Total No. of Printed Pages—11

6 SEM TDC CHM M 7 (N/O)

2019

(May)

CHEMISTRY

(Major)

Course : 607

(Spectroscopy)

The figures in the margin indicate full marks for the questions

(New Course)

Full Marks : 48

Pass Marks : 14

Time : 2 hours

1. Choose the correct answer : 1×5=5

(a) Symmetric top molecules have

(i) two equal moments of inertia and one different

(ii) all the three moments of inertia equal

(iii) all the three moments of inertia different

(iv) all the moments of inertia zero

(b) The shift of an absorption maximum towards longer wavelength is known as

(i) hypsochromic effect

(ii) bathochromic effect

(iii) hyperchromic effect

(iv) hypochromic effect

(c) The absence of absorption bands near $1600\ cm^{-1}$, $1580\ cm^{-1}$ and $1500\ cm^{-1}$ is a sure proof for the absence of

(i) aromatic ring

(ii) carbonyl group

(iii) —OH group

(iv) secondary amino group

(d) The multiplicity of the signals in $CH_3CH_2OCH_2CH_3$ in NMR spectrum is

(i) two triplets

(ii) a triplet and a quartet

(iii) two singlets

(iv) two doublets

(e) Using 4358 Å lines of mercury as the source of radiation, a Raman line was observed at 4447 Å. The Raman shift was

(i) $460\ cm^{-1}$

(ii) $89\ cm^{-1}$

(iii) $89 \times 10^{-8}\ cm^{-1}$

(iv) $460 \times 10^{-8}\ cm^{-1}$

2. Answer any *five* of the following : 2×5=10

(a) What do you mean by fundamental vibrations and overtones?

(b) What is mutual exclusion principle? Explain with examples.

(c) The nuclei like ^{12}C and ^{16}C do not exhibit NMR spectra. Explain why.

(d) What do you mean by a good solvent in UV spectroscopy and what is its effect on absorption maximum?

(e) Explain the effects of change of solvents on $n \rightarrow \pi^*$ and $\pi \rightarrow \pi^*$ transitions.

(f) HCl molecule is microwave active. Explain properly.

UNIT—I

3. *(a)* Discuss the effect of isotopic substitution on the rotational spectra of a diatomic molecule. 2½

(b) In the absorption rotational spectrum of CO, the first line has a wave number of $3{\cdot}8424\ cm^{-1}$. Calculate the bond length between C and O atoms. 2½

UNIT—II

4. *(a)* Show that the frequency of the absorbed radiation in pure vibrational spectra is equal to the fundamental frequency of vibration ν_0 of the molecule. 3

(b) Sketch the normal modes of vibration of a linear triatomic molecule AB_2 and predict the IR active bands. 2

Or

Write a short note on fingerprint region. 2

(c) The force constant of HF is listed at $880\ cm^{-1}$. At what wave number is the fundamental $\upsilon = 0 \rightarrow \upsilon = 1$ vibrational absorption expected? 3

UNIT—III

5. *(a)* What are Stokes and anti-Stokes lines? Explain why the anti-Stokes lines are weaker than that of Stokes lines. 2+2=4

(b) Discuss about the rotational Raman spectra in linear molecule. 3

Or

Write any three differences between Raman spectra and infrared spectra. 3

UNIT—IV

6. *(a)* Describe the terms chromophores, auxochromes, bathochromic shift and hypsochromic shift giving examples. 4

(b) Write the selection rules for electronic transitions. 2

Or

Explain why ethanol is a good solvent for UV measurement but not for IR. 2

UNIT—V

7. *(a)* Discuss briefly the principle of NMR spectroscopy. 4

Or

What is chemical shift in NMR spectroscopy? Mention the factors that affect chemical shift. 2+2=4

(b) Explain why TMS is used as internal standard in NMR spectroscopy. 2

Or

Describe the ESR spectrum of a single electron in contact with a single proton. 2

(c) Describe briefly spin-spin relaxation process. 1

(Old Course)

Full Marks : 48

Pass Marks : 19

Time : 3 hours

1. Choose the correct answer : 1×5=5

(a) Raman effect is

(i) absorption of light

(ii) emission of light

(iii) inelastic scattering of light

(iv) elastic scattering of light

(b) The internal energy of a molecule is its

(i) rotational energy

(ii) vibrational energy

(iii) translational energy

(iv) All of the above

(c) The radiation in the wavelength range 400 nm–800 nm corresponds to

(i) ultraviolet

(ii) infrared

(iii) visible

(iv) far IR

(d) The electronic spectra consist of

(i) a large number of absorption bands

(ii) a large number of closely packed lines

(iii) a large number of peaks

(iv) None of the above

(e) The molecule which is microwave active is

(i) HCl

(ii) CO_2

(iii) H_2

(iv) N_2

2. Answer any *five* of the following : 2×5=10

(a) Water is a good solvent for UV and visible spectroscopy but not for IR spectroscopy. Explain.

(b) Explain mutual exclusion principle with example.

(c) What do you mean by fundamental vibrations and overtones?

(d) Microwave studies are done only in gaseous state. Why?

(e) What is 'hot band' in vibrational spectra?

(f) Explain Fermi resonance with one example.

UNIT—I

3. (a) The rotational spectra of HF have lines 41·9 cm^{-1} apart. Calculate the bond length of H—F bond in HF. 2½

(b) Discuss the effect of isotopic substitution on the rotational spectra of a diatomic molecule. 2½

UNIT—II

4. (a) Roughly sketch the fundamental vibrations of water molecule. Show how many of them are IR active and Raman active. 2

(b) Explain fundamental frequencies and combination bands with example. 3

Or

Calculate the force constant for $H^{35}Cl$ from the fact that the fundamental vibrational frequency is $8{\cdot}667 \times 10^{13}$ s^{-1}. 3

(c) Sketch the normal modes of vibration of a linear triatomic molecule AB_2 and predict the IR active bands. Give reason in support of your answer. 3

UNIT—III

5. (a) State and explain the rule of mutual exclusion principle with example. 3

(b) Write the difference between Raman spectra and IR spectra. 3

(c) Mention the essential conditions for a molecule to be Raman active. 1

UNIT—IV

6. (a) State and explain Franck-Condon principle. 3

(b) Explain the effects of change of solvents on $n \rightarrow \pi^*$ and $\pi \rightarrow \pi^*$ transitions. 2

(c) Define chromophore with example. 1

UNIT—V

7. *(a)* Discuss briefly the principle of NMR spectroscopy. 4

(b) Draw the high resolution NMR spectra of 1-chloropropane and 2-chloro-propane. 1+1=2

(c) Define coupling constant. 1

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