KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2010/2011

INSTITUTIONAL BASED PROGRAMME (IBP) – DECEMBER SESSION

EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE

SCH 203: THEORY OF SPECTROSCOPIC METHODS

DATE: Thursday, 28th April, 2011 TIME: 4.30 p.m. – 6.30 p.m.

INSTRUCTIONS:

Answer **ALL FOUR** questions.

Useful information

$N_A = 6.022 \times 10^{23}$ mole $^{-1}$

$h = 6.6262 \times 10^{-34}$ Js

$c = 2.998 \times 10^{10}$ cms^{-1}

$\pi = 3.142$

Q.1 a) Explain the dual nature of electromagnetic radiation, giving the mathematical relationships between the various parameters. (6 marks)

b) Explain the factors that contribute to broadening of spectral transitions (6 marks)

c) Explain the mechanism for absorption of electromagnetic radiation in microwave spectroscopy. (4 marks)

d) Explain the factors that lead to intensities of spectral transitions. (6 marks)

Q.2 a) Write concisely on the quantum theory of Raman effect. (7 marks)

b) Explain the mechanism of absorption of radiation in I.R. spectroscopy. (3 marks)

c) Determine the moment of inertia of HF whose bond length is 1.23×10^{-10}m.

(H = 1.008, F = 18.998) (5 marks)

d) In Raman spectroscopy, the Stoke's lines are more intense than the anti-Stoke's lines. Explain. (3 marks)

Q.3 a) Sketch the vibrational modes of SCl_2, naming their symmetry. (3 marks)

b) Explain the following terms as used in vibrational spectroscopy:

i) fundamental transition (1½ marks)

ii) overtone transition (1½ marks)

c) The fundamental and the first overtone transitions of NO are centred at 1876.06 cm^{-1} and 3724.20 cm^{-1}respectively. Determine the equilibrium vibrational frequency and the force constant for the species.

(N = 14.0067, O = 15.9994) (8 marks)

Q.4 a) The rotational spectrum of HF shows that the separations between successive lines decrease with the increase in the value of the rotational quantum number. Explain. (3 marks)

b) A particular species is known to undergo a spectroscopic transition between the ground state and an excited with a life-time of 1.4×10^{-5} sec. Determine the approximate uncertainty in the excited state energy level and the width of the associated spectral line in Hertz. (4 marks)

c) The microwave spectrum of CN shows a series of equidistant lines separated by 3.7978 em^{-1}.

Determine the moment of inertia and the bond length of the species.

(C = 12.0106, N = 14.0067)

(9 marks)

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