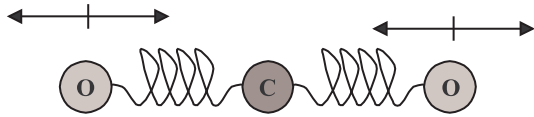


### Chapter 13 Problem 40 †



#### Given

$$f = 4.0 \times 10^{13} \text{ Hz}$$

$$m_O = 16 u$$

$$1u = 1.67 \times 10^{-27} \text{ kg}$$

#### Solution

Find the effective spring constant for the carbon-oxygen bond.

The oxygen atom acts like it is attached to a spring which in turn is attached to a fixed object (carbon atom is not moving). The natural frequency of a mass on a spring is given as

$$\omega_0 = \sqrt{\frac{k}{m}}$$

The angular frequency is related to the frequency by the relationship

$$\omega_0 = 2\pi f$$

Substituting this into the first equation and solving for the spring constant gives

$$2\pi f = \sqrt{\frac{k}{m}}$$

$$k = m(2\pi f)^2$$

The mass of oxygen atom is 16 times the mass of one atomic unit. Therefore, the effective spring constant is

$$k = 16(1.67 \times 10^{-27} \text{ kg}) ((2\pi)4.0 \times 10^{13} \text{ Hz})^2$$

$$k = 1.69 \times 10^3 \text{ N/m}$$

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†Problem from Essential University Physics, Wolfson