

43. We neglect air resistance for the duration of the motion (between “launching” and “landing”), so  $a = -g = -9.8 \text{ m/s}^2$  (we take downward to be the  $-y$  direction). We use the equations in Table 2-1 (with  $\Delta y$  replacing  $\Delta x$ ) because this is  $a = \text{constant}$  motion.

- (a) At the highest point the velocity of the ball vanishes. Taking  $y_0 = 0$ , we set  $v = 0$  in  $v^2 = v_0^2 - 2gy$ , and solve for the initial velocity:  $v_0 = \sqrt{2gy}$ . Since  $y = 50 \text{ m}$  we find  $v_0 = 31 \text{ m/s}$ .
- (b) It will be in the air from the time it leaves the ground until the time it returns to the ground ( $y = 0$ ). Applying Eq. 2-15 to the entire motion (the rise and the fall, of total time  $t > 0$ ) we have

$$y = v_0 t - \frac{1}{2}gt^2 \implies t = \frac{2v_0}{g}$$

which (using our result from part (a)) produces  $t = 6.4 \text{ s}$ . It is possible to obtain this without using part (a)’s result; one can find the time just for the rise (from ground to highest point) from Eq. 2-16 and then double it.

- (c) SI units are understood in the  $x$  and  $v$  graphs shown. In the interest of saving space, we do not show the graph of  $a$ , which is a horizontal line at  $-9.8 \text{ m/s}^2$ .

