

Task#85499

Why does vibrational fundamental frequency decreases with the increase in masses of bonding atoms? Explain with suitable examples.

solution: Fundamental frequency of vibration is given by $(\nu) = \frac{1}{2\pi} \times \sqrt{\left(\frac{K}{\mu}\right)} \dots \dots (1)$

Where, k = force constant (Bond strength), μ = Reduced mass of vibrating bonding atoms,
 $\mu = \frac{m_1 \times m_2}{m_1 + m_2}$; where, m_1 and m_2 are the mass of two bonding atom.

From equation (1) it is clear that with increasing mass of bonding atom reduced mass increases and Fundamental vibrational frequency decreases. Since it is inversely proportional to square root of reduced mass of atoms.

Example,

F-H(4000 cm^{-1})	Cl-H(2890 cm^{-1})	Br-H(2650 cm^{-1})
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Since Reduced mass(μ) = Br-H > Cl-H > F-H & m_1 : Br > Cl > F,