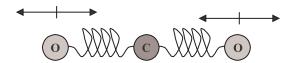
## Chapter 13 Problem 40 <sup>†</sup>



## Given

$$f = 4.0 \times 10^{13} Hz$$
  
 $m_O = 16 u$   
 $1u = 1.67 \times 10^{-27} kg$ 

## 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

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

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

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

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

$$k=1.69\times 10^3~N/m$$

<sup>&</sup>lt;sup>†</sup>Problem from Essential University Physics, Wolfson