

87. We adopt the positive direction choices used in the textbook so that equations such as Eq. 4-22 are directly applicable.

(a) With the origin at the firing point, the y coordinate of the bullet is given by $y = -\frac{1}{2}gt^2$. If t is the time of flight and $y = -0.019$ m indicates where the bullet hits the target, then

$$t = \sqrt{\frac{2(0.019)}{9.8}} = 6.2 \times 10^{-2} \text{ s.}$$

(b) The muzzle velocity is the initial (horizontal) velocity of the bullet. Since $x = 30$ m is the horizontal position of the target, we have $x = v_0t$. Thus,

$$v_0 = \frac{x}{t} = \frac{30}{6.3 \times 10^{-2}} = 4.8 \times 10^2 \text{ m/s.}$$