M. SC. (Analytical Chemistry) / M. SC. (Organic Chemistry) /M. SC. (Inorganic Chemistry) Sem-II (Choice Based Credit & Grade System) : SUMMER - 2019

SUBJECT : PHYSICAL CHEMISTRY – II

Day : Tuesday
Date : 09/04/2019

S-2019-1172

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

N.B.:

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

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	$= 23.06$ l cal mol^{-1} $= 1.602 \times 10^{-12}$ erg $= 8065.5$ cm^{-1}
6.	Gas Constant	$R = 8.314 \times 10^{7}$ eg 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 is predissociation? Give diagrammatic illustration of the appearance of predissociation during transitions.

b) Discuss the classical theory of Raman effect.

c) Draw and write about the allowed rotational energies of rigid diatomic molecule. Give its selection rule.

d) Explain the vibration – rotation spectrum of CO molecule.

e) What is the principle of electron spin resonance spectroscopy? Explain 'g' factor involved in it.

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

a) What do you understand by Born – Oppenheimer Approximation of electronic spectroscopy of molecules? How vibrational coarse structure is observed for electronic spectroscopy?

b) Discuss the effect of isotopic substitution in case of rotation spectrum of a rigid diatomic molecule.

c) Explain the principle used in Mössbauer spectroscopy.

B) Solve **ANY ONE** of the following: **[05]**

a) A sample was excited by the 4358 Å line of mercury. A Raman line was observed at 4447 Å. Calculate Raman shift in cm^{-1}.

b) The value of $\overline{W}_e$ and x_e in the ground state ($^3\pi_\mu$) and a particular excited state ($^3\pi_g$) of C_2 are

	$\overline{W}_e$	x_e
G.S.	16141.4 cm^{-1}	7.11×10^{-3}
E.S.	1788.2 cm^{-1}	9.19×10^{-3}

Find number of vibrational energy levels below the dissociation limit and hence the dissociation energy of C_2 in both states.

SECTION – II

Q.3 Attempt **ANY THREE** of the following: **[15]**

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

b) What are Scavengers? How were they used in the radiolysis of water?

c) Explain direct isotope dilution analysis.

d) Explain in detail "Neutron Activation Analysis".

e) Explain the Cerenkov radiation phenomenon observed in the charged particles.

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

a) Discuss the effect of pH and LET on the radical and molecular yields of water radiolysis.

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

c) Discuss the working of Fricke dosimeter.

B) Solve **ANY ONE** of the following: **[05]**

a) A ruby weighing 0.5g was irradiated in a neutron flux of 10^{12} n cm^{-2} s^{-1} for exactly 24 hrs and ^{51}Cr activity (τ = 27.7 days) counted immediately thereafter. It was found to give 35,000 c s^{-1}. Given:
i) σ for ^{50}Cr = 15.9 b **ii)** counting efficiency = 10%
iii) ^{50}Cr content of natural chromium = 4.35%. Find the chromium content of the ruby.

b) Calculate the $\overline{Z/A}$ values for:
i) acetic acid **ii)** Carbon tetrachloride

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