10. We know the distance between the pitcher's mound and home plate, and we know the horizontal speed of the ball, so we can calculate the time of flight. In the absence of air resistance the speed in the horizontal direction will be a constant 90 miles/hour (40.2 m/s). With no acceleration the relationship between the displacement and speed is

$$\Delta x = v\,t.$$

We want to determine the time of flight, so we divide each side of the equation by v to get

$$(\Delta x / v) = v\,t / v$$

$$t = \Delta x / v$$

$$t = (18.44\text{ m}) / (40.2\text{ m/s})$$

$$t = 0.459\text{ s}$$

For an object in free fall with an initial velocity of zero in the vertical direction the vertical displacement is

$$\Delta y = -(1/2)\,g\,t^2$$

We determined above that the time of flight is $t = 0.459$ s.

$$\Delta y = -(1/2)\,(9.8\text{ m/s}^2)\,(0.459\text{s})^2$$

$$\Delta y = -1.03\text{ m}$$

This shows that when the baseball reaches home plate the baseball will be 1.03 m (3.38 ft) below the level at which it was released. This explains why the pitcher stands on a mound. Note that the time of travel for the baseball is less than half a second. This does not offer the batter much time to decide whether and where to swing the bat.