Total No. of Questions :6]

SEAT No. :

P1458

[Total No. of Pages : 3

[5223]-21
M.Sc.-I
PHYSICAL CHEMISTRY
CH - 210 :Physical Chemistry - II
(2008 Pattern) (Semester - II) (Old)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) *Answers to the TWO sections should be written in SEPARATE answer books.*
2) *ALL questions are COMPULSORY.*
3) *Figures to the RIGHT SIDE indicate FULL marks.*
4) *Use of logarithmic table/calculator is ALLOWED.*
5) *Neat diagrams must be drawn WHEREVER necessary.*

Physico - Chemical Constants

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

P.T.O.

SECTION - I

Q1) Attempt any three of the following: **[15]**

a) Explain the applications of ESR spectroscopy.

b) What is centrifugal distortion? Explain the effect of centrifugal distortion on the rotational energy levels of a diatomic molecule.

c) How does isotopic substitution help in determing the CO and CS bond length in linear OCS molecule.

d) Discuss advantages of FTIR Spectroscopy.

e) Explain the factors which affects the width of Spectral line.

Q2) Attempt any three of the following: **[15]**

a) Explain the classical theory of Raman effect.

b) Discuss pure rotational Raman Spectra for linear diatomic molecule.

c) Explain the structure of nitrous oxide molecule in the light of XPES.

d) Write a note on Fartrant diagram.

e) Write the expression for Morse function and explain harmonic and anharmonic oscillators with respect to selection rule, zero point energy and energy equation.

Q3) Solve any two of the following: **[10]**

a) The fundamental vibrational frequency for HCl is 2886 cm^{-1}, and first overtone is 5668cm^{-1}. Calculate anharmonicity constant and equilibrium vibrational frequency.

b) Predict the position of rotational Raman spectral lines for $^{14}N_2$. [B = 1.99cm^{-1}, excitation frequency = 891 TH_2].

c) The energy change in a transition is 4.00×10^{-22}] $molecule^{-1}$. Calculate number of molecules in the excited state at 27°C, if there are 1000 molecules in the ground state.

SECTION - II

Q4) Attempt any three of the following: **[15]**

a) Explain the construction and working of Scintillator counter.

b) Give the different conversions of radiation absorption units.

c) Derive the rate equation for the decay constant of radioactive element. Explain its characteristic of the equation.

d) What is the breeder reactor? Explain the principle of breeding with an example.

e) How to assess the volume of blood in patient by using radiotracer technique.

Q5) Attempt any three of the following: **[15]**

a) Explain the terms G-value, electronic absorption coefficient, spur and δ – ray track.

b) Write a note on Lea Gray-Platzman and Samuel-Maggi model.

c) Explain the three phases in India's nuclear energy programme.

d) Discuss applications of Neutron activation analysis.

e) Enlist different modes of interaction of γ -radiation with matter. Explain one of them.

Q6) Solve any two of the following: **[10]**

a) The half life period of a radioisotope is 24.5m. How much of it would be left after 30m if its initial amount is 1.0gm?

b) 0.1 gm of a medicinal plant extract containing Mn was irradiated in a neutron flux of 10^{12}n.cm^{-2}s^{-1} for 5 minutes. The activity counted after 10h. of cooling period was 2500cpm with a HPGe detector with detection efficiency 20%. Determine the percentage of Mn in the extract.

[Given: σ =13.3b, $t_{½}$= 2.58h for ^{56}Mn, γ -ray abundance = 100%]

c) Assuming no loss of thermal or fast neutrons occurs, calculate the reproduction factor for a reactor for which the fast fission factor is 1.03, the number of fast neutrons generated per thermal neutron used up is 1.32, the resonance escape factor is 0.89 and the thermal utilisation factor is 0.87.