Name ___KEY___

Free Fall Problems

1 a) A cannon fires a cannonball straight up at 30 m/s. How long is the cannonball in the air? (time up and down)

$$V_f = V_i + at \qquad t = \frac{30}{9.8} = 3.06 \; sec$$
$$0 = 30 - 9.8t \qquad \qquad \text{TimE to toP}$$
$$9.8t = 30 \Rightarrow \qquad \text{of Path}$$

$V_i = 30 m/s$
$V_f = 0$
$d = *$
$a = -9.8$
$t = \; ?$

Total = 3.06(2)
6.1 sec

b) How high does the cannonball go? 3.06

$$d = \frac{V_i + V_f}{2} \cdot t = \frac{0+30}{2}(6.1) = \boxed{45.9 \; m}$$

2 a) An archer fires an arrow straight up into the air. She times the arrow and it is in the air for 5 seconds. How high does the arrow go in 2.5 seconds (the top of the path)? (hint What is the velocity at the top of the path?)

$$d = V_f \cdot t - \tfrac{1}{2}at^2$$
$$d = 0 - \tfrac{1}{2}(-9.8)(2.5)^2 = \boxed{30.6 m}$$

b) How fast did she shoot the arrow? (what is the initial velocity?)

$$V_f = V_i + at \qquad \boxed{V_i = 24.5 m/s}$$
$$0 = V_i - 9.8(2.5)$$

$V_i = *$
$V_f = 0$
$d = ?$
$a = -9.8$
$t = 2.5$

c) How fast is the arrow going when it hits the ground?

$$V_f = V_i + at$$
$$V_f = 0 - 9.8(2.5) \qquad \boxed{V_f = -24.5 m/s}$$

3 a) A mountain climber wants to figure out how high a cliff is, so he drops a rock off the ledge. The rock takes 2.6 seconds to hit the ground. How high is the cliff?

$$d = V_i t + \tfrac{1}{2}at^2$$
$$d = 0 + \tfrac{1}{2}(-9.8)(2.6)^2 = \boxed{-33.1m \; displacement}$$
33.1 m high

$V_i = 0$
$V_f = *$
$d = ?$
$a = -9.8$
$t = 2.6$

b) How fast does the rock hit the ground?

$$V_f = V_i + at$$
$$V_f = 0 - 9.8(2.6) = \boxed{25.5 \; m/s}$$

c) What acceleration does the rock experience?

$$\boxed{a = -9.8 \; m/s^2}$$