 B.A. RNLK-/Physical Chemistry/CC-11/22

2022

Physical Chemistry

[Fifth Semester]

Paper - CC-11

Full Marks : 40

Time : 2 hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

Illustrate the answers wherever necessary.

Group - A

Answer any five from the following : **5×2=10**

1. a) Justify that the ground state vibrational level of a diatomic molecule is more densely populated.

b) Write down the electronic transition involved in formaldehyde.

c) What is bioluminescence? Cite an example of bioluminescene.

d) Phosphoresscene is a slower process than fluorescene because (choose the correct option)

(A) phosphorescene occurs at longer wavelengths than fluorescence.

(B) spin angular momentum is not conserved in phosphorescene process

(C) both A and B

(D) none of the above.

e) The fraction of surface (θ) covered by an adsorbate at a pressure (P) is given by $\theta=m_1P/(1+m_2P)$, where m_1 and m_2 are constants. Suggest two plots that are linear comment on the slope and intercepts of such plots.

f) What is CMC, write down the effect of temperature on it.

g) Aqueos solution of benzoic acid becomes weak acid when it absorbs radiation –Explain.

h) Write the physical significance of Reynolds number.

Group - B

Answer any four from the following : 5×4=20

2. a) The first rotational absorption of $^{12}C^{16}O$ occurs at 3.8412 cm^{-1} and that for $^{13}C^{16}O$ at 3.6734 cm^{-1}. Calculate the atomic weight of C-13. Mention the assumption used, if any.

   [Given, ^{16}O=15.9994 and ^{12}C=12.0000]

   b) The Morse potential function V9r), for a diatomic molecule may be expressed as $V(r)=De[1-e^{-\alpha(r-re)}]^2$ Calculate $V(r_e)$, $V(\infty)$, and α in the above expression. $(2\frac{1}{2}\times2)=5$

3. (a) A photochemical reaction was carried using a monochromic radiation (490 nm) of intensity 100 W. When the sample was irradiated for 30 min, 0.3 mole of the reactant was decompsed. Estimate the quantum efficiency assuming 50% absorption.

   b) The C=O bond energy in acetone is 728 kJ mol^{-1}. Does the light of 250 nm be able to break the bond? (3+2)=5

4. (a) The surface tension of ethyl acetate (T_c=523K) is 25 dyne/cm at 0ºC. Estimate its value at 50ºC.

   (b) Why does surface tension of water almost vanish at its critical temperature?

5. (a) In a photochemical reaction, $A \rightarrow 2B+C$, the quantum efficiency with 500 nm light in 2×10^{-2} mol einstein^{-1}. After exposure of 300 moles of A to the light, 2 m moles of B is formed. The number of photons absorbed by A is –

   (b) The optical density of a solution never be negative– Why? (3+2)=5

6. (a) the density of Lithium metal is 0.53 g.cm^{-1} and the separation of the planes of the metal is 350 pm. Determine whether the lattice is f.c.c. or b.c.c. [M of Li = 6.94g/mol]

   (b) Calculate the % of pack of f.c.c. crystal. (3+2)=5

7. (a) Draw the schematic representation on the formation of oil-in-water and water-in-oil.

   (b) Coagulation power increases considerably with increasing valence of the coagulating ion. (3+2)=5

Group - C

Answer one from the following : **1×10=10**

8. (a) Sketch the IR active and IR inactive modes of vibration for carbon dioxide molecule.

   (b) Classify the following molecules in terms of symmetric top, spherical top and asymeetric top category : vinyl chloride, BCl_3, CCl_4 and H_2O.

   (c) Find the maximum populated rotational energy level of moledule at 25ºC for which $^{12}CO^{16}$ $\bar{B}=1.93cm^{-1}$.

   (d) What is Born-Oppenheinmer approximation.

   (3+3+3+1)=10

9. (a) Ethylene has a UV absorption peaks at 162 nm with molar absorption coefficient cm^{-1} mol^{-1} lit. Calculate the absorbance of 162 nm radiation through a sample of ethylene gas at 25ºC and 10 torr for a cell of length 1 cm.

   (b) An aqueous solution of iodine is shaken with CS_2 and also with charcoal. In each case some iodine was

extracted. What are the difference between the two phenomena.

(c) What is Miller indices? What is meant by (110) plane? Draw the 110) plane of a simple cubic crystal.

(3+3+4)=10