Answer on Question#40739-Chemistry-Inorganic Chemistry

Question

Calculate the fundamental frequency of H Cl 1 35 bond if its force constant value is 516 $N \cdot m^{-1}$.

Solution

The fundamental vibration frequency of a chemical bond is calculated by the formula:

$$\nu_o = \frac{1}{2\pi}\sqrt{\frac{k}{\mu}},$$

where, and ***k*** is the force constant of the bond (***k*** = 516 $N \cdot m^{-1}$) and ***μ*** is the reduced mass of the diatomic molecule, equal to

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

In case of H–Cl m_1 = $1 \cdot 10^{-27}$kg (H) and m_2 = $35 \cdot 10^{-27}$kg (Cl). Thus

$$\mu = \frac{1 \cdot 10^{-27} \cdot 35 \cdot 10^{-27}}{1 \cdot 10^{-27} + 35 \cdot 10^{-27}} = 9.7 \cdot 10^{-28}\ kg$$

The fundamental frequency of H–Cl bond is

$$\nu_o = \frac{1}{2\pi}\sqrt{\frac{k}{\mu}} = \frac{1}{2 \cdot 3.14}\sqrt{\frac{516}{9.7 \cdot 10^{-28}}} = 1.2 \cdot 10^{14}\ s^{-1} = 1.2 \cdot 10^{5}\ GHz$$

Answer: $1.2 \cdot 10^{14}$ s^{-1}