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SARDAR PATEL UNIVERSITY

M. Sc. Materials Science, 4th Semester Examination

30/11/2012
Friday
Time: 02.30 p.m. to 05.30 p.m.

PS04CMTS01 : SPECTROSCOPY

Total Weightage/Marks: 70

Note: (i) All the six questions are compulsory.

(ii) Figures to the right indicate marks.

Q. 1 Select the correct answer from questions (i) to (viii). **[8]**

(i) Emission of radiation can be measured by the method

(a) Flame Photometry (b) Raman Spectroscopy

(c) Visible Spectroscopy (d) Conductometry

(ii) Separation of rotational energy levels can be determined using

(a) UV Spectroscopy (b) Microwave Spectroscopy

(c) X-ray Spectroscopy

(iii) Which type of transition occurs in pyridin when exposed to UV radiation

(a) $\eta \rightarrow \sigma^*$ (b) $\pi \rightarrow \pi^*$

(c) $\eta \rightarrow \pi^*$

(iv) Light source used for IR radiation

(a) Xenon arc tube (b) Hydrogen lamp

(c) Nernst glower

(v) Selection rules for a polyatomic molecules undergoing perpendicular vibration is

(a) $\Delta v = \pm 1, \pm 2$

(b) $\Delta v = \pm 1, \pm 2...$ (c) $\Delta v = \pm 1, \pm 2...$

$\Delta J = \pm 1$ $\Delta J = 0, \pm 1$

P.T.O

(vi) In Mossbauer spectrum, quadrupole splitting is observed to the complexes which have

(a) I < 1 (b) I = 0

(c) I > 1

(vii) Bending vibration frequency of CO_2 molecule is

(a) IR active (b) Raman active (c) None of this

(viii) Material used for the construction of all in IR- Spectroscopy is .

(a) KBr (c) Quartz (c) Polyethylene

Q. 2 Answer any seven of the following questions. **[14]**

(a) Write the characteristics of electromagnetic radiation.

(b) How a double beam spectrophotometer works?

(c) What is absorbance and how it is related to transmittance?

(d) Write the principle of atomic absorption spectroscopy.

(e) What are chromophores & auxochroms, give examples.

(f) What is binding energy? How it is related to kinetic energy?

(g) What is resonance absorption?

(h) What are equivalent and non equivalent protons?

(i) What is inverse population?

Q. 3 (a) Considering a diatomic molecule is rigid rotor, establish various allowed energy levels and obtain the general equation for rotational transition. **[06]**

(b) The first line corresponding to J=0 appears in the rotational spectrum of CO molecule at 20.7 cm^{-1}. Calculate the bond length of this molecule. **[06]**

OR

(b) The HCl molecule in gaseous state shows pure rotational lines at the following frequencies 20.7, 41.5, 62.0, and 83.0 cm^{-1}. Find out the bond length of this molecule. **[06]**

Q. 4 (a) Discuss the spectrum of a diatomic molecule undergoing anharmonic type oscillation under IR radiation. [06]

(b) Find out the fundamental absorption frequency in wave number of HCl molecule. The force constant of this molecule is 1×10^6 dyne/cm. what will be the population at v=1 state at 70°C. [06]

OR

(b) The fundamental and first overtone transitions of 'CO' molecule are centred at 1876.06 cm^{-1} and 3724.20 cm^{-1} respectively. Evaluate equilibrium vibration frequency, the anharmonicity and the zero point energy of the molecule. [06]

Q. 5 (a) What are chemical shift? How the position of signals is determined in NMR spectroscopy? [06]

(b) Give the structure(s) consistent with following sets of NMR data (any two).

Compound	^{1}H NMR data	Nos. of protons
$C_{10}H_{14}$	(a) Singlet δ 1.3	9H
	(b) Singlet δ 7.29	5H
$C_3H_6Br_2$	(a) Quintet δ 2.58	2H
	(b) Triplet δ 3.85	4H
$C_{17}H_{20}N_2O$	(a) Singlet δ 3.1	12H
	(b) Doublet δ 6.75	4H
	(c) Doublet δ 7.75	4H

Q. 6 (a) Discuss the nature of Mossbeaur spectra of Fe(II) and Fe(III) complexes in weak and strong ligand field [06]

(b) With suitable block diagram, give a brief account of ruby laser or gas laser [06]

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