MASTER OF SCIENCE (CHEMISTRY) (CBCS - 2018 COURSE)
M.Sc. (Chemistry) Sem-II AC : WINTER- 2022
SUBJECT : PHYSICAL CHEMISTRY - II

Day : Wednesday | Time : 10:00 AM-01:00 PM

Date : 28-12-2022 | **W-20144-2022** | Max. Marks : 60

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 table / 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) Explain the chemical shift observed in Mossbauer spectroscopy.
b) What do you mean by 'hyperfine splitting' observed in case of electronic spin resonance spectroscopy?
c) Explain fortrat diagram.
d) Draw all the vibrational modes of water (H_2O) observed in terms polarizability ellipsoid in Raman spectra.
e) Describe simple Harmonic oscillator.

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

i) State the Frank-Condon principle and explain the intensity of vibrational – electronic spectra.
ii) Give a brief classification of molecule depending upon the moment of inertia with example.
iii) Explain the rule of mutual exclusion.

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

i) The pure rotational spectrum of gaseous HCl consists of a series of equally spaced lines separated by 20.80 cm^{-1}.
Calculate the intermolecular distance of the molecule.
(The atomic masses are: H = 1.673×10^{-27} kg, $^{35}Cl = 58.06 \times 10^{-27}$ kg).

ii) The fundamental vibrational frequency of HCl is 2890 cm^{-1}. Calculate the force constant of this molecule.
The atomic masses are H = 1.673×10^{-27} kg, Cl = 58.06×10^{-27} kg.

SECTION – II

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

a) List the ionic, radical and molecular products of radiolysis of water. How the molecular products are formed?
b) Discuss the primary effects observed due to charged particle interactions with matter.
c) How the radioisotopes is used to determine the solubility of sparingly soluble salt?
d) Discuss the interaction of γ - radiation with matter by photoelectric effect.
e) Explain principle, construction and working of Scintillation counter.

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

i) Discuss the different units used for measuring radiation energy.
ii) Explain Samuel-Magee and Leg-Gray-Platzmann model for radiolysis of water.
iii) How the radioisotopes is used to find the reaction mechanism of fumaric acid by $KMnO_4$.

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

i) Assuming γ - radiation from ^{60}Co interacts mainly by Compton scattering. Calculate dose absorbed in 6 hrs by:
a) Chloroform
b) Bromoform at a position at which the radiation dose measured by a Fricke dosimeter is 4.06 Gy min^{-1}, given $\overline{Z/A}$ for the Fricke solution is 0.553.

ii) The ^{14}C to ^{12}C ratio in a sample of wood is 20 % as that in atmosphere. Calculate the age of wood. (Half-life period of ^{14}C is 5730 yrs.)

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