stereoisomers of 1, 2-Bromobutane and give their relation amongst each other. 3.5

(b)i) Assign R or S configuration to following isomers : 3





- (ii) Assign E or Z to following geometrical isomers : 3



- (c) Why is boat conformation of cyclohexane less stable than chair conformation ? 3

7. (a) Carry out the following conversions (**any three**). 2×3=6

(i) Ethylchloride to n-butane

(ii) 1-propene to Isopropyl alcohol

(iii) Propyne into but-2-yne]

(iv) But-1-yne to but-2-one

- (b) (i) Discuss the free radical mechanism for the chlorination of methane.

3.5

- (ii) Explain peroxide effect in case of hydrohalogenation of alkenes in the presence of peroxides. 3

B. Write short notes on following **(any five)**.  
2.5×5=12.5

- (a) Oxemercuration and demercuration reaction
- (b) Homolytic and Heterolytic fission
- (c) Markovnikov's Rule
- (d) Hyperconjugation
- (e) Geometrical Isomerism
- (f) Inductive effect



This question paper contains 4+2 printed pages]

Roll No.

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S. No. of Question Paper : 7411

Unique Paper Code : 32175915

HC

Name of the Paper : Solutions, Phase Equilibrium,

Conductance, Electrochemistry and  
Functional Group Organic Chemistry

Name of the Course : Chemistry : Generic Elective

Semester : VIII

Duration : 3 Hours

Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt six questions in all, three questions  
from each Section.

Use separate answer-sheets for Section A and Section B  
and do not intermix the sections.

### Section A

Attempt 3 questions in all in this section.

Question No. 1 is compulsory.

All questions carry equal marks.

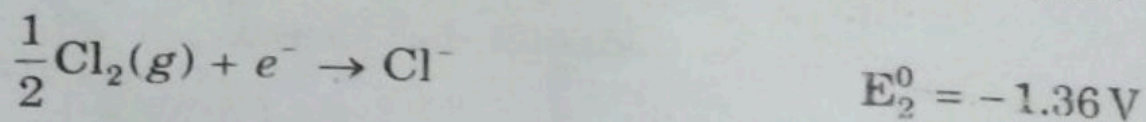
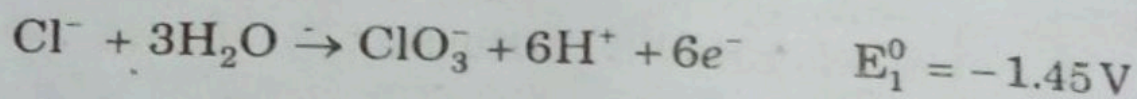
Use of scientific calculators is allowed but they  
cannot be shared.

P.T.O.

1. Attempt any five :

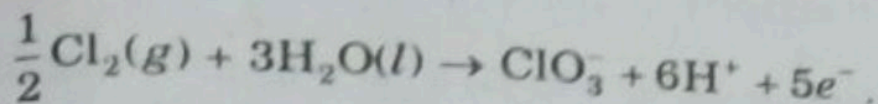
- (a) The variation of molar conductivity on dilution of a strong electrolyte differs from that of a weak electrolyte. Sketch a diagram indicating the typical variation of molar conductivities for these two electrolytes.
- (b) State and explain Kohlrausch's law of independent migration of ions. How does it help in determining the molar conductivity at infinite dilution of a weak electrolyte ?
- (c) KCl-NaCl-H<sub>2</sub>O system is regarded as 3-component system whereas KCl-NaBr-H<sub>2</sub>O system is regarded as 4-component system.
- (d) The elevation in boiling point is observed when a non-volatile solute is dissolved in a volatile solvent.
- (e) The standard electrode potential of hydrogen electrode is taken as zero at all temperatures.

(f) The standard e.m.f. for the cell reactions :





Calculate the standard e.m.f. for the cell reaction :



- (g) The dissociation constant of acetic acid is  $1.75 \times 10^{-5}$  and :

$$\Lambda_{\text{CH}_3\text{COOH}}^0 = 390.6 \times 10^{-4} \Omega^{-1} \text{m}^2 \text{mol}^{-1}$$

Calculate the specific conductance of 0.01 M acetic acid solution.

$$5 \times 2\frac{1}{2} = 12\frac{1}{2}$$

- 2 (a) State Nernst distribution law and with its help explain how multistep extraction of a solute is more effective than a single step extraction for a given volume of extracting solvents ?

- (b) An organic acid is distributed between 500 ml each of a solvent A and water. In water the acid is dissociated while in solvent A its normal molecules are present. The concentration of the acid in the aqueous layer is 6.0 gm and in the layer of solvent A it is 0.72 gm. If the partition coefficient of the acid between solvent A and water is 0.16, calculate the degree of dissociation of the acid in the aqueous layer.

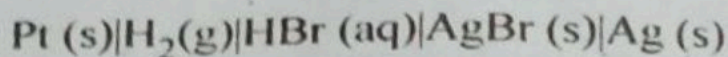
$$7\frac{1}{2} + 5$$

P.T.O.

3. (a) Construct a properly labelled phase diagram for the binary system A-B from the following data :
- (i) Melting Point of A =  $1060^{\circ}\text{C}$
  - (ii) Melting Point of B =  $330^{\circ}\text{C}$
  - (iii)  $\text{A}_2\text{B}$  decomposes at  $420^{\circ}\text{C}$  to give a liquid of 45 mol% B.
  - (iv)  $\text{AB}_2$  has a peritectic at  $255^{\circ}\text{C}$  and the melt is 71 mol% B.
  - (v) Eutectic is  $215^{\circ}\text{C}$  and 84 mol% B.
- No solid solution formed. Also, describe cooling curve for 10 mol% of B.

(b) Describe the sequence of events that take place when the component A (in liquid form) is added to a binary system of two partially miscible liquids B and C.  $7\frac{1}{2}+5$

4. (i) Derive the relationship between cell potential with  $\Delta G$ ,  $\Delta H$  and  $\Delta S$  of the cell reaction.
- (ii) The standard emf of the cell



was measured over a range of temperature and the data was fitted to the following polynomial,

$$E^0/\text{V} = 0.07131 - 4.99 \times 10^{-4} \left( \frac{T}{\text{K}} - 298 \right) - 3.45 \times 10^{-6} \left( \frac{T}{\text{K}} - 298 \right)^2$$



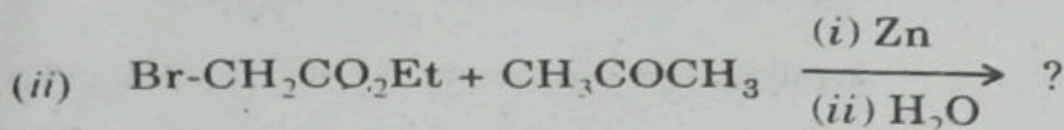
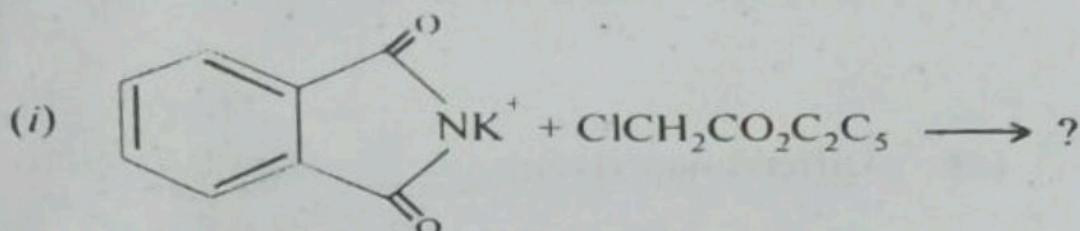
Evaluate the standard cell reaction, Gibbs energy, enthalpy and entropy at 298 K.

( $F = 9.6486 \times 10^4 \text{ C mol}^{-1}$  and  $1 \text{ CV} = 1 \text{ J}$ ).  $7\frac{1}{2}+5$

### Section B

Attempt any *three* questions.

(a) Complete the following reactions :



(b) Write the mechanism of Hell-Vohlard-Zelinsky reaction.

(c) Write down the structure of cellobiose.

(d) Explain with mechanism Hofmann Bromamide reaction.

4,3,2,3,5

Write short notes on the following :

(i)  $\alpha$ -helix structure of proteins

(ii) Reformatsky Reaction

(iii) Hinsberg test

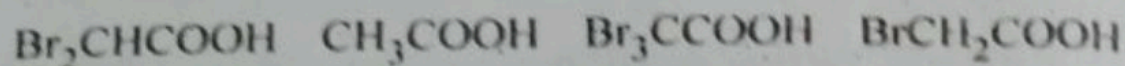
(iv) Strecker synthesis.

3,5,3,3,3

7. (a) Using N-protecting agent, synthesize the dipeptide :  
Gly - Ala
- (b) How will you convert D-arabinose to D-glucose ?
- (c) Write down the structure of ninhydrin complex with an  $\alpha$ -amino acid.
- (d) What is Zwitter ion ? Explain with a suitable example.

3,4,3,2,5

8. (a) Differentiate Hofmann *Vs.* Saytzeff elimination.
- (b) Explain Mutarotation with suitable example.
- (c) Arrange the following in the increasing order of their acidity and justify it :



- (d) What is an isoelectric point ? What happens to the solubility of an amino acid at this point ? 4,3,3,2,5



[This question paper contains — printed pages]

Sr. No. of the Question Paper : 8690

Roll No. ....

Unique Paper Code : 42177925

Name of the Paper : Chemistry of d-block elements, quantum chemistry and spectroscopy

HC

Name of the Course : B.Sc. Prog. ~~(in B.Sc.)~~ : Chemistry : OSE

Semester : V

Duration : 3 Hours

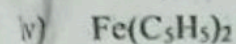
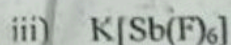
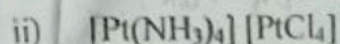
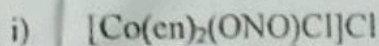
Maximum Marks : 75 Marks

### Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt three question from Section A and three question from Section B.
3. All Questions carry equal marks
4. Use Separate answersheets for Section A and Section B
5. Calculators and log tables may be used.

### Section A

Q1 (a) Write the IUPAC names of the following coordination compounds.



4 X 1 = 4

(b) Write the formulae for the following complexes.

i) Diamminechloroethylenediaminenitroplatinum(IV) chloride

ii) Hexamminecobalt(III)-trioxalatochromate(III)

2 X 1 = 2

(c) Give reasons for the following:

- i)  $\text{Cu}^{2+}$  coordination complexes are coloured while that of  $\text{Zn}^{2+}$  are colourless. 2
- ii)  $\text{KMnO}_4$  is intensely coloured even if Mn has  $3d^0$  configuration. 2
- iii) Absorption spectrum of a lanthanide is sharp and not influenced by ligands. 2.5

Q2 (a) What do you understand by inner orbital and outer orbital complexes? Explain suitably with the help of one example for each. 2



Draw the various isomers for dichlorobis(ethylenediamine)cobalt(III). 4

A compound with the empirical formula  $\text{Co}(\text{NH}_3)_5\text{SO}_4\text{Br}$  exists in two forms: red and violet. Solution of red form gave a precipitate of  $\text{AgBr}$  with  $\text{AgNO}_3$ , silver nitrate. The violet form gives no such precipitate with  $\text{AgNO}_3$ , but gave a white precipitate on addition of aqueous  $\text{BaCl}_2$ , barium chloride solution. From these observations, write down the structural formula of the both forms. What is this isomerism called? 3

Give the hybridization and structure of each of the following complexes by using VBT  $[\text{FeF}_6]^{3-}$  and  $[\text{NiCl}_4]^{2-}$  3.5

What are low spin and high spin complexes? Discuss the bonding in  $\text{CoF}_6$  and  $[\text{Co}(\text{NH}_3)_6]^{3+}$  in terms of crystal field theory. 4

What is Jahn Teller Distortion? Describe its significance in a  $d^9$  complexes of  $\text{Cu}(\text{II})$  and  $d^8$  complexes of  $\text{Ni}(\text{II})$  with a strong field ligand cyanide ( $\text{CN}^-$ ) ion. Give the number of unpaired electrons in the following coordination complexes. Also comment on the magnetic property of each citing valid reason(s). 4

$[\text{Co}(\text{NH}_3)_6]^{3+}$  low spin  
 $[\text{Co}(\text{NH}_3)_6]^{2+}$  high Spin  
 $\text{K}_4[\text{FeF}_6]$  high Spin 4.5

- Write short note (*any five*):
- Electronic configurations of lanthanides and actinides
  - Drawbacks of Valence bond theory
  - Factors affecting magnitude of crystal field splitting energy  $\Delta$
  - Catalytic property of the transition metals
  - Lanthanide Contraction
  - Lantimar Diagram and its applications
  - Spectrochemical series
- 5 x 2.5

**Section B**

- Which of the following mathematical functions are acceptable wavefunctions
- $\Psi = \tan x$
- $\Psi = e^{-x^2}$  2
- Can "zero point energy" of particle in 1-D box be zero. Explain with suitable reasons. 3
- State Stark- Einstein law of photochemical equivalence 2
- Solve Schrodinger wave equation for a particle of mass 'm' moving in a 1-D box of length 'l' 5.5



- Q6 (a) Do operators A and B commute if
- $A=d/dx$  and  $B=x^2$
  - $A= x$  and  $B=d/dx$
- (b) How do molecular and atomic spectroscopy differ? 4
- (c) Give the physical significance of  $\Psi$  and  $\Psi^2$ . 3
- (d) What is normalization of the wavefunction? Normalize the wavefunction  $\Psi=A\sin(n\pi x/l)$  for a particle of mass 'm' moving in a 1-D box of length 'l'. 2
- 3.5
- Q7 (a) What are the selection rules for the rotational and vibrational transitions of a diatomic molecule. The rotational spectrum of CO shows a series of equidistant lines spaced  $3.84 \text{ cm}^{-1}$  apart. Calculate the moment of inertia and the bond length of C=O bond. 5.5
- (b) What are symmetric & asymmetric stretching & bending modes? Illustrate these by taking  $\text{SO}_2$  or  $\text{H}_2\text{O}$  as an example. 4
- (c) Which of the following molecules are rotationally and vibrationally active and why (*any two*) 3
- $\text{CO}_2$ , ii)  $\text{H}_2\text{S}$  iii)  $\text{N}_2\text{O}$
- Q8 (a) What are primary and secondary processes in photochemical reactions? Explain with the help of suitable example. 2.5
- (b) Derive Lambert-Beer's Law. What are its limitations? 4
- (c) Write short note (*any three*)
- Frank-Condon principle and its significance
  - Bathochromic and hypsochromic shift
  - Fluorescence and Phosphorescence
  - Photoelectric cells
  - Effect of (inter- and intramolecular) hydrogen bonding on vibrational frequency
  - Photophysical & photochemical processes
- 3 x 2 = 6

Sr. No. of Question Paper : 8691  
 Unique Paper Code : 42177926  
 Name of the Paper : ORGANOMETALLICS, BIOINORGANIC CHEMISTRY, POLYNUCLEAR  
 Name of the Course : HYDROCARBONS AND UV, IR SPECTROSCOPY  
 Semester : DSE : *Chemistry*  
 Duration : 5  
 Maximum Marks : 3 Hours  
 : 75

Roll No. ....

HC

Instruction for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **six** questions in all.
3. **Three** questions from each section (A and B).
4. All questions carry equal marks.

**Section - A**

1. (a) Explain structure, hybridization and magnetic behaviour of Potassium dichromate including its oxidizing behaviour.
- (b) Write the reaction of potassium permanganate with concentrated sulphuric acid when: Potassium permanganate is in excess and when sulphuric acid is in excess.
- (c) (i) Explain the basis of qualitative identification of sulphide ions with sodium nitropruside.
- (ii) Describe the preparation of hexaamminecobalt(III) chloride.

(4.5, 4, 4)

2. (a) Using the molecular orbital diagram of carbon monoxide, explain why it acts as an electron donor and acceptor through carbon and not through oxygen
- (b) Give two reactions of ferrocene which show it is more reactive than benzene.

P.T.O



(c) In which organometallic i.e.  $(\pi-C_5H_5)_2Fe$  or  $(\pi-C_5H_5)_2Co$  oxidation occur easily. Explain briefly. (4.5, 4, 4)

3. (a) Explain, giving reason, the variation of carbon-oxygen stretching frequency in the following carbonyl compounds:  $[Fe(CO)_4]^{2-}$   $1790\text{ cm}^{-1}$ ;  $[Co(CO)_4]^-$   $1920\text{ cm}^{-1}$ ;  $[Ni(CO)_4]$   $2040\text{ cm}^{-1}$ .

(b) Free Heme is oxidised but Haemoglobin is not oxidised by dioxygen. Explain it.

(c) Write short note on chromyl chloride including its preparation, structure and chemical properties. (4.5, 4, 4)

4. (a) Discuss trigger mechanism for cooperativity of oxygenation of Haemoglobin.

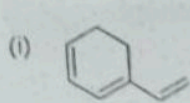
(b) Two different structures are consistent with the 18 electron rule for  $Co_2(CO)_8$ . How will you predict the structure on the basis of infra red spectra studied?

(c) Where and in what form is iron stored in the human body? How is it taken from the storage sites to the sites for incorporation into haemoglobin? (4.5, 4, 4)

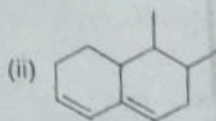
### Section - B

Note: Attempt any three questions.

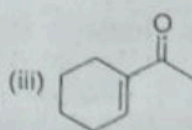
Q5 (a) Using Woodward-Fischer rules, calculate the  $\lambda_{max}$  (nm) of UV absorption for the following compounds:



Base value = 253 nm



Base value = 214 nm



Base value = 215 nm

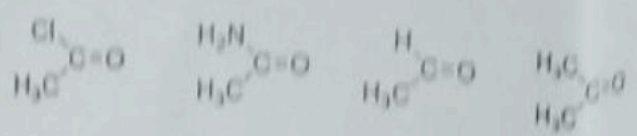
(b) Explain the following terms:-

- (i) Finger print region
- (ii) Chromophore
- (iii) Auxochromes
- (iv) Bathochromic Shifts

P.T.O

(c) Why does UV spectrum of organic compound consist of bands and not sharp peaks? (4, 5, 6, 2)

Q 6. (a) Arrange the following organic compounds, giving reasons, in increasing order of their carbonyl frequency in Infrared spectrum:



(b) How will you distinguish between the following pairs of compounds using IR spectroscopy (any three)?

- (i)  $\text{CH}_3\text{COOH}$  and  $\text{CH}_3\text{COOCH}_2\text{CH}_3$
- (ii)  $\text{CH}_3\text{COCH}_3$  and  $\text{CH}_3\text{CH}_2\text{OCH}_3$
- (iii)  $\text{CH}_3\text{CH}_2\text{COCl}$  and  $\text{CH}_3\text{CH}_2\text{OCH}_3$
- (iv)  $\text{CH}_3\text{COCH}_3$  and  $\text{CH}_3\text{CHO}$

(c) Convert the following :-

- (i) Pyrrole to 2-nitropyrrole
- (ii) Naphthalene to 1,4-naphthaquinone
- (iii) Furan to 2-bromofuran

(3, 5, 6, 3)

Q 7. (a) Synthesize the following using ethylacetoacetate:-

- (i) 2-Methylbutanoic acid
- (ii) Pentan-2-one
- (iii) Hexane-2,5-dione
- (iv) Crotonic acid

(b) Give the synthesis of ethylacetoacetate by Claisen ester condensation with mechanism.

(c) Explain acidic nature of methylene hydrogens in ethylacetoacetate.

(6, 4, 2.5)

Q 8. (a) Explain the following (any two):

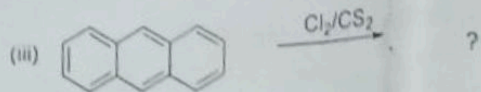
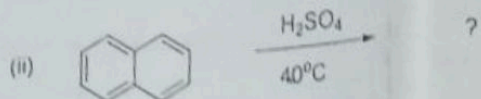
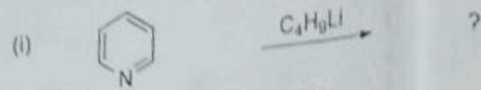
- (i)  $\alpha$ -position in naphthalene is more suitable for monosubstitution.
- (ii) Electrophilic substitution in pyridine takes place at 3-position
- (iii) Pyrrole is an aromatic compound

P.T.O



(b) Compare the basicity of pyridine with that of pyrrole and justify your conclusions on the basis of their structure.

(c) Complete the following reactions (any four):



(6, 2.5, 4)