M. SC. (ANALYTICAL CHEMISTRY) / M. SC. (ORGANIC CHEMISTRY) /M. SC. (INORGANIC CHEMISTRY) SEM-II (CHOICE BASED CREDIT & GRADE SYSTEM) WINTER -2017

SUBJECT: PHYSICAL CHEMISTRY-II

Day : Monday
Date : 23/10/2017

Time : 03.00 PM TO 06.00 PM
Max. Marks : 60.

W-2017-0770

N.B.:

1) All questions are **COMPULSORY.**
2) Both the sections should be written in **SEPARATE** answer books.
3) Figures to the **RIGHT** indicate full marks.
4) Draw neat labeled diagrams **WHEREVER** necessary.
5) Use of logarithmic tables/ calculator is **ALLOWED.**
6) Graph papers will be provided.

Physico-Chemical Constants

1.	Avogadro Number	$N = 6.022 \times 10^{23}$ mol^{-1}
2.	Boltzmann Constant	$k = 1.38 \times 10^{-16}$ erg K^{-1} molecule^{-1}
		$= 1.38 \times 10^{-23}$ J K^{-1} molecule^{-1}
3.	Planck Constant	$h = 6.626 \times 10^{-27}$ erg s
		$= 6.626 \times 10^{-34}$ J s
4.	Electronic Charge	$e = 4.803 \times 10^{-10}$ esu
		$= 1.602 \times 10^{-19}$ C
5.	1 eV	$= 23.06$ k cal mol^{-1}
		$= 1.602 \times 10^{-12}$ erg
		$= 8065.5$ cm^{-1}
6.	Gas Constant	$R = 8.314 \times 10^{7}$ erg K^{-1} mol^{-1}
		$= 8.314$ J K^{-1} mol^{-1}
		$= 1.987$ cal K^{-1} mol^{-1}
7.	Faraday Constant	F = 96487 C equiv^{-1}
8.	Speed of light	$c = 2.997 \times 10^{10}$ cm s^{-1}
		$= 2.997 \times 10^{8}$ m s^{-1}
9.	1 cal	$= 4.184 \times 10^{7}$ erg
		$= 4.184$ J
10.	1 amu	$= 1.673 \times 10^{-27}$ kg
11.	Bohr magneton	$\beta_e = 9.274 \times 10^{-24}$ J T^{-1}
12.	Nuclear magneton	$\beta_n = 5.051 \times 10^{-27}$ J T^{-1}
13.	Mass of an electron	$m_e = 9.11 \times 10^{-31}$ kg
14.	Mass of proton	1.672×10^{-27} kg

P.T.O.

SECTION-I

Q.1 Attempt any **THREE** of the following: **(15)**

a) What do you understand by Rigid Diatomic molecule with respect to Microwave spectroscopy? The expression for E_J, the rotational energy level is $E_J = \frac{h^2}{8\pi^2 I} J(J+1)$ joules. Explain in detail each term involved in the equation.

b) Isotopic substitution in diatomic molecules has effect on the rotational energy levels. How does this effect can estimate the isotopic mass accurately?

c) The vibration rotation spectrum of carbon monoxide show PR contour under low resolution. Maximum intensity is given by

$$\bar{\nu}_{\text{max-intensity}} = \bar{\omega}_0 \pm 2B\left(\sqrt{kT/2Bhc} + \frac{1}{2}\right).$$

Derive $B \approx hc(\Delta\bar{\nu})^2 / 8kT \text{ cm}^{-1}$ where $\Delta\bar{\nu}$ is separation between two maxima.

d) Distinguish between Reyleigh scattering and Raman scattering. Discuss briefly the quantum theory of Raman effect.

e) The significant component of Raman spectroscopy instrument is exciting source. Discuss the characteristics of two different exciting sources (i) spiral mercury lamp (ii) laser beam.

Q.2 **A)** Attempt any **TWO** of the following: **(10)**

a) State the Franck – Condon principle. How the principle is applied to intensity of lines in the vibrational electronic spectra of the molecules?

b) Sketch a typical Fortrat diagram with B′ < B″. Explain the concept of band head and give the expression for finding the band head.

c) Give the applications of Mossbauer spectroscopy in brief.

B) Solve any **ONE** of the following: **(05)**

a) Find out the relative population in the state J = 1 when B = 2 cm^{-1} and room temperature is 300 K.

b) The λ value of radiation absorbed is 15 μm. Express this value in terms energy change involved in the process. Find the value in joules per mole.

SECTION-II

Q.3 Attempt any **THREE** of the following: **(15)**

a) Define the different units used for measuring the radiation dose. What are the requirements of a good chemical dosimeter?

b) Enlist the different types of scintillators. Explain the construction and working of scintillation counter.

c) Explain the use of radio tracer to determine the diffusion coefficient of a substance.

d) Discuss the various methods to form the hydrated electron. Draw the neat structure of it and give its physical and chemical properties.

e) Write a short note on "Compton scattering."

Q.4 **A)** Attempt any **TWO** of the following: **(10)**

a) Discuss the primary effects due to passage of charged particles through matter. Explain the terms tracks, spurs and del-rays.

b) Explain the use of radioactive sulphur in determining the surface area of $BaSO_4$ precipitate.

c) Discuss the linear, mass, atomic and electronic absorption coefficients.

B) Solve any **ONE** of the following: **(05)**

a) $e^{\mu} = 0.211$ barn per electron and density of methanol is 0.740 g cm^{-3}. Find out the atomic and linear absorption coefficient of methanol.

b) Find the dose absorbed by BaC_2O_4 in four hours when exposed to ^{60}Co radiation in terms of rads. If the dose absorbed by Fricke solution at the same position is 3.45 Gy/ min
(Given: Z of Ba = 26, C =06, O = 08, A of Ba = 53, C = 12, O = 16)

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