

More Kinematics + Freefall problems

1. A bullet from a rifle with a velocity of 330 m/s is fired into a dense material that stops the bullet in a distance of 30 cm. What is the bullet's acceleration?

$$V_f^2 = V_i^2 + 2ad$$

$$0 = 330^2 + 2(.3)a$$

$$0 = 108900 + .6a$$

$$a = \frac{-108900}{.6}$$

$$a = -182000 \text{ m/s}^2$$

$V_i = 330$   
 $V_f = 0$   
 $d = .3$   
 $a = ?$   
 $t = *$

2. A bullet traveling horizontally with a velocity of 350 m/s hits a board and passes through emerging with a speed of 210 m/s. If the thickness of the board is 4.0 cm, how much time does it take for the bullet to pass through?

$V_i = 350$   
 $V_f = 210$   
 $d = .04$   
 $a = *$   
 $t = ?$

$$d = \frac{V_i + V_f}{2} t$$

$$.04 = \frac{350 + 210}{2} t$$

$$280t = 0.04$$

$$t = 0.00014 \text{ sec}$$

3. A student drops a ball from the top of a tall building; it takes 2.8 seconds for the ball to reach the ground.

- a) What was the ball's speed just before hitting the ground?

$$V_f = V_i + at$$

$$V_f = 0 - 9.8(2.8) = -27.4 \text{ m/s}$$

$V_i = 0$   
 $V_f = ?$   
 $d =$   
 $a = -9.8$   
 $t = 2.8$

- b) What was the height of the building?

$$d = \frac{V_i + V_f}{2} t = \frac{0 + 27.4}{2} (2.8) = 38.4 \text{ m}$$

4. A Boy throws a stone straight up with an initial speed of 15 m/s.

- a) What is the maximum height the stone reached before it begins to fall back down?

$$V_f^2 = V_i^2 + 2ad$$

$$0 = 15^2 + 2(-9.8)d$$

$$225 = 19.6d$$

$$d = 225/19.6 = 11.5 \text{ m}$$

- b) What is the speed of the stone as it hits the ground?

$$V_f = -15 \text{ m/s}$$

$V_i = 15$   
 $V_f = 0$   
 $d = ?$   
 $a = -9.8$   
 $t = *$

- c) How long was the stone in the air?

$$V_f = V_i + at$$

$$-15 = 15 - 9.8t$$

$$9.8t = 30$$

$$t = 30/9.8 = 3.06 \text{ sec}$$