

[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
- For galvanic cells the value of E°_{cell} is always greater than 1.
 - In case of concentration cells both half cells are chemically identical with differing in concentrations.
 - The value of the hydrogen overvoltage for lead cathode is less than platinum cathode under same conditions.
 - Liquid junction potential cannot be removed completely, but it can be minimised.
 - For sulfuric acid the activity can be represented as $a = (m \cdot \gamma_{\pm})^2$
 - For ideal solution, the value of activity coefficient is always equal to one.
 - With change in pH of solution the value of overvoltage remains same.
 - 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
- is a linear polymer.
(Polyester, glycogen, bakelite, starch)
 - is a thermoplastic polymer.
(PVC, starch, nylon, cellophane)
 - The repeated unit in a polymer is called-----
(Monomer, elastomer, fibres, resin)
 - 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. ω_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. CCl_4 | v. ESR spectra |
| f. Hyperfine splitting of deuterium | vi. $I=1/2$ |
| g. γ | vii. 2 peaks |
| | viii. 3 peaks |
| | ix. Gyromagnetic ratio |
| | x. Spin quantum number |
