U.G. 5th Semester Examination - 2020

CHEMISTRY

[HONOURS]

Course Code : CHEM-H-CC-T-12

Full Marks : 40 Time : $2\frac{1}{2}$ 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.

1. Answer any **five** questions: 2×5=10

   i) Explain why homonuclear diatomic molecules do not exhibit pure rotational spectrum but exhibit rotational Raman spectrum.

   ii) What do you mean by magnetic active and inactive nuclei in NMR study?

   iii) Explain why many of the lower rotational levels are thickly populated.

   iv) Explain why hot bands in IR Spectra shows red shift in comparison to normal band.

   v) What do you mean by surface active and inactive agents?

   vi) Ferric ion can be identified in group analysis by the addition of ammonium chloride and ammonium hydroxide to precipitate as ferric hydroxide. But in most cases no precipitate is found on filter paper though turbidity appears- explain why?

   vii) Write the principle for the determination of surface area of adsorbate using BET equation.

2. Answer any **two** questions from the following: 5×2=10

   i) What are Rayleigh, Stokes and antistokes lines in Raman spectra? Explain these from quantum mechanical viewpoint. $1\frac{1}{2}+3\frac{1}{2}=5$

   ii) Explain why fluorescence emission stops as soon as the light source is removed, where as phosphorescence continues long after the removal of light source. $2\frac{1}{2}+2\frac{1}{2}=5$

   iii) The radiation of wave length 2500 A^0 was passed through a cell containing 10 ml of a solution which was 0.05(M) in oxalic acid and 0.01(M) in uranyl sulphate. After absorption of 80 joules of radiation energy, the concentration of oxalic acid was reduced and the whole solution was neutralised by 8 ml of 0.1(N) $KMnO_4$ solution.

Calculate the quantum yield for the photochemical decomposition of oxalic acid at this wave length. 5

iv) a) What do you mean by surface energy? Write its dimension. 1+1=2

b) Calculate the energy expended in breaking down a large spherical drop of water with volume of 0.1 ml into droplets having mean radius of 10^{-5}cm at 25°C. The surface tension of water at this temperature is 72.25 dynes/cm. 3

3. Answer any **two** questions from the following: 10×2=20

i) a) Explain P, Q and R branches of IR spectra considering anharmonic oscillation and rigid rotation of a diatomic molecule from the quantum mechanical viewpoint. 5

b) The wave numbers of pure rotational lines of HI is given by $\bar{\nu} = (19.5\ J)\ cm^{-1}$ where J is rotational quantum number. Calculate (i) the bond length, (ii) rotational frequency at J=1 level, (iii) the period of rotation for J=2, (iv) rotational level of maximum population at 27°C and (v) the change in rotational constant when H is replaced by D. 5

ii) a) What are the reasons for low quantum yield? Write two uses of photosensitized reactions. 2+2=4

b) Define Larmor precision and chemical shift in NMR spectra. 3

c) The benzene anion radical has a g-value of 2.001. At what magnetic field it may exhibit resonance in ESR spectrometer operating at 8.1 GHz? 3

iii) a) Explain why a fine metallic needle can float on water though its weight is slightly higher than buoyancy. 2

b) Explain Hardy- Schultz rule and show that it is a consequence of freundlich adsorption isotherm. 2+2=4

c) If V is the volume of the gas adsorbed at a given pressure P and the plot of P/V against P at constant temperature gives a straight line with slope $2.02\times10^{-3}\ mL^{-1}$ and intercept to P/V axis as $1.1\times10^{-5}\ mL^{-1}$, then calculate V_{mono} and adsorption-desorption equilibrium constant. 4

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