(**REVISED COURSE 2018**)

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

Q1. Answer the following (**any four**)

A. Define dipole moment. Explain how dipole moment is useful in deciding geometry of **(5)**
i) CH_4 molecule ii) NH_3 molecule.

B. Derive expression for the wave numbers of line in the rotational spectrum of a diatomic molecule. **(5)**

C. What is a vibrational-rotational spectrum? Write any four characteristics of vibrational – rotational spectrum of a diatomic molecule. **(5)**

D. What are the three kinds of scattered beams of radiation in Raman spectrum? Explain the quantum theory of Raman spectra. **(5)**

E. The frequency separation of successive lines in the rotational spectrum of $^{1}H^{35}Cl$ is $1.09 \times 10^{5}\ m^{-1}$, while that of $*H\ ^{35}Cl$ is $2.12 \times 10^{5}\ m^{-1}$. Calculate isotopic mass of *H. **(5)**

F. A substance was irradiated with visible radiation of wavelength 5 x 10^{-7}m. The first stokes line appeared at 6 x 10^{-7}m. Calculate the Raman shift and energy change for the transition. **(5)**

Q2. Answer the following (**any four**)

A. Define molal elevation constant. **(5)**
0.75g of solute was dissolved in 90g of benzene at 298K. The solution had a boiling point0.30K higher than that of benzene. If $K_b$for benzene is 2.53Kmol^{-1}kg, calculate the molar mass of the solute.

B. State Raoult's law. **(5)**
Describe the Ostwald and Walker's method to determine vapour pressure.

C. Derive thermodynamically the relation between the freezing point depression of a dilute solution of non-volatile solute and the mole fraction of the dissolved solute. **(5)**

D. What is reverse osmosis? Give its applications (any two) **(5)**

E. Explain the Lindeman's unimolecular theory of reaction rate. **(5)**

F. With the help of suitable diagram explain flash photolys is technique for studying kinetics of fast reactions. **(5)**

Q3. Answer the following (**any four**)

A. Explain the construction, principle and working of Geiger muller counter. **(5)**

B. Discuss the use of radioisotope as tracers in Photosynthesis and hydrolysis of esters. **(5)**

C. Discuss the factors controlling nuclear fission process. **(5)**

D. What is a nuclear power reactor? Explain the basic components of a power reactor. **(5)**

E. Calculate the Q value and threshold energy of the following nuclear reactions. **(5)**

$$O^{18} + H^1 \rightarrow F^{18} + n^1$$

Given

O^{18} = 17.9992amu

F^{18} = 18.0010amu

H^1 = 1.0078amu

n^1 = 1.0089amu

F. Define half life period. A wooden chair and a freshly cut tree gives 3.8 and 7.6 counts $min^{-1}g^{-1}$ of carbon whose half life time is 5760 years. Calculate the age of the wooden chair. **(5)**

Q4 Answer the following (**any four**)

A. What is electrophoresis? How it is studied experimentally? **(5)**

B. Explain Helmholtz and Stern's concept of electrical double layer. **(5)**

C. Give an account of colloidal electrolytes. **(5)**

D. Define : i) adsorbate ii) adsorbent. **(5)**
Assuming that the adsorption of hydrogen gas forms a complete monolayer on the surface of charcoal, the volume of hydrogen reduced to S.T.P. was found to be 1.80cm^3 per gm of the adsorbent. Calculate the surface area of adsorbent if area occupied by one hydrogen molecule is 15.8 X 10^{-20} m^{-2}

E. Discuss any two methods by which colloids acquire electric charge. **(5)**

F. Give application of surfactants in i) food industry ii) pesticide formulation **(5)**

Q5

A. **Fill in the blanks with the correct option provided (<u>any five</u>)** **(5)**

1. The dipole moment of HCl molecule is ---------- HF molecule.
(a) greater than (b) lesser than (c) same as

2. The molecular energies can be arranged as ----------.
(a) $E_{ele}>E_{vib}>E_{rot}$ (b) $E_{ele}>E_{rot}>E_{vib}>$ (c) $E_{vib}>E_{ele}>E_{rot}$

3. Raman shift is ---------- for stokes line.
(a) negative (b) positive (c) zero

4. Scissoring vibrations are ----------
(a) In plane vibration. (b) out of plane vibrations (c) coupled vibrations

5. A linear molecule like XeF_2 will show---------- vibrations.
(a) 4 (b) 5 (c) 9

6. UV – Vis are associated with----------transitions
(a)vibrational (b) rotational (c) Electronic spectra

7. Rayleigh scattering takes place when----------.
(a)$\lambda_i > \lambda_s$ (b) $\lambda_i = \lambda_s$ $_i$ (c) $\lambda_i < \lambda_s$

8. The unit for moment of inertia is ----------.
(a)Kgm^2 (b) Kgm (c) Kg/m^2

B State whether the statement is **TRUE or FALSE** (**any five**). **(5)**

1. A semipermeable membrane is permeable to solute molecules.

2. According to Raoult's law relative lowering of vapour pressure for a solution is equal to mole fraction of solute.

3. For slow reactions probability factor P<1

4. Addition of a non-volatile solute to a solvent will lead to an increase in freezing point.

5. Liquids with weak intermolecular forces are less volatile.

6. The rate of most of the reactions increase by factor of two for 10 degree rise in temperature.

7. According to collision theory, the colliding molecules possess translational motion only.

C Match the following (**any five**) **(5)**

Column A	Column B
1. Chain reaction	a. not affected by magnetic field
2. Stellar bodies	b. reaction proceeds at steady rate
3. γ rays	c. minimum energy for reaction to proceed.
4. Multiplication factor =1	d thermonuclear reactions
5. Threshold energy	e. release of positrons
6.Artificial radioactivity	f. secondary neutrons
7.Radioactive dating	g. C^{12}
8.Dead time	h. Primary neutrons
	i. C^{14}
	j. no response from the counter

D State whether the statement is **TRUE or FALSE** (**any five**). **(5)**

1. Lyophilic sols are less stable than lyophobic sols.

2. Langmuir's isotherm fails at high pressure.

3. Charcoal is a good adsorbent for permanent gases.

4. Fog is a colloidal system of liquid in gas.

5. The movement of dispersion medium under the influence of an electric field is called electro-osmosis.

6. Chemisorption is an irreversible process.

7. Gel is a system in which liquid is a dispersed phase and solid is the dispersion medium.

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