10. A horizontal rifle is fired at a bull's-eye. The muzzle speed of the bullet is 670 m/s. The gun is pointed directly at the center of the bull's-eye, but the bullet strikes the target 0.025 m below the center. What is the horizontal distance between the end of the rifle and the bull's-eye?

The distance below the center of the bullseye and the point where the bullet hits is due to the gravity pulling the bullet down while in flight. The time the bullet falls is equal to the time the bullet travels from the rifle to the bullseye. So we can find the time the bullet is in flight from the distance the bullet fell. We first consider the vertical motion.

We know v_{0y} =0, a_y = g since there is no upward motion of the bullet, we will just leave everything positive. We want time and we know y so the equation

$$y = v_{0y}t + \frac{1}{2}a_y t^2 = \frac{1}{2}gt^2$$

Is useful. Now solve for time

$$t^2 = \frac{2y}{g}$$

$$t = \sqrt{\frac{2y}{g}} = \sqrt{\frac{2(0.025\ m)}{9.80\ {}^{m}/_{s^2}}} = \sqrt{5.102\ s^2} = 7.143\ x\ 10^{-2} s$$

The x motion has v_{0x} = 670 m/s, a_x = 0 as there is no air resistance being accounted for, we now have a time t = 0.0714 s and we can find x using

$$x = v_{0x}t + \frac{1}{2}a_x t^2 = v_{0x}t = (670\ {}^{m}/_{s})(0.0714\ s) = 47.84\ m$$

$$\boxed{x = 48\ m}$$