

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

P.T.O.

SECTION – I

- Q.1** Attempt **ANY THREE** of the following: [15]
- What is predissociation? Give diagrammatic illustration of the appearance of predissociation during transitions.
 - Discuss the classical theory of Raman effect.
 - Draw and write about the allowed rotational energies of rigid diatomic molecule. Give its selection rule.
 - Explain the vibration – rotation spectrum of CO molecule.
 - 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]
- What do you understand by Born – Oppenheimer Approximation of electronic spectroscopy of molecules? How vibrational coarse structure is observed for electronic spectroscopy?
 - Discuss the effect of isotopic substitution in case of rotation spectrum of a rigid diatomic molecule.
 - Explain the principle used in Mössbauer spectroscopy.

- B)** Solve **ANY ONE** of the following: [05]
- 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} .
 - The value of \bar{W}_e and x_e in the ground state ($^3\Pi_u$) and a particular excited state ($^3\Pi_g$) of C_2 are

	\bar{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]
- Discuss the linear, mass, atomic and electronic absorption coefficients.
 - What are Scavengers? How were they used in the radiolysis of water?
 - Explain direct isotope dilution analysis.
 - Explain in detail “Neutron Activation Analysis”.
 - Explain the Cerenkov radiation phenomenon observed in the charged particles.

- Q.4 A)** Attempt **ANY TWO** of the following: [10]
- Discuss the effect of pH and LET on the radical and molecular yields of water radiolysis.
 - What is hydrated electron? Give the structure and properties of hydrated electron.
 - Discuss the working of Fricke dosimeter.

- B)** Solve **ANY ONE** of the following: [05]
- A ruby weighing 0.5g was irradiated in a neutron flux of $10^{12} \text{ n cm}^{-2} \text{ s}^{-1}$ for exactly 24 hrs and ^{51}Cr activity ($\tau = 27.7$ days) counted immediately thereafter. It was found to give $35,000 \text{ c s}^{-1}$. Given:
 - σ for $^{50}\text{Cr} = 15.9 \text{ b}$
 - counting efficiency = 10%
 - ^{50}Cr content of natural chromium = 4.35%. Find the chromium content of the ruby.
 - Calculate the \bar{Z}/\bar{A} values for:
 - acetic acid
 - Carbon tetrachloride

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