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

Day : Tuesday
Date : 12/7/2022

S-20144-2022

Time : 03:00 PM-06:00 PM
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 effect of Isotopic substitution on rotational spectra.

b) What is predissociation? Give diagramatic illustration of the appearance of predissociation during transition.

c) Discuss a typical experimental set up used for the study of Raman spectroscopy and explain Raman spectrum.

d) Explain quadrupole effect of Mossbauer spectroscopy.

e) Elaborate on Fortrat diagram.

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

a) State and explain the rule of mutual exclusion and its converse.

b) Distinguish between Raman and IR spectroscopy.

c) What do you understand by Born-oppenheimer approximation of electronic spectroscopy of molecules? How vibrational coarse structure is observed for electronic spectroscopy.

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

a) The pure rotational spectrum of gaseous HCl contains a series of equally spaced lines separated by 20.80 cm^{-1}. Calculate the internuclear distance of the molecule. The atomic masses of H and Cl are 1.673×10^{-27} kg and 58×10^{-27} kg respectively.

b) Calculate the force constant for the bond in HCl from the fact that the fundamental vibration frequency is 8.667×10^{13} s^{-1} (Mass of H = 1.00 and that of Cl = 35.5)

SECTION-II

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

a) Explain the decay kinetics.

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

c) Explain different types of radioactive decay with suitable examples.

d) Discuss the effect of pH and LET on the radical and molecular fields of water radiolysis.

e) What is hydrated electron? Give the structure and properties of hydrated electron.

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

a) Explain carbon dating as an application of radioisotopes.

b) Discuss in detail 'Neutron Activation Analysis'.

c) Write a note on Scintillation counter.

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

a) Calculate the $\overline{Z/A}$ values for:

i) Acetic acid ii) Carbon tetrachloride

b) Find the biologically effective dose in Sieverts and in rem for a radiation dose of 0.6 Gy due to

i) α – particle ii) Thermal Neutrons iii) γ – radiation.

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