EASTERN UNIVERSITY, SRI LANKA
THIRD EXAMINATION IN SCIENCE -2003/2004
(June/July 2005)
SECOND SEMESTER
CH 306 SURFACE CHEMISTRY AND MOLECULAR SPECTROSCOPY

Answer all questions **Time: 01 hour**

Plank constant (h) = 6.626×10^{-34} Js
Velocity of light (c) = 3×10^{-10} cms^{-1}

1. a) i) Define the term "adsorption isotherm".

ii) The dynamic equilibrium of a gas A chemisorbed by the surface M is given by

$$A\,(g) + M\,(surf) \rightleftharpoons AM\,(surf),$$

with the rate constants K_a for adsorption and K_d for desorption at fixed temperature T and a partial pressure p. Show that the Langmuir isotherm for the fractional coverage (θ) of the adsorbed molecule A is related by the expression,

$$\frac{1}{\theta} = 1 + \frac{1}{bp}$$

Where $b(T) = \frac{K_a}{K_d}$

iii) The two gasses A and B undergo non-dissociative adsorption on the same surface with the equilibrium constants b_A and b_B respectively. Show that the fractional coverage of the gas A (θ_A) is,

$$\theta_A = \frac{b_A p_A}{1 + b_A p_A + b_B p_B}$$

Where p_A and p_B partial pressure of gas A and gas B.

Cont..

b) Freundlich isotherm is given by the equation

$$v = kC^n$$

Where v is the mass adsorbed per unit mass of adsorbent, C is the solution's concentration and k and n are constants. Check the applicability of this isotherm to the following data for the adsorption of acetic acid on charcoal at 25°C and find the value of the parameters k and n.

$[CH_3COOH]$/ mol L^{-1}	0.05	0.10	0.50	1.00	1.50
v/g	0.04	0.06	0.12	0.16	0.19

(Where v is the mass adsorbed per unit mass of charcoal)

2) a) i) Define "moment of inertia" in terms of mass of the i^{th} atom (m_i) and perpendicular distance to the i^{th} particle from the axis of rotation (r_i)

ii) Rotational absorption lines from $^1H^{35}Cl$ gas were found at the following wave numbers: 83.32, 104.13, 124.73, 145.37, 165.89, 186.23, 206.60, and 226.86 cm^{-1}. Calculate the moment of inertia and the bond length of the molecule. (Reduced mass of $^1H^{35}Cl$ is 1.627×10^{-27} kg)

b) The fundamental and first overtone transitions of $^{14}N^{16}O$ occur at 1876.06cm^{-1} and 3724.20cm^{-1} respectively. Evaluate the anharmonicity constant (x_e) and the equilibrium vibration frequency (ω_e).

c) Explain clearly how you would distinguish the isomers of N_2F_2 spectroscopically.

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