

39. We adopt the positive direction choices used in the textbook so that equations such as Eq. 4-22 are directly applicable. The coordinate origin is at ground level directly below impact point between bat and ball. The *Hint* given in the problem is important, since it provides us with enough information to find v_0 directly from Eq. 4-26.

- (a) We want to know how high the ball is from the ground when it is at $x = 97.5$ m, which requires knowing the initial velocity. Using the range information and $\theta_0 = 45^\circ$, we use Eq. 4-26 to solve for v_0 :

$$v_0 = \sqrt{\frac{g R}{\sin 2\theta_0}} = \sqrt{\frac{(9.8)(107)}{1}} = 32.4 \text{ m/s} .$$

Thus, Eq. 4-21 tells us the time it is over the fence:

$$t = \frac{x}{v_0 \cos \theta_0} = \frac{97.5}{(32.4) \cos 45^\circ} = 4.26 \text{ s} .$$

At this moment, the ball is at a height (above the ground) of

$$y = y_0 + (v_0 \sin \theta_0) t - \frac{1}{2} g t^2 = 9.88 \text{ m}$$

which implies it does indeed clear the 7.32 m high fence.

- (b) At $t = 4.26$ s, the center of the ball is $9.88 - 7.32 = 2.56$ m above the fence.