Eastern University, Sri Lanka

Third Year Second Semester Examination in Science

2010/2011 (September/ October 2015)

CH 306 Surface Chemistry and Molecular spectroscopy (Proper)

Answer all questions Time: 01 hour

Velocity of light (c) =2.99x10^8 m s^{-1} Gas constant (R) = 8.314 J K^{-1} mol^{-1}

Plank's constant (h) = 6.626 x 10^{-34}J s

1.

(a) i) Write the BET adsorption isotherm and identify the terms in this equation.

ii) Show that at low pressures and for large values of '*c* 'this equation reduces to Langmuir equation and explain this behavior.

(30 marks)

(b) For the adsorption of N_2 on 1.00 g of ZnO the volumes (converted to 0^0 C and 1 atm) of N_2 adsorbed were 1.06 and 2.08 cm^3 g^{-1} when the equilibrium pressures were 183 and 533 mmHg respectively. Assuming Langmuir behavior,

i) Calculate the equilibrium constant (or adsorption constant)

ii) If N_2 molecule covers 1.2 x 10^{-18} m^2, calculate the surface area of a 1 g sample of ZnO.

(45 marks)

(c) The contact angle for water on clean glass is close to zero. Calculate the surface tension of water at 20° C. At that temperature water climbs to a height of 4.96 cm in a clean glass capillary tube with internal radius of 0.300 mm. The density of water at 20° C is 998.2 kg m^{-3}.

(25 marks)

2.

(a) Consider the $v = 2 \rightarrow 3$ rotation –vibrational band of the $^{11}B^{19}F$ molecule within the harmonic oscillator, rigid – rotator approximation. The vibrational frequency and rotational constant of this isotopomer ($^{10}B^{19}F$) are equal to 1402.13 cm^{-1} and 1.50724 cm^{-1}, respectively.

i) Write the energy expression for rotation –vibrational spectra of harmonic oscillator

ii) Determine the frequency or spectral position (in cm^{-1}) of the P- branch transition with $J = 4 \rightarrow 3$

iii) Calculate the vibrational frequency (cm^{-1}) for $^{10}B^{19}F$

iv) Predict the equilibrium bond length of BF

(75 Marks)

(b) Briefly explain the quantum theory of Raman Effect in terms of originating stokes, anti-stokes lines in the spectrum.

(25 Marks)

****