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H-6323

M.Sc. (Semester-II) Examination, July 2022

CHEMISTRY

[Paper : MSC-203]

(Physical Chemistry)

Time Allowed : Three Hours

Maximum Marks : 70

Minimum Passing Marks : 25

Note : This question paper is in four sections. All sections are **compulsory**. Attempt questions as per instructions given in each section.

SECTION-A

(Objective Type Questions)

Note : Attempt **any ten** questions. Each question carries **1** mark. [10x1=10]

1. (i) Identify the wavelength range which correspond to the microwave region of spectrum :

(a) 10 m – 1 cm

(b) 1 cm – 100 μm

(c) 10 nm – 100 pm

(d) 1 μm – 10 nm

(ii) The molecule which is IR inactive but Raman active is :

(a) HCl

(b) N_2

(c) SO_2

(d) Protein

(iii) In the Born-oppenheimer approximation :

(a) Eel > Evib > Erot > Etr

(b) Erot > Etr > Evib > Eel

(c) Etr > Erot > Evib > Eel

(d) Evib > Eel > Erot > Etr

(iv) The third law of thermodynamics states that in the limit $T \rightarrow 0$:

(a) G = 0

(b) S = 0

(c) V = 0

(d) H = 0

(v) The half life period of a radioactive nuclide is 3 hours. In 9 hours its activity will be reduced by a factors of :

(a) 1/9

(b) 1/8

(c) 1/27

(d) 1/C

(vi) Pre and Past 1850 paintings preferably differentiated by which method :

(a) Neutron activation analysis

(b) Isotope dilution analysis

(c) Neutron absorptiometry

(d) Radiochromatography

(vii) According to Fick's first law of diffusion the dimensions of diffusion coefficient D is_____.

(viii) The photon of wavelength 500 nm corresponds to_____cm^{-1}.

(ix) In Raman spectrum the gap between the first stokes line and the next stokes lines is_____ cm^{-1}.

(x) The $t_{1/2}$ of a reaction is doubled as the initial concentration of the reactant is doubled. The order of the reaction is_____.

(xi) Based on Langmuir absorption isotherm reaction of high pressure becomes_____order.

(xii) In uranium reactor the substance which slow down the fast neutrons known as_____.

SECTION-B

(Very Short Answer Type Questions)

Note : Attempt **any five** questions. Each question carries **02** marks. [5x2=10]

2. (i) What are the selection rule for the rotational transition as a diatomic molecule ?

(ii) What information obtained from vibrational spectrum ?

(iii) What is Raman Scattering ?

(iv) What is molecularity of reaction ?

(v) Write two application of electronic spectroscopy of molecules.

(vi) What is Beta emission ?

(vii) Enumerate application of radioisotope in agriculture.

SECTION-C

(Short Answer Type Questions)

Note : Attempt **any five** questions. Each question carries **04** marks. [5x4=20]

3. (i) Show that the rotational level whose quantum number is given by the expression

$$J_{\max} = \sqrt{\frac{KT}{2hcB}} - \frac{1}{2}$$ has a maximum population.

(ii) What is the general appearance and selection rules for the vibrational transitions of a diatomic molecule executing harmonic vibrations ?

(iii) What are the Rayleigh, stokes and antistokes lines ?

(iv) Discuss about predissociation of molecules.

(v) What is meant by chemical potential ? Derive the Gibbs-Duhem equation ?

(vi) Discuss briefly Langmuir's unimolecular theory of absorption. Derive an expression for Langmuir's absorption isotherm.

(vii) Write about neutron activation analysis.

SECTION-D

(Essay Type Questions)

Note : Attempt **any three** questions. Each question carries **10** marks. [3x10=30]

4. State and illustrate with suitable potential energy curves the Franck-Condon principle in the vibronic spectrum of a diatomic molecule.

5. Explain the term fugacity and fugacity coefficient. How the fugacity can be determined at low pressure and high pressure ? What is the physical significance of fugacity ?

6. Discuss following :

   (a) G.M. Counter and Scintillation Counter

   (b) ^{3}H and ^{32}P isotope preparation

7. What do you understand by the degress of freedom of molecules ? How many fundamental vibration possessed by CO_2 and H_2O molecules. Illustrate its (for CO_2 and H_2O) following vibrational modes :

(a) Symmetric stretch

(b) Antisymmetric stretch

(c) Bending

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