(**3Hours**)   [**Total Marks: 100**]

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

Constants	
Avogadro's Number N = 6.023×10^{23}	Charge on electron = 1.66×10^{-19}C
Boltzmann constant k = 1.38×10^{-23}J/K	Mass of an electron = 9.1×10^{-31}Kg
Faraday constant F = 96500 coulombs	
Gas constant R = 8.314 J/mol/K	$\Pi = 3.142$
Planck constant h = 6.625×10^{-34}Js	
Speed of light in vacuum c = 3.0×10^8 m/s	$\dfrac{2.303\ RT}{F} = 0.0592$ at 298 K

Q1   **Answer the following (<u>any four</u>)**

A   Derive expression for the cell emf for concentration cell with transference   **(5)**
reversible to cation.

B   Set up the electrode concentration cell without transference reversible to cation   **(5)**
using HCl electrolyte and obtain an expression for its emf.

C   Define: Overvoltage. How is it determined experimentally?   **(5)**

D   A solution of silver nitrate with concentration of 0.1 mole per dm^3 is   **(5)**
electrolysed with a platinum cathode. Predict whether hydrogen gas will be
liberated at cathode or silver will get deposited.
Assume overvoltage of hydrogen on platinum to be equal to zero and
$E^0_{Ag/Ag+} = 0.799$ V.

E   The emf of the following cell with transference is 0.0 20 volt. Calculate the   **(5)**
transport number of cation and anion.

$^{(-)}$ Ag (s) – AgCI(s)│HCI (a_1 =0.017)│ HCI (a_2 =0.008)│ AgCI (s) – Ag (s) $^{(+)}$

F   Define activity coefficient. Obtain the expressions for activities of uni -   **(5)**
bivalent and uni - trivalent electrolytes.

Q2   **Answer the following (<u>any four</u>)**

A   a) Define : i) Polymerization ii) Degree of polymerisation   **(2)**

b) The intrinsic viscosity of a solution of polymer in an organic solvent is   **(3)**
1.82dl g^{-1} at 298K. Calculate the Molar mass of the polymer
(Given K= 5.1×10^{-4} α =0.73).

B   What are light emitting polymers? Give their applications.   **(5)**

C   Classify the polymers on the basis of their source and structure with suitable   **(5)**
examples.

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D   a) Explain the term curing agents. What are their types? **(3)**

b) What are antioxidants? How are they classified? **(2)**

E   Describe the method of determination of molecular weight of polymer using Ostwald's viscometer. **(5)**

F   A polymer sample has 100g, 200g and 300g of polymers of molecular weight 10,000, 20,000 and 30000 respectively. Calculate (i) $\overline{Mn}$ (ii) $\overline{Mw}$ **(5)**

Q3   **Answer the following (<u>any four</u>)**

A   State de-Broglie's equation. Prove that de – Broglie wavelength of electron is given by $\lambda = h / \sqrt{2meV}$, where m is the mass of electron accelerated by a potential V. **(5)**

B   State the drawbacks of classical mechanics. Explain any one in detail. **(5)**

C   Define commutative and non commutative operators. State whether the following operators are commutative or non commutative? **(5)**
   i) $\hat{A} = d/dx$ and $\hat{B} = x^2$ on function $f(x) = e^{-2x}$
   ii) $\hat{A} = d/dx$ and $\hat{B} = \int$ on function $f(x) = \sin 5x$

D   Define the following: **(5)**
   i)Valence band ii) Conduction band iii) Forbidden energy gap
   iv) Conductors v) Insulators .

E   Explain the construction and working of Bacon's $H_2 – O_2$ fuel cell. **(5)**

F   State Heisenberg's uncertainty principle. Calculate uncertainty in the position of electron weighing 9.1×10^{-31} kg and moving with 1/5 [th] of velocity of light, if the uncertainty in momentum is 2.5%. **(5)**

Q4   **Answer the following (<u>any four</u>):**

A   Explain the working of NMR Spectrometer with the help of a diagram. **(5)**

B   Explain relaxation processes in NMR spectroscopy? Why is relaxation process important? **(5)**

C   What is Larmor's Precession? Explain in detail. **(5)**

D   With the help of schematic diagram describe the construction and working of E.S.R. Spectrometer **(5)**

E   What is hyperfine structure? How does it arise? **(5)**

F   How does ESR spectrum of hydrogen differ from deuterium? **(5)**

Q5A   **Fill in the blanks with the correct option provided (<u>any five</u>)** **(5)**
   a)   For electrolytes of the same type the values of mean ionic activity coefficient are ------ .
   i) Nearly the same   ii) Different   iii) Zero
   b) $ZnCl_2$ is an example of------.
   i)Uni - univalent electrolyte   ii) bi-bivalent electrolyte
   iii) bi univalent electrolyte

c) In a ------ the electrical energy available for doing work is less than free energy decrease.
   i) reversible cell   ii) irreversible cell   iii) electrolytic cell

d) For concentration cell, E^o_{cell} is -------.
   i) zero   ii) negative   iii) one

e) Saturated solution of KCl is used in making salt bridge because
   i) velocity of K^+ and CI^- is nearly same   ii) velocity of K^+ and CI^- is different.
   iii) KCI is soluble in water.

f) Tafel proposed, the theory of ---------.
   i) electrolytic dissociation   ii) hydrogen overvoltage   iii) both (i) and (ii)

g) In concentration cell two electrodes are chemically --------- .
   i) identical   ii) different   iii) inert

h) Reduction of metal ion leads to deposition of the metal on the -------------- .
   i) anode   ii) cathode   iii) reference electrode

B   **State whether the following statements are <u>TRUE or FALSE</u> (<u>any five</u>).**   **(5)**

a) Vulcanized rubber is an example of thermosetting plastic.

b) Thermoplastic polymers cannot be recycled.

c) Antistatic agents are hydroscopic chemicals.

d) For synthetic polymers $\overline{Mw} > \overline{Mn}$.

e) The degree of polymerization is a measure of weight of polymer.

f) Methyl cellulose is a semi synthetic polymer.

g) Epoxy resins are thermosetting resins.

C   **Match the following (<u>any five</u>)**   **(5)**

Column A	Column B
1. Einstein	a. Finite valued
2. Quanta	b. Range of energy of an electron
3. Compton	c. Quantisation of radiation
4. Dynamic variable	d. p-n junction
5. Planck	e. Discrete packets of energy
6. State function	f. Momentum
7. Depletion layer	g. Scattering of electrons
8. Energy Band	h. Transverse waves
	i. Photoelectric effect
	j. Infinite valued

D   **State whether the following statements are <u>TRUE or FALSE.</u> (<u>any five</u>)   (5)**

a) ESR spectroscopy is useful in the study of metal complexes

b) The mutual exchange of spin in precessing nuclei gives rise to spin-spin relaxation

c) The NMR spectrum cannot be recorded with zero spin nuclei.

d) The hyperfine structure of the ESR spectrum is due to nucleus-nucleus interaction

e)   With the process of transfer of hydrogen nucleus to higher energy state by absorption of radiation is called excitation

f) A nucleus with zero spin interacts with the applied magnetic field.

g) For $^{12}_{6}C$ the total spin of the nucleus is one.

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