

A rifle with a barrel length of 60 cm fires a 10 g bullet with a horizontal speed of 410 m/s. The bullet strikes a block of wood and penetrates to a depth of 13 cm.

- (1) What constant resistive force does the wood exert on the bullet?
- (2) How long does it take the bullet to stop?
- (3) Sketch v vs. t for the bullet as it enters the wood and comes to rest.

Solution (1)

$$F = ma$$

$$v^2 = v_0^2 + 2a \Delta x$$

$$a = \frac{v^2 - v_0^2}{2 \Delta x}$$

$$F = m \left(\frac{v^2 - v_0^2}{2 \Delta x} \right)$$

$$v = 0 \text{ m/s}$$

$$v_0 = 410 \text{ m/s}$$

$$\Delta x = 12 \text{ E-2 m}$$

$$m = 10. \text{ E-3 kg}$$

$$F = 10. \text{ E-3 kg} \frac{(0 \text{ m/s})^2 - (410 \text{ m/s})^2}{2 (12 \text{ E-2 m})}$$

$$= \boxed{7.0 \text{ E3 N}}$$

Solution (2)

$$\text{from (1)} \quad a = \frac{v^2 - v_0^2}{2 \Delta x}$$

$$v = v_0 + a \Delta t$$

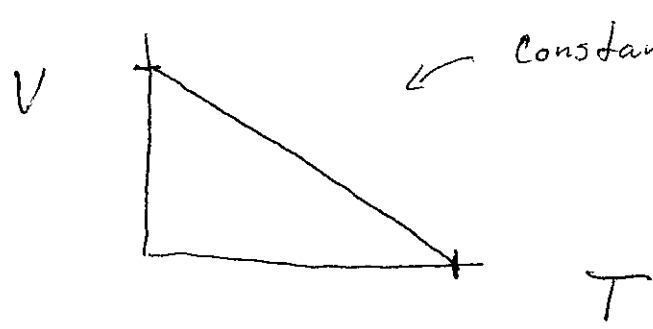
$$\Delta t = \frac{v - v_0}{a} = \frac{v - v_0}{\left(\frac{v^2 - v_0^2}{2 \Delta x}\right)} = \frac{(v - v_0) 2 \Delta x}{v^2 - v_0^2}$$

$$= \frac{(0 - 410 \text{ m/s}) 2 (12 \text{ E-} 2 \text{ m})}{0^2 - (410 \text{ m/s})^2}$$

$$= 5.85 \text{ E-} 4 \text{ s}$$

$$\boxed{5.9 \text{ E-} 4 \text{ s}}$$

Solution (3)



constant $F \Rightarrow$ constant a
 \Rightarrow constant slope
 v vs T