

## MOTION PRACTICE #3 ANSWER KEY

1. You accelerate your car from the metered ramp onto the freeway.
- a. If your car goes from rest ( $0 \text{ mi/hr}$ ) to  $60 \text{ mi/hr}$  in 10 seconds, what is the value of the acceleration of the car? Express in both  $\text{mi/hr}^2$  AND  $\text{m/s}^2$ .

$$V_1 = 0$$

$$V_2 = 60 \text{ mi/hr} = 26.8 \text{ m/s}$$

$$\Delta t = 10 \text{ s} = 0.0028 \text{ hr}$$

$$a = \frac{V_2 - V_1}{\Delta t}$$

$$a = \frac{(60 - 0) \text{ mi/hr}}{0.0028 \text{ hr}} = \boxed{21,000 \text{ mi/hr}^2}$$

$$\frac{60 \text{ mi}}{\text{hr}} \left| \frac{1,609 \text{ (m)}}{1 \text{ mi}} \right| \left| \frac{1 \text{ hr}}{3600 \text{ (s)}} \right| = \underline{26.8 \text{ m/s}}$$

$$a = \frac{(26.8 - 0) \text{ m/s}}{10 \text{ s}} = \boxed{2.7 \text{ m/s}^2}$$

- b. How far, in meters, did your car travel during the above acceleration?

$$V_1 = 0 \text{ m/s}$$

$$a = 2.7 \text{ m/s}^2$$

$$t = 10 \text{ s}$$

$$d = ?$$

$$d = v_1 t + \frac{1}{2} a t^2$$

$$= \frac{1}{2} (2.7 \text{ m/s}^2) (10 \text{ s})^2$$

$$d = 134 \text{ m} \Rightarrow \boxed{d = 130 \text{ m}}$$

2. You are pushing your friend in a wheelbarrow race. Good times! If you go from rest to  $3.2 \text{ m/s}$  in 6 seconds accelerating uniformly:

- a. What was your average speed?

$$V_1 = 0 \text{ m/s}$$

$$V_2 = 3.2 \text{ m/s}$$

$$\bar{v} = \frac{V_1 + V_2}{2}$$

$$= \frac{0 + 3.2 \text{ m/s}}{2}$$

$$\boxed{\bar{v} = 1.6 \text{ m/s}}$$

- b. How far did you go during the 6 seconds?

$$\bar{v} = 1.6 \text{ m/s} \quad \bar{v} = \frac{d}{t} \quad \rightarrow \quad d = \bar{v} \cdot t$$

$$t = 6 \text{ s} \quad \quad \quad = (1.6 \text{ m/s})(6 \text{ s})$$

$$d = ? \quad \quad \quad \boxed{d = 9.6 \text{ m}}$$

- c. What was your acceleration?

$$a = ?$$

$$V_1 = 0 \text{ m/s}$$

$$V_2 = 3.2 \text{ m/s}$$

$$\Delta t = 6 \text{ s}$$

$$a = \frac{V_2 - V_1}{\Delta t}$$

$$= \frac{3.2 \text{ m/s} - 0 \text{ m/s}}{6 \text{ s}}$$

$$\boxed{a = 0.53 \text{ m/s}^2}$$

3. You go hiking and want to know how high you are above a canyon. You carefully drop a rock off a ledge. It takes 6 seconds to reach the bottom of the canyon.

Down is + dir.



free fall!

a. How high is the canyon?

$$v_1 = 0 \text{ m/s}$$

$$\rightarrow a = g = 9.80 \text{ m/s}^2$$

$$t = 6 \text{ s}$$

$$d = ?$$

$$d = v_1 t + \frac{1}{2} a t^2$$

$$= \frac{1}{2} (9.80 \text{ m/s}^2) (6 \text{ s})^2$$

$$d = 176 \text{ m} \Rightarrow \boxed{d = 180 \text{ m}}$$

b. Assuming no air resistance, what was the acceleration of the rock as it fell?

$$\boxed{a = g = 9.80 \text{ m/s}^2}$$

Because the rock is in free fall!

c. What is the instantaneous speed, in m/s, of the rock just as it hits the ground?

$v_2 = ?$   
 $d = 176 \text{ m}$   
 $t = 6 \text{ s}$   
 $v_1 = 0$

$$v_2 = v_1 + at$$

$$= 0 + (9.80 \text{ m/s}^2)(6 \text{ s})$$

$$\boxed{v_2 = 59 \text{ m/s}}$$

4. You throw a baseball straight up in the air as hard as you can! It takes 4 seconds to reach the top of its path.



@ top of its path!

free fall →

a. What was the speed, in m/s, of the ball as you released it?

$$v_2 = 0 \text{ m/s}$$

$$t = 4 \text{ s}$$

$$a = -9.80 \text{ m/s}^2$$

$$v_2 = v_1 + at$$

$$v_1 = -at$$

$$= -(-9.80 \text{ m/s}^2)(4 \text{ s})$$

$$\boxed{v_1 = 39 \text{ m/s}}$$

b. How high did the ball go?

$$v_1 = 39 \text{ m/s}$$

$$v_2 = 0 \text{ m/s}$$

$$a = g = -9.80 \text{ m/s}^2$$

$$t = 4 \text{ s}$$

$$d = ?$$

$$d = v_1 t + \frac{1}{2} a t^2$$

$$= (39 \text{ m/s})(4 \text{ s}) + \frac{1}{2} (-9.80 \text{ m/s}^2)(4 \text{ s})^2$$

$$\boxed{d = 78 \text{ m}}$$

c. What was the instantaneous velocity of the ball at the top of its path?

$$V_{\text{top}} = 0 \text{ m/s}$$

The "turn around" point!  
Free fall situation!

d. What was the acceleration of the ball at the top of its path?

$$a = g = -9.80 \text{ m/s}^2$$

The ball is in free fall!

e. Sketch a quantitative v-t graph for the ball for the upward motion (make upward be a positive velocity).

