

[Time: 3 Hours]

[Total Marks: 100]

Please check whether you have got the right question paper.

**N.B.**

- All Questions are compulsory.
- Figures to the right indicate full marks.
- The use of log-table/non-programmable calculator is allowed.
- Answers for the same question as far as possible should be written together.

**Q.1** Answer ANY FOUR of the following:

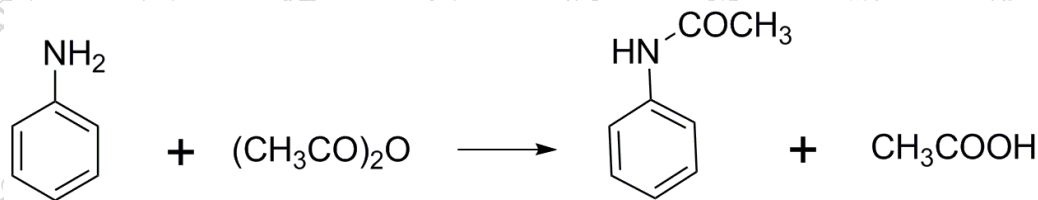
- A** Give the full form of NGP. Explain with a suitable example the effect of NGP on kinetics and stereochemistry of the reaction. **5**
- B** Explain the following terms: **5**
- pyrolytic elimination
  - $A_{Ac}2$
  - heterolytic fission
  - basicity
  - saponification
- C** With the help of a well labelled Jablonski diagram explain any three relaxation (decay) processes which an electronically excited molecule undergoes to loose energy. **5**
- D** What are pericyclic reactions? List how they are classified? Explain Electrocyclic reactions with a suitable example. **5**
- E** What is photoreduction? Explain the mechanism of photoreduction of benzophenone. **5**
- F** Distinguish between the following:
- acidity and electrophilicity **3**
  - transition state and reaction intermediate **2**

**Q.2** Answer ANY FOUR of the following:

- A** Write a note on the following- **5**
- Centre of symmetry,
  - Plane of symmetry
  - Atropisomerism
- B** Write a note on stereochemistry of allenes. **5**
- C** Define: Agrochemicals. Give advantages and disadvantages of Agrochemicals. **5**
- D** (a) Give synthesis of indole-3-acetic acid. **3**  
(b) Give preparation of pyridine-N-oxide from pyridine. **2**
- E** Write the reaction of following reagents with quinoline- **5**
- bromine in concentrated  $H_2SO_4$  at  $75^\circ C$ ,
  - fuming  $HNO_3$  and concentrated  $H_2SO_4$  at  $0^\circ C$
  - $H_2$ , Pt in methanol
- F** Write Bischler-Napieralski synthesis for 1-methyl isoquinoline. **5**

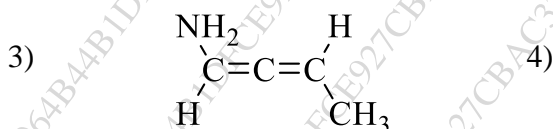
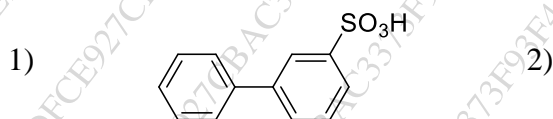
**Q.3** Answer any **four** of the following :

- A**
- Define Regioselectivity? Give an example of Chemoselectivity? **3**
  - What is E-factor? Give its significance. **2**
- B**
- Give an example of Multicomponent synthesis? **3**
  - Give the preparation of adipic acid from D-glucose using green chemistry reactions? **2**
- C** Define Atom economy? Calculate the percentage atom economy of the following reaction? **5**



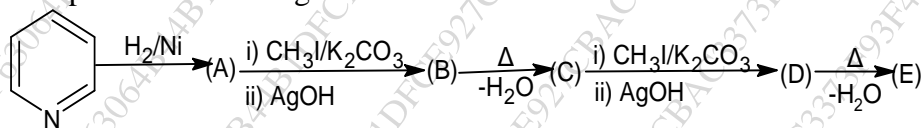
Atomic Weights: C=12, H=1, O= 16, N=14

- D** Give the synthesis of the following from a suitable starting compound: **5**
- 2-pentanol using a suitable Grignard reagent
  - p-nitroaniline
- E** Write the structural formula for each of the following compounds: **5**
- 4,4'- dimethyl diphenyl
  - 4-chloro-benzo[b] pyridine
  - Penta-2,3-diene-1-oic acid
  - Spiro [4.4] non-1-ene
  - 2-methyl bicyclo [4.2.0] oct-3-ene
- F** Give IUPAC names for each of the following compounds: **5**



**Q.4** Answer **any four** of the following:

- A** Explain the following terms used in uv-visible spectroscopy with example: **5**  
 a) Chromophore- Chromophore interactions  
 b) Various possible electronic transitions
- B** a) Explain the mass spectral fragmentation pattern of 2-methyl pentane. **3**  
 b) Discuss in brief the principle of mass spectrometry. **2**
- C** Give the synthesis of: **5**  
 a) Adrenaline by Ott's synthesis method  
 b) Citral from 6-Methyl hept-5-en-2-one
- D** a) What are alkaloids? Write any two class of alkaloids with suitable example. **3**  
 b) State isoprene rule. **2**
- E** Complete the following reaction. **5**



- F** Give analytical evidence to prove the following: **5**  
 a) Citral is acyclic monoterpenoids.  
 b) Presence of isopropylidene group in citral.

**Q.5** Do as Directed

**A** Choose the most appropriate option ( answer **any 5**): **5**

**i)** Which of the following reactions is a thermal decomposition of xanthate esters?

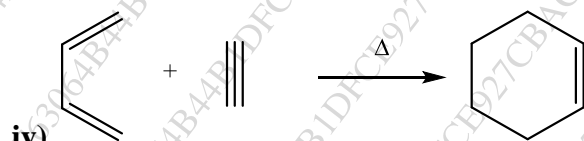
- a) Cope elimination  
 b) Chugaev reaction  
 c) Sigmatropic reaction  
 d) Pyrolysis of acetates

**ii)** How is an electrophile defined?

- a) Electron deficient species  
 b) Negatively charged species  
 c) Electron rich species  
 d) Lewis base

**iii)** Which of the following is not a nucleophile?

- a)  $\overset{\ominus}{\text{O}}\text{H}$   
 b)  $\overset{\cdot\cdot}{\text{R}}\overset{\cdot\cdot}{\text{O}}\text{H}$   
 c)  $\overset{\oplus}{\text{R}_3\text{C}}$   
 d)  $\text{H}_2\overset{\cdot\cdot}{\text{O}}$



Identify the reaction.

- a) Cheletropic reaction  
 b)  $(2\pi + 2\pi)$  Cycloaddition  
 c) Group Transfer reaction  
 d)  $(4\pi + 2\pi)$  Cycloaddition



Classify the above reaction.

- a) Acyl Electrophilic substitution  
 b) Alkyl Electrophilic substitution  
 c) Acyl Nucleophilic substitution  
 d) Alkyl Nucleophilic Substitution

vi) In which of the following reactions is carbon monoxide eliminated as a by-product?

- |                                       |   |
|---------------------------------------|---|
| a) Norrish Type I at room temperature | b) Norrish Type I at elevated temperature |
| c) Norrish Type II                    | d) Cope Elimination                       |

vii) What does ISC stand for?

- |                                  |                          |
|----------------------------------|--------------------------|
| a) Internal System Crossing      | b) Inter-System Crossing |
| c) Internal Sensitised Crossover | d) Intra-System Crossing |

viii) Pick the correct statement with respect to photoisomerisation of stilbene.

- It is a direct reaction that takes place via the Singlet state.
- It is a direct reaction that takes place via the Triplet state
- It is a photosensitised reaction that takes place via the Singlet state
- It is a photosensitised reaction that takes place via the Triplet state

**B** State whether following are True or False- (ANY FIVE)

**5**

- Always an optically active compound must contain at least one chiral carbon atom
- Alternating axis of symmetry is also known as rotation-reflection axis.
- Endosulfan is a plant growth regulating hormone.
- Fungicides are the chemicals that destroy, prevent or inhibit the growth of weeds.
- Electrophilic substitution reactions on isoquinoline takes place preferably at positions 5 and 8.
- Isoquinoline is also known as 2-azanaphthalene.
- Pyridine-N-oxide is less basic than pyridine.

**C** Fill in the blanks (Answer any five)

**5**

- There are \_\_\_\_\_ principles of Green Chemistry
- The concept of Atom economy was developed by \_\_\_\_\_.
- In a greener pathway to synthesize Adipic acid, the starting material used is \_\_\_\_\_.
- Synthesis of p-bromoaniline from Aniline is a \_\_\_\_\_ synthesis.
- In the reduction of m-dinitrobenzene to m-nitroaniline the chemoselective reagent used is \_\_\_\_\_.
- In spiro [2.3] hexane, the smaller ring contains \_\_\_\_\_ number of carbon atoms.
- To name the fused and bridged ring systems the numbering starts from the \_\_\_\_\_ carbon atom.
- Two phenyl rings bonded by a single covalent bond is called a \_\_\_\_\_.

**D Match the following columns. (Attempt any five)****5**

<b>Column P</b>	<b>Column Q</b>
a. Codenine	1. Insulin
b. Citral	2. Mass spectrometry
c. Peptide	3. Endocrine glands
d. Adrenaline	4. Lemon grass oil
e. Hormones	5. -NH <sub>2</sub> group
f. Auxochrome	6. Epinephrine
g. m/z value	7. Opium poppy

(Time: 3 hours)

Total Marks: 100

N.B.: (1) All questions are compulsory.

(2) Figures to the right indicate full marks.

(3) Use of log table/ non-programmable calculator is allowed.

**Q.1 Attempt any four of the following. 20**

- A) Define quality. Explain the terms: 1) quality control and 2) quality assurance.
- B) Determine the mass percent composition of each element in calcium nitrate.  $\text{Ca}(\text{NO}_3)_2$   
(Atomic weight of Ca = 40, N = 14, O = 16)
- C) Calculate molarity and molality of solution containing 8.5 g of NaCl dissolved in  $0.7 \text{ dm}^3$  of solution. Density of the solution is  $1.0 \text{ g cm}^{-3}$  (Given: atomic weight of Na = 23 and Cl = 35.5)
- D) What are difficulties encountered in sampling of solids? Explain the terms bulk ratio and size to weight ratio.
- E) Explain the importance of quality concepts in industry.
- F) Describe sampling of homogeneous and heterogeneous liquids.

**Q.2 Attempt any four of the following. 20**

- A) Discuss the theory of redox indicators and explain how ferroin indicator is suitable in the redox titration of  $\text{Fe}^{2+}$  versus  $\text{Ce}^{4+}$ .
- B) What are metal ion indicators? Give the three properties of good metal ion indicator with suitable examples.
- C) What are complexometric titrations? Explain Back titration and Displacement titration.
- D) Derive an expression for potential of the system at the equivalence point and after the equivalence point in the titration of Fe (II) with Ce(IV) solution.
- E) What are complexometric titrations? Discuss any two techniques used to increase the selectivity of EDTA.
- F)  $25.0 \text{ cm}^3$   $0.1 \text{ M}$  Fe (II) solution is titrated with  $0.1 \text{ M}$  Ce (IV) in acidic medium Calculate the potential  
i) at the equivalence point  
ii) on addition of  $12.5 \text{ cm}^3$   $0.1 \text{ M}$  Ce (IV)  
Given :  $E^0_{\text{Pt/Fe}^{3+}/\text{Fe}^{2+}} = 0.771 \text{ V}$   
 $E^0_{\text{Pt/Ce}^{4+}/\text{Ce}^{3+}} = 1.44 \text{ V}$

**Q.3. Attempt any four of the following. 20**

- A) What are the different types of burners used in flame photometry? Explain any one of them.
- B) Explain electrothermal atomiser. Give any three limitations of AAS.
- C) Explain the principles underlying the emission of fluorescent light. How does fluorescence differ from phosphorescence?
- D) Explain phosphorescence. Give two applications of phosphorimetry.

- E) Draw a schematic diagram of turbidimeter and explain turbidimetric titrations using turbidimetric titration curve.  
 F) Discuss the instrumentation of nephelometry with the help a labelled diagram.

**Q.4**

**Attempt any four of the following.**

**20**

- A) What are the factors affecting solvent extraction? Explain any one.  
 B) Discuss the principle of solid phase extraction. Give any two points of comparison between solvent extraction and solid phase extraction.  
 C) What are the requirements for high pressure pump used in HPLC? Name any two high pressure pumps.  
 D) Explain the role of precolumn used in HPLC. Give any two applications of HPLC.  
 E) Name the detectors used in HPTLC and explain any one of these in brief.  
 F) What are the advantages and limitations of HPTLC.

**Q.5**

**A) Select the correct option and complete the following statements: (any five)**

**05**

- a) \_\_\_\_\_ materials cannot be used for validation of a method.  
 i) Reference ii) Certified reference  
 iii) Standard reference  
 b) A chemical of lowest purity is \_\_\_\_\_ grade.  
 i) GR ii) LR iii) AR  
 c) The normality of 0.5 M H<sub>2</sub>SO<sub>4</sub> is \_\_\_\_\_.  
 i) 0.05 ii) 1.0 iii) 0.25  
 d) 10µg of solute in 1 litre of solution is 10 \_\_\_\_\_ solution.  
 i) ppm ii) ppb iii) ppt  
 e) If solution contains 40 g of KCl and 60 g of water, then it contains \_\_\_\_\_ % (w/w) KCl.  
 i) 60 ii) 40 iii) 100  
 f) \_\_\_\_\_ is used for sampling of compact solid.  
 i) Split tube thief ii) concentric tube thief iii) split-barrel sampler  
 g) \_\_\_\_\_ method is mostly used to draw sample from a cylinder filled with gas at higher temperature.  
 i) Flushing ii) Displacement iii) Expansion  
 h) \_\_\_\_\_ is excellent solvent used for dissolution of many metal oxides.  
 i) Conc. HCl ii) Conc. H<sub>2</sub>SO<sub>4</sub> iii) Conc. HNO<sub>3</sub>

**Q.5**

**B) State whether true or false: (any five)**

**05**

- a) Murexide is used as indicator in Fe<sup>2+</sup> versus Ce<sup>4+</sup> titration.  
 b) Ferroin indicator is a complex of 1-10 phenanthroline with Fe (II)  
 c) PO<sub>4</sub><sup>3-</sup> can be titrated by direct titration of EDTA  
 d) EDTA is standardised by using standard solution of ZnSO<sub>4</sub>  
 e) During titration of Fe (II) with Ce (IV) the potential after equivalence point depends on ratio of [Fe<sup>2+</sup>] / [Fe<sup>3+</sup>]

- f) The transition potential of ferroin indicator is 0.76 V in 1 M H<sub>2</sub>SO<sub>4</sub>
- g) Eriochrome black T indicator exhibits blue colour between pH 7 to 11

Q.5

C)

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

05

- a) \_\_\_\_\_ is the study of the emission of radiation by element when their salt solutions are sprayed into the flame.
- b) Only small portion of sample reaches the flame in \_\_\_\_\_ burner of flame photometry.
- c) In AAS, the steady light from hollow cathode lamp is converted into pulsating light by \_\_\_\_\_.
- d) Phosphorimetric experiments are normally carried out at \_\_\_\_\_ temperature.
- e) Secondary filter in fluorimetry absorbs \_\_\_\_\_ light.
- f) In \_\_\_\_\_ the detector is mounted on a turntable for positioning at different angle.
- g) A turbidimeter measures \_\_\_\_\_ as a function of concentration of suspensions.
- h) A nephelometer measures the intensity of \_\_\_\_\_ light.

Q.5

D)

**Match the columns: (any five)**

05

**Column A**

**Column B**

- |   |  |
|---|--|
| a) Difference in pH <sub>1/2</sub> values | (i) Sample application as bands or spots                 |
| b) HPTLC                                  | (ii) Measure of separability of two ions                 |
| c) Refractive index detector              | (iii) Applicable to solute exists in same molecular form |
| d) UV Detector                            | (iv) Extraction of Fe (III) in ether in acidic medium    |
| e) Partition coefficient                  | (v) Highly temperature sensitive detector                |
| f) Ion pair formation                     | (vi) Multistage separation                               |
| g) Counter current extraction             | (vii) Mercury source with 254 and 280 nm wavelength      |

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[Time: 3Hours]

[Total marks: 100]

N.B. : (1) All questions are compulsory.

(2) Figures to the right indicate full marks.

(3) Use of logarithmic table/non-programmable calculator is allowed.

1. Attempt **any four** of the following:

- A. What is symmetry element? Discuss the following symmetry elements with one example each **5**  
 i) Axis of symmetry  
 ii) Improper rotation axis
- B. What is point group? Discuss the point groups  $C_{\infty v}$  and  $D_{\infty h}$  with suitable example in each. **5**
- C. Draw molecular orbital diagram for CO molecule. Discuss its bond order and magnetic behaviour. **5**
- D. What is SALCs of atomic orbitals? Explain the formation of molecular orbitals in Beryllium dihydride molecule. **5**
- E. Explain the triangular structure of  $H_3^+$  ion on the basis of molecular orbital theory **5**
- F. Write the comparison between homonuclear and heteronuclear diatomic molecule. **5**

2. Attempt **any four** of the following:

- A. Explain the term Lattice parameter. Derive relation between density and lattice parameter. **5**
- B. Define Atomic Packing factor. Show that the atomic packing factor for FCC unit cell is 74%. **5**
- C. Calculate the number of atoms per unit cell of a metal having the lattice parameter 2.9 Å and density is 7.87 g/cm<sup>3</sup>. Atomic weight of metal is 55.85 and Avogadro constant is  $6.023 \times 10^{23}$ . **5**
- D. Define point defect. Differentiate between Schottky and Frenkel defect. **5**
- E. Explain the following: **5**  
 i) Critical temperature.  
 ii) Meissner effect.
- F. Write short note on Fullerenes and Alkali metal fullerenes as a superconductor. **5**

3. Attempt **any four** of the following:

- A. What are f-block elements? **5**  
 Give its ideal and observed electronic configurations of lanthanides.
- B. Discuss the spectral properties of lanthanides. **5**
- C. Give reasons : **5**  
 i] Similarities between Zirconium and Hafnium.  
 ii] Variation in the properties of lanthanides.

- D.** i. Explain the binodal curve of magnetic moments of  $\text{Ln}^{3+}$  ions. **3**  
 ii. Explain the extraction process of lanthanides with respect to -  
 a] Concentration **2**      b] Cracking of the mineral **2**
- E.** Write a short note on Solvent extraction method. **5**
- F.** How do lanthanides occur in nature? **2**  
 Give any three applications of Lanthanides. **3**
- 4.** Attempt **any four** of the following:
- A.** Distinguish between : **5**  
 (i) protic and aprotic solvent (ii) Ionising and non-ionising solvents
- B.** With reference to  $\text{N}_2\text{O}_4$  explain following **5**  
 (i) acid-base reaction (ii) Solvate formation
- C.** Write a short note on allotropes of sulphur **5**
- D.** Describe the use of platinized asbestos and vanadium pentoxide in the oxidation of  $\text{SO}_2$  to  $\text{SO}_3$  **5**
- E.** Give one method of preparation of  $\text{IF}_5$  and explain the bonding and structure of  $\text{IF}_5$  **5**
- F.** Describe the bonding and structure of hypochlorite ion ( $\text{ClO}^-$ ) on the basis of VSEPR theory **5**
- 5.** Answer the following:
- A.** Select whether the following statements are **true** or **false** (Any five) **5**
- $\text{BF}_3$  molecule belongs to the  $\text{C}_3\text{V}$  point group.
  - The symmetry element identity is obtained by rotation of  $360^\circ$
  - Centre of symmetry is denoted by  $\sigma$ .
  - The molecules having more than two atoms of the same or different elements are known as polyatomic species.
  - Total number of electrons in CO is 15
  - Molecular orbital are denoted by wave function is  $\psi$ .
  - Molecular orbitals with lower energy give rise to antibonding molecular orbitals.
  - In triangular ion, triply degenerate orbitals are labelled as 't'.
- B.** Fill in the blank with appropriate words given in the bracket (Any five ) **5**  
 [two, vacancy defect, Frenkel defect, 0.52, Meissner effect, conventional, lattice point]
- Number of atoms per unit cell in bcc structure is \_\_\_\_\_.
  - Atomic packing factor in simple cubic cell is \_\_\_\_\_.
  - Schottky defect in the crystal is \_\_\_\_\_.
  - When atom is missing from its lattice site and occupy interstitial space between lattice site results in \_\_\_\_\_.
  - The positions occupied by particles in the crystal lattice are called \_\_\_\_\_.
  - $\text{Nb}_3\text{Sn}$  is an example of \_\_\_\_\_ superconductor.
  - The effect of ejecting out the flux lines of magnetic field is known as \_\_\_\_\_.

- C.** Select and write the appropriate answer. (Any five) **5**
- a.** The position of actinides in periodic table is -----
- a. 3<sup>rd</sup> group and 7<sup>th</sup> Period. b. 3<sup>rd</sup> group and 3<sup>rd</sup> Period.  
 c. 7<sup>th</sup> group and 3<sup>rd</sup> Period. d. 8<sup>th</sup> group and 5<sup>th</sup> Period
- b.** The electronic configuration of lutetium [atomic number =71] is-----
- a. [Xe] 4f<sup>7</sup> 5d<sup>1</sup> 6s<sup>2</sup>. b. [Rn] 4f<sup>0</sup> 5d<sup>1</sup> 6s<sup>2</sup>.  
 c. [Xe] 4f<sup>14</sup> 5d<sup>1</sup> 6s<sup>2</sup>. d. [Ar] 4f<sup>0</sup> 5d<sup>0</sup> 6s<sup>2</sup>.
- c.** The anomalous oxidation states of lanthanides are -----
- a. 1+, 2+. b. 1+, 3+. c. 4+, 5+. d. 2+, 4+.
- d.** The colourless lanthanide ion among the following is -----
- a. La<sup>3+</sup>. b. Pr<sup>3+</sup>. c. Nd<sup>3+</sup>. d. Sm<sup>3+</sup>.
- e.** The cracking of mineral in extraction of lanthanides from monazite ore involves removal of -----
- a. thoria (ThO<sub>2</sub>). b. aluminium. c. potassium. d. chromium.
- f.** The main ores of Lanthanides are -----.
- a. Bauxite b. Alumina c. Monazite d. Cryolite
- g.** An average separation factor achieved for adjacent lanthanides in 15.8 M nitric acid is -----.
- a. 2.0 b. 1.5 c. 2.0 d. 3.5
- h.** The lanthanide compound used as catalysts in hydrogenation and oxidation reactions is-----.
- a. Lanthanum oxides. b. Promethium nitrate.  
 c. Samarium oxalate. d. Neodymium sulphate.

- D.** Match the column: (Any five) **5**
- |  |   |
|--|---|
| <p><b>a.</b> Group 17</p> <p><b>b.</b> HOCl</p> <p><b>c.</b> Liquid NH<sub>3</sub></p> <p><b>d.</b> BF<sub>3</sub></p> <p><b>e.</b> Amide in liq. NH<sub>3</sub></p> <p><b>f.</b> AB<sub>4</sub>E<sub>2</sub></p> <p><b>g.</b> Soft rubber like mass</p> | <p><b>i.</b> Strong oxidising agent</p> <p><b>ii.</b> ns<sup>1</sup>, np<sup>6</sup></p> <p><b>iii.</b> Octahedral</p> <p><b>iv.</b> Base</p> <p><b>v.</b> ns<sup>2</sup>, np<sup>5</sup></p> <p><b>vi.</b> Plastic sulphur</p> <p><b>vii.</b> Poor solvent for ionic compound</p> <p><b>viii.</b> Bent 'T' shape</p> |
|--|---|
-

[Time: 3 Hours]

[Total marks: 100]

**N.B. : (1) All questions are compulsory.****(2) Figures to the right indicate full marks.****(3) Use of logarithmic table/non-programmable calculator is allowed.**Physical constants:

$$N=6.022 \times 10^{23}$$

$$h=6.626 \times 10^{-34} \text{ J s}$$

$$F=96500 \text{ Coulombs}$$

$$k=1.38 \times 10^{-23} \text{ K}^{-1}$$

$$R=8.314 \text{ J/K/mol}$$

$$1 \text{ a.m.u.} = 1.66 \times 10^{-27} \text{ kg} = 931 \text{ MeV}$$

$$c= 3 \times 10^8 \text{ m/s}$$

$$H=1 \text{ a.m.u.}$$

$$\pi= 3.142$$

$$Cl = 35.5 \text{ a.m.u.}$$

**1. Attempt any four of the following:**

- A.** Explain the structure of  $\text{CO}_2$  and  $\text{SO}_2$  on the basis of dipole moment. **5**
- B.** Derive an expression for frequency separation of lines in the rotational spectrum of a diatomic molecule. **5**
- C.** Explain P and R branch lines in rotational –vibrational spectra. **5**
- D.** What is Raman effect and Raman shift? Explain Stokes and anti-Stokes lines. **5**
- E.** The frequency separation in rotational spectra of  $\text{HCl}$  is  $1100 \text{ m}^{-1}$ . Calculate the bond length. **5**
- F.** Define zero point energy. The vibrational frequency of a molecule is  $5.1 \times 10^5 \text{ m}^{-1}$ . Calculate the zero point energy of the molecule. **5**

**2. Attempt any four of the following:**

- A.** Derive the expression for the relationship between the freezing point of depression of a solution and the mole fraction of the dissolved solute. **5**
- B.** Describe the Beckmann method and Rast method to determine depression in freezing point. **5**
- C.** Define van't Hoff factor. What is significance? How is it useful in the study of association or dissociation of electrolytes in solution? **5**
- D.** What is fast reaction? Describe the stop flow method to study the kinetics of fast reaction. **5**
- E.** Explain the following terms. **5**
- i) Activation energy
- ii) Molecular activation
- F.** Calculate the boiling point of a solution containing 1.04 g of anthracene ( $M = 176$ ) in 70 g Chloroform. The boiling point of pure chloroform is  $334.2 \text{ K}$  and its ebullioscopic constant is  $3.85 \text{ K kg mol}^{-1}$  **5**

3. Attempt **any four** of the following:
- A. What is a scintillation counter? Describe its working with particular reference to the Photomultiplier tube. **5**
- B. Explain how radioisotopes are used as tracers in reaction mechanism of Photosynthesis and structure determination. **5**
- C. Explain with the help of a labelled diagram, the principle and working of a nuclear reactor. **5**
- D. What is a scintillation counter? Describe its working with particular reference to the Photomultiplier tube. **5**
- E. Calculate Q – value for the following nuclear reaction – **5**  
 $^{235}\text{U} + {}^1_0\text{n} \rightarrow {}^{141}\text{Ba} + {}^{92}\text{Kr} + 3 {}^1_0\text{n}$   
 Given isotopic masses in a.m.u. –  
 U = 235.1175                      Kr = 91.9264  
 Ba = 140.9527                      n = 1.0089
- F. The activity of a radioelement falls to half its initial value in 5 days. **5**  
 Calculate (i) decay constant and (ii) the time for the activity to fall to  $1/10^{\text{th}}$  its original value.
4. Attempt **any four** of the following:
- A. Discuss with the example, theory of preferential adsorption accounting for charge on colloids. **5**
- B. What is meant by electrokinetic potential? List the four electrokinetic effects associated with colloids? **5**
- C. Write a short note on Donnan membrane equilibrium. **5**
- D. What are surfactants? Give applications of surfactants. **5**
- E. State the postulates of Langmuir adsorption isotherm. **5**
- F.  $15 \times 10^{-3} \text{ dm}^3$  of nitrogen is adsorbed by 1 g of powder copper at S. T. P. **5**  
 Calculate its surface area. (1 molecule of  $\text{N}_2$  occupies  $1.7 \times 10^{-19} \text{ m}^2$  surface.)
5. **Answer the following:**
- A. State whether the following statements are **true or false (Any five)** **5**
- Unit of dipole moment is kg.
  - Water has a linear structure.
  - Rotational spectra is observed in HBr molecule.
  - For linear molecules degrees of freedom is  $(3n-5)$ .
  - In stretching vibrations, the bond length changes.
  - Scissoring vibrations are in-plane vibrations.
  - Twisting vibrations are out-of-plane vibrations.
  - Raman spectra is obtained due to scattering of radiation.
- B. Fill in the blank with appropriate words given in the bracket (**Any five**) **5**
- [ ----- ]
- is not of the colligative property.  
 [ vapour pressure , Elevation of boiling point ,  
 Depression of frizzling point , Osmotic pressure ]

- b. The relative lowering of vapour pressure is equal to the -----of the solute in a solution  
[ fraction , mole fraction , normality, molarity]
- c. A semipermeable membrane is permeable to-----molecule only.  
[ solvent , solute , solution , collides ]
- d. A Beckmann thermometer is a ----- thermometer.  
[ regular , normal , differential , fractional ]
- e. The van't Hoff equation for osmotic pressure is valid for ----- solution.  
[ concentrated , saturated , dilute , distilled water ]
- f. The rate of reaction increased by a factor of ----- for 100 rise in temperature.  
[ two , one , zero , ten ]
- g. Kinetics of photochemical reactions are studied using ----- method.  
[ stop flow , flash , photolysis , flash photolysis ]

C. Select and write the appropriate answer. (Any five)

5

- a. Which type of radiation is the least penetrating?  
a) alpha  
b) beta  
c) gamma  
d) neutron
- b. Nuclear fission always  
a) has Very less energy released.  
b) is an energetically favorable process for heavy atoms.  
c) a neutron is split into a neutron and an electron.  
d) are non spontaneous.
- c. Which particle is absorbed when  $^{58}\text{Fe} \rightarrow ^{59}\text{Fe}$ ?  
 $? + ^{58}\text{Fe} \rightarrow ^{59}\text{Fe}$   
a)  $\alpha$  particle  
b) electron  
c) neutron  
d) proton
- d. Name the coolant used in the nuclear reactor?  
a) Plutonium  
b) Thorium  
c) Graphite  
d) Boron
- e. The atomic number increases by one during what type of radioactive decay?  
a) alpha  
b) beta  
c) gamma  
d) positron

- f.  $\alpha$  particles are identical with
- Helium nucleus
  - Hydrogen nucleus
  - Electron
  - proton
- g. These have an unstable nucleus and undergoes radioactive decay.
- Radioisotopes
  - Isotones
  - Isobars
  - isotopes
- h. Which isotope of Uranium has the capacity to sustain the chain reaction?
- U-230
  - U-235
  - U-245
  - U-225

**D. Match the column:**

(Any five) 5

- |  |                                    |
|--|------------------------------------|
| a. Freundlich Adsorption Isotherm        | i. Smoke                           |
| b. Langmuir Adsorption Isotherm          | ii. Foam                           |
| c. Adsorbent                             | iii. Gelatin                       |
| d. Aerosol solid                         | iv. $\frac{x}{m} = kP^{1/n}$       |
| e. Lyophobic sol                         | v. Gold sol                        |
| f. Emulsifier                            | vi. $\theta = \frac{K_p}{1 + K_p}$ |
| g. $\text{AgNO}_3$ added to excess of KI | vii. Silica gel                    |
|  | viii. Surfactant                   |
|  | ix. Negatively charged sols        |
|  | x. Positively charged sols         |

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