

### Answer on Question #73583-Physics-Other

In a linear chain of two different types of atoms of masses  $m$  and  $M$  the displacement of the two atoms in the  $k=0$  optical branch are  $u$  and  $v$  respectively. Show that  $u/v = -m/M$

#### Solution

For a diatomic chain (of two different types of atoms of masses  $m$  and  $M$  that interact with same force constant  $C$ ):

$$\frac{u}{v} = \frac{C(1 + e^{-ika})}{2C - M\omega^2}$$

In the  $k=0$  optical branch:

$$\omega^2 = 2C \left( \frac{1}{m} + \frac{1}{M} \right)$$

Thus,

$$\frac{u}{v} = \frac{C(1 + e^{-i(0)a})}{2C - M\omega^2} = \frac{C(1 + 1)}{2C - M\omega^2} = \frac{C}{C - \frac{1}{2}M\omega^2}$$

$$\frac{u}{v} = \frac{C}{C - \frac{1}{2}M2C \left( \frac{1}{m} + \frac{1}{M} \right)} = \frac{1}{1 - \frac{M}{m} + 1} = -\frac{m}{M}$$

Answer provided by <https://www.AssignmentExpert.com>