

School of Chemistry and Biochemistry, TIET, Patiala
Applied Chemistry (UCB008)
Tutorial Sheet (IR Spectroscopy)

1. What do you understand by force constant? How is the force constant of a molecule related to its vibrational frequency?
 2. Calculate the approximate frequency of C-H (cm^{-1}) stretching from the following data:
 $k = 500 \text{ Nm}^{-1}$, $m_{\text{C}} = 20 \times 10^{-24} \text{ g}$, $m_{\text{H}} = 1.6 \times 10^{-24} \text{ g}$. **(Ans: 3084 cm^{-1})**
 3. $^1\text{H } ^{35}\text{Cl}$ has a force constant (k) value of 480 N/m . Calculate the fundamental frequency and its wavenumber. **(Ans: $8.66 \times 10^{13} \text{ Hz}$, 2888 cm^{-1})**
 4. What is the vibrational mode? Draw various vibrational modes of CO_2 and H_2O . How many bands will appear in the IR spectra of these molecules?
 5. Distinguish between the following from their IR spectra:
(a) Ethanol and dimethyl ether **(b)** Primary and secondary amines
 6. How inter- and intra- hydrogen bonding can be distinguished from IR spectroscopy?
 7. How does the O-H stretch in the IR spectrum of a carboxylic acid differ from the O-H stretch of an alcohol?
 8. Why IR absorption due to C=O stretching occurs at higher frequencies than stretching of C=C bond?
 9. Distinguish between an ester and ketone on the basis of IR spectroscopy.
 10. Rank the following bonds in order of increasing stretching frequency (cm^{-1}) in IR spectroscopy: O-H, $\text{C}\equiv\text{N}$, C-N and C=O
 11. Write IR absorption frequencies (cm^{-1}) for the following groups:
(i) Alkane -C-H, C-C (ii) Alkene =CH, C=C (iii) Alkyne, $\equiv\text{C-H}$, $\text{C}\equiv\text{C}$
(iv) Alcohols O-H (v) Ether C-O (vi) Aldehyde, Ketone C=O
(vii) Nitrile $\text{C}\equiv\text{N}$ (viii) Amine C-N
 12. IR spectra are often characterized as molecular finger-prints. Comment on it.
 13. Why are inorganic compounds useful as sample "windows" and matrix material for IR analysis?
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