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 \(-9.8 \text{ m/s}^2\).