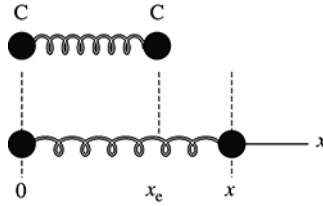


11.22. Model: Assume the carbon-carbon bond acts like an ideal spring that obeys Hooke's law.

Visualize:



The quantity $(x - x_e)$ is the stretching relative to the spring's equilibrium length. In the present case, bond stretching is analogous to spring stretching.

Solve: (a) The kinetic energy of the carbon atom is

$$K = \frac{1}{2}mv^2 = \frac{1}{2}(2.0 \times 10^{-26} \text{ kg})(500 \text{ m/s})^2 = 2.5 \times 10^{-21} \text{ J}$$

(b) The energy of the spring is given by

$$U_s = \frac{1}{2}k(x - x_e)^2 = K$$
$$\Rightarrow k = \frac{2K}{(x - x_e)^2} = \frac{2(2.5 \times 10^{-21} \text{ J})}{(0.050 \times 10^{-9} \text{ m})^2} = 2.0 \frac{\text{N}}{\text{m}}$$