7.42 The potential energy of an interaction is given by $U(x) = ax^2$, where a = 6.4 J/m². (a) If the initial speed of a 0.82 kg object in this system is 2.23 m/s at $x = 0$, how far does the object travel before it reaches a speed of $v = 0$? (b) Does your answer in part a depend on whether the object is traveling in the positive or negative x direction?

$$\Delta E = 0 \Rightarrow E_f - E_i = 0 \Rightarrow E_f = E_i$$

$$\Rightarrow K_i + U_i = K_f + U_f$$

$$\Rightarrow \frac{1}{2}mv_i^2 + U(x_i) = \frac{1}{2}mv_f^2 + U(x_f)$$

$$m = 0.82\ \text{kg}$$

$$v_i = 2.23\ \text{m/s},\ x_i = 0$$

$$v_f = 0,\ x_f = ?$$

$$\Rightarrow \frac{1}{2}mv_i^2 = a x_f^2$$

$$\Rightarrow x_f = \pm\sqrt{\frac{mv_i^2}{2a}}$$

$$= \pm\sqrt{\frac{(0.82\ \text{kg})(2.23\ \text{m/s})^2}{2(6.4\ \text{J/m}^2)}}$$

$$= \pm 0.56\ \text{m}$$

(a) 0.56 m

(b) No, $K(v_i) = K(-v_i)$