

[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.****Physical Constants:**

$$N = 6.023 \times 10^{23}$$

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

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

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

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

$$\text{Charge on electron} = 1.66 \times 10^{-19} \text{ C}$$

$$\text{Mass of an electron} = 9.1 \times 10^{-31} \text{ kg}$$

$$2.303RT / F = 0.05916 \text{ at } 298\text{K}$$

$$\pi = 3.142$$

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

- A. Write a note on liquid junction potential. Give functions of salt bridge. 5
- B. What are galvanic cells? Classify them. 5
- C. Derive an expression for the emf of electrolyte concentration cell with transference reversible to cation. 5
- D. Derive an expression for the emf of electrode concentration cell reversible to anion. 5
- E. Explain the terms i) Polarization ii) Decomposition potential 5
- F. Define overvoltage. In electrolysis of 2 N sulfuric acid, the hydrogen overvoltage at lead cathode was found to be 0.64 V at 298 K for a given current density. What will be the hydrogen overvoltage if the current density is increased to twice its present value for the same cathode under same condition. (Given:  $b = 0.12$ ) 5

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

- A. How are polymers classified on the basis of physical properties? 5
- B. Explain the method for determination of molecular weight of polymers. 5
- C. Write a note on curing agents. 5
- D. What are stabilisers? Explain with examples. 5
- E. What is LEP? How are they prepared? 5
- F. Equal weights of polymer molecules each of molecular weight 40,000 g/mol and 50,000 g/mol are mixed. Calculate  $\bar{M}_n$  and  $\bar{M}_w$ . 5

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

- A. What is an operator? How is multiplication of operators carried out? Show that the following pairs of operator commute. 5  
 $\frac{d^2}{dx^2}$  and  $\frac{d}{dx}$  on  $f(x) = \sin x$
- B. What are the salient features of a black body radiation? How does classical theory explain the variation of intensity with respect to Temperature? 5
- C. Explain the Planck's theory of quantisation. 5
- D. The work function of silver metal is 4.7 eV. Calculate the Kinetic energy and velocity of the electron ejected when a radiation of wavelength 300 nm is incident on the silver surface. Will photoelectrons be observed? 5
- E. Explain the Structure of Solar cell with the help of diagram. 5
- F. Explain how Hydrogen be generated by direct electrolysis of water. 5

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

- A. Explain the term nuclear spin in NMR. 5
- B. Explain spin-spin and spin- lattice relaxation in NMR. 5
- C. Explain the principle and fundamental equation of NMR. 5
- D. Explain the principle of ESR spectroscopy. 5
- E. Write a note on ESR spectrometer. 5
- F. Explain the ESR spectra of hydrogen. 5

5. Answer the following:

- A. Select whether the following statements are true or false (**Any five**) 5
  - a. For galvanic cells the value of  $E^\circ_{\text{cell}}$  is always greater than 1.
  - b. In case of concentration cells both half cells are chemically identical with differing in concentrations.
  - c. The value of the hydrogen overvoltage for lead cathode is less than platinum cathode under same conditions.
  - d. Liquid junction potential cannot be removed completely, but it can be minimised.
  - e. For sulfuric acid the activity can be represented as  $a = (m \cdot \gamma_{\pm})^2$
  - f. For ideal solution, the value of activity coefficient is always equal to one.
  - g. With change in pH of solution the value of overvoltage remains same.
  - h. The cell represented as,  $\text{Zn} / \text{ZnSO}_4 \parallel \text{AgNO}_3 / \text{Ag}$  is an example of chemical cell.
- B. Fill in the blank with appropriate words given in the bracket. (**Any five**) 5
  - a. -----is a linear polymer.  
(Polyester, glycogen, bakelite, starch)
  - b. ----- is a thermoplastic polymer.  
(PVC, starch, nylon, cellophane)
  - c. The repeated unit in a polymer is called-----  
(Monomer, elastomer, fibres, resin)
  - d. ----- is used as adhesives.  
(Liquid resin, fibres, rubber, nylon)

- e. Polymers having long range elasticity are called-----  
(Elastomers, gum, nylon, protein)
- f. Weight average molar mass is denoted as-----  
( $M_w$ ,  $M_n$ ,  $M_z$ ,  $M_v$ )
- g. LED is made of -----material.  
(semi-conductor, nylon, terylene, rubber)

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

5

- a. Newton's law of mechanics is the backbone of
  - i. Quantum mechanics
  - ii. Classical mechanics
  - iii. Wave mechanics
  - iv. Body mechanics
- b. Total radiation emitted per unit surface area is called.
  - i. Energy
  - ii. Intensity
  - iii. Power
  - iv. Surface energy
- c. The waves which do not travel in vacuum.
  - i. Matter
  - ii. Translational
  - iii. Rotational
  - iv. vibrational
- d. A -wave function contains information about
  - i. Volume occupied by a particle.
  - ii. location and motion of particle
  - iii. area occupied by the particle.
  - iv. shape of the particle
- e. Schrodinger equation is a
  - i. First order differential equation.
  - ii. Second order differential equation.
  - iii. Partial differential equation.
  - iv. Nonlinear differential equation.
- f. Hamiltonian is given by.
  - i. Kinetic Energy
  - ii. Potential energy
  - iii. Sum of kinetic and potential energy
  - iv. momentum
- g. One of the ways to tap solar energy is
  - i. stark effect
  - ii. Photovoltaic effect
  - iii. Einstein effect
  - iv. Compton effect
- h. The band possessed by valence electrons is called
  - i. Valence band
  - ii. Conduction band
  - iii. Forbidden energy gap.
  - iv. Equivalent band

**D.**

Match the column (Any five )

**5**

- |    |                                  |       |                             |
|----|----------------------------------|-------|-----------------------------|
| a. | ${}^6\text{C}^{13}$              | i.    | $\omega_0$                  |
| b. | ${}^7\text{N}^{14}$              | ii.   | Solvent in NMR spectrometer |
| c. | Angular velocity                 | iii.  | $I=0$                       |
| d. | ${}^6\text{C}^{12}$              | iv.   | $I=1$                       |
| e. | $\text{CCl}_4$                   | v.    | ESR spectra                 |
| f. | Hyperfine splitting of deuterium | vi.   | $I=1/2$                     |
| g. | $\gamma$                         | vii.  | 2 peaks                     |
|    |                                  | viii. | 3 peaks                     |
|    |                                  | ix.   | Gyromagnetic ratio          |
|    |                                  | x.    | Spin quantum number         |

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