* Numerical :-

(1) $f = 95\ MHz$

$\lambda = ?$

$\rightarrow f = \frac{c}{\lambda}$

$\lambda = \frac{c}{f} = \frac{3 \times 10^8}{95 \times 10^6}$ $\boxed{= 3.15}$ m

(2) $f = 810\ KHz$

$\lambda = ?$

$\rightarrow \lambda = \frac{c}{f} = \frac{3 \times 10^8}{810 \times 10^3}$ $\boxed{= 370}$ m

(3) wavenumber $= 2200\cancel{6}\ cm^{-1}$

$\lambda = ?$

$f = ?$

$\rightarrow \lambda = \frac{1}{2200\cancel{0}} = 4.54 \times 10^{-4}$ cm

$= 4.54\ \mu m$

$\rightarrow f = \frac{3 \times 10^8}{4.54 \times 10^{-6}} = 0.660 \times 10^{14}$

(6) $M = 2.5 \times 10^{-26}$ kg $= 2.5 \times 10^{-23}$ g

$\bar{\nu} = 2900$ cm^{-1} $= 29$ m^{-1}

$k = ?$

$\rightarrow \nu = \bar{\nu} \times 3 \times 10^{8}$

$= 87 \times 10^{8}$

$\rightarrow \nu = \frac{1}{2\pi c}\sqrt{\frac{k}{M}}$

$\therefore \sqrt{\frac{k}{M}} = 5.4636 \times 10^{10}$

$\therefore k = 29.85 \times 10^{20} \times 2.5 \times 10^{-23}$

$\therefore k = 0.74625$ gm m sec^{-2}

(7) $k = 1840$ N/m $= \text{kg} \cdot \frac{m}{s^2} \cdot \frac{1}{m} = 1.8$ gm/sec

$\nu = ?$

$m_1 = 19.9 \times 10^{-27}$ kg

$m_2 = 26.6 \times 10^{-27}$ kg

$M = \frac{529.34 \times 10^{-24} \times 10^{-24}}{49.5 \times 10^{-24}}$

$= 10.63 \times 10^{-24}$

$\rightarrow \nu = \frac{1}{2\pi c}\sqrt{\frac{1.8}{10.63 \times 10^{-24}}}$

$= \frac{1}{2\pi c}\sqrt{0.169 \times 10^{24}}$ $= 6.546 \times 10^{10}$

(5) wavenumber = ? (C=C)

$k = 5 \times 10^5 \times 2$ gm sec^{-2}

$\cancel{m_1 = 20 \times 10^{-24}}$ gm

$\cancel{m_2 = 1.6 \times 10^{-24}}$ gm

$\cancel{\mu = \frac{m_1 m_2}{m_1 + m_2}} =$

$m_1 = 12$ amu

$m_2 = 12$ amu

$\mu = \frac{12 \times 12}{24} = 6$ amu

$= \frac{6 \times \cancel{1.6 \times 10^{-24}}}{6.023 \times 10^{23}}$ gm $= 9.6 \times 10^{-}$

$\rightarrow v = \frac{1}{2\pi}\sqrt{\frac{K}{\mu}}$

$= \frac{1}{2\pi}\sqrt{\frac{10 \times 10^5}{}}$

$= \frac{1}{2\pi}\sqrt{\frac{10 \times 10^5}{9.6 \times 10^{-24}}}$

$= \frac{1}{2\pi}\sqrt{1.0416 \times 10^{29}}$

$= 5.139 \times 10^{13}$

$\rightarrow$ wavenumber $= \frac{5.139 \times 10^{13}}{3 \times 10^8}$

$= 1.713 \times 10^5$

Frequency

(4) $\nu = \frac{1}{2\pi}\sqrt{\frac{K}{\mu}}$ ← bond strength

↑ reduced mass

calculate freq. of C-H bond.

$K = 5 \times 10^5$ gm sec^{-2}

$m_1 = 20 \times 10^{-24}$ gm

$m_2 = 1.6 \times 10^{-24}$ gm

$\mu = m_1 m_2 / m_1 + m_2 = 32 \times 10^{-24} / 21.6 = 1.48 \times 10^{-24}$

$\rightarrow \nu = \frac{1}{2 \times 3.14}\sqrt{\frac{5 \times 10^5}{1.48 \times 10^{-24}}}$

$= \frac{1}{2 \times 3.14}\sqrt{3.37 \times 10^{29}}$

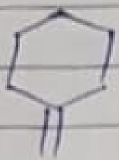
$= \cancel{1.8357} \times \frac{5.805 \times 10^{14}}{6.28}$

$= 9.24 \times 10^{13}$

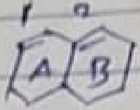
$\rightarrow \bar{\nu} = \frac{9.24 \times 10^{13}}{3 \times 10^{8}} = 3.08 \times 10^{5}$

↓

wavenumber

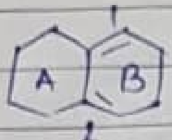
1) 

Exocyclic bond

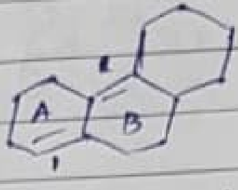
(2) 

hetro Anolur

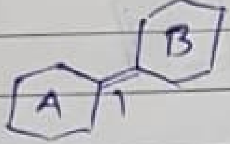
Endocyclic (1-A, 2-B)
Exocyclic (2-A)

(3) 

Homo Annolar
Endocyclic (1-B, 2-B)
exocyclic (1-A, 2-A)

(4) 

Hetro Annolar
Endocyclic (1-A, 2-B)
Exocyclic (1-B, 2-A, 2-C)

5) 

Exocyclic (1-A, 1-B)

Formula

λ_{max} = Base value + Summation of substituent contribution + Summation of other contribution

Base Value

Homo Annolar Diene : 253nm
Hetro Annolar Diene : 214nm
Endo cyclic : x
Exo cyclic : 5nm

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$\theta = ?$ $\quad hlk = 100$

$a = 2.814 \mathring{A}$

$n = 2$

$\lambda = 0.714 \mathring{A}$

$$d = \frac{a}{\sqrt{h^2+l^2+k^2}} = \frac{2.814}{\sqrt{1^2+0^2+0^2}} = 2.814 \mathring{A}$$

$$2 \cdot d \sin\theta = n\lambda$$

$$\sin\theta = \frac{\cancel{2} \times \cancel{2.814} \, 0.714 \mathring{A}}{\cancel{2} \times 2.814 \mathring{A}}$$

$$\theta = 14.69.$$

Q. for $\sin\theta = 1$ we get the highest λ

① $n = 1$

$2 \cdot d \sin\theta = n\lambda$

$\lambda_{max} = \frac{2 \times 2.83 Å \times 1}{1}$

$=$

② $n = 2$

$2 \cdot d \sin\theta = 2 \cdot \lambda$

Q. $\theta = 12^\circ$ $\lambda = ?$

$d = 3.035 \times 10^{-10} m$

$n = 1$

$2 \cdot d \sin\theta = n\lambda$

$\lambda = \frac{2 \times 3.035 \times 10^{-10} \times \sin 12^\circ}{1}$

$= 0.63 Å \times 2$

$= 1.25 Å$

Q. $\lambda = 2.20 Å$

$n = 1$

$\theta = 27^\circ 8'$

$d = ?$

$2 \cdot d \cdot \sin\theta = n\lambda$

$d = \frac{n\lambda}{2\sin\theta} = \frac{1 \times 2.20 Å}{2 \cdot 0.45} = 2.4 Å$

CH_3 CH_3

$x = 10$

$y = = 11$

$R_{end} = 2$

$Re_{x0} = 0$

$\lambda = 0.071 \, nm$

$hkl = 110$

$a = 0.28 nm.$

θ = glancing angle $\theta = ?$

order of diffraction $n = 2$

Bragg's law $2d \sin\theta = n\lambda$

$$d = \frac{a}{\sqrt{h^2 + k^2 + l^2}}$$

$$= \frac{0.28 \times 10^{-9}}{\sqrt{1^2 + 1^2 + 0^2}} = \frac{0.28 \times 10^{-9}}{\sqrt{2}}$$

$$2 \times \frac{0.28 \times 10^{-9}}{\sqrt{2}} \sin\theta = 2 \times 0.071 \times 10^{-9}$$

$\sin\theta = 0.3586$

$\theta = 21^\circ$

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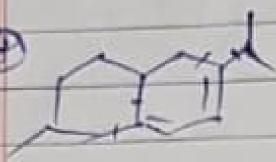
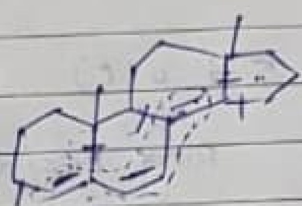
(6) 

$\lambda_{max} = 214 + 5 + 2(5)$
$= 214 + 15$
$= 229$

(7) 

$\lambda_{max} = 253 + 4(5) + 5$
$= 253 + 25$
$= 278$

(8) 

$\lambda_{max} = 214 + 5(5) + 30 + 3(15)$
$= 214 + 25 + 30 + 15$
$= 214 + 70$
$= 284$

* $\lambda_{max} = 114 + 5x + y(48.0 - 1.7y) - 16.5 R_{endo} - 10 R_{exo}$

λ_{max} = is the wavelength
x is number of alkyl substituent/ ring residues in the conjuget system.
y =

R_{endo} =
R_{exo} =

(5) Alkyl substituent = 5 nm

(6) Double bond extending conjugation = 30 nm

(7) polar grs. O alkyl = 6 nm

: Cl, Br = 5 nm

NR_2 = 60 nm

O·AC = 0 nm

(1) 

$\lambda_{max} = 214 + 5 + 4(5)$

Ring Residue

$= 239$

(2) 

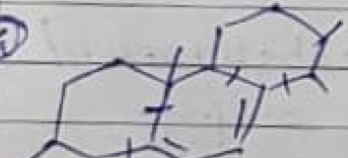
$\lambda_{max} = 214 + 5 + 3(5)$

$= 234$

(3) 

$\lambda_{max} = 214 + 3(5) + 5$

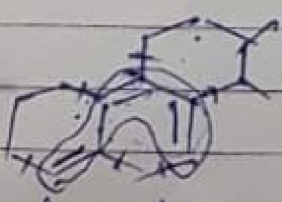
$= 234$

(4) 

$\lambda_{max} = 253 + 5 + 4(5) + 5$

$= 253 + 25 + 5$

$= \cancel{278}\ 283$

(5) 

when homo & hetro both are present take the max one

$\lambda_{max} = \cancel{214} + 253 + 4(5) + 6(5) + 30$

$= \cancel{424 + 205}\ \cancel{253 + 30 + 30}$

$= \cancel{312}$ $\quad 313 + 15 = 328$

$= 253 + 20 + 30 + 30$

$= 333$