Motion Problems

NAME_____ DATE_____ BLOCK____

1. Hans stands at the rim of the Grand Canyon and yodels down to the bottom. He hears his yodel echo back from the canyon floor 5.20 s later. Assume that the speed of sound in air is 340.0 m/s. How deep is the canyon at this location?

Given:
$t = 2.6\,s$
$V = 340.0\,m/s$

$d = Vt$
$= (2.6\,s)(340.0\,m/s)$
$= 884\,m$

Answer: 884 m

2. The world speed record on water was set of October 8, 1978 by Ken Warby of Blowering Dam, Australia. If Ken drove his motorboat a distance of 1000 m in 7.045 s, how fast was his boat moving a) in m/s? b) in mi/h?

Given:
$d = 1000\,m$
$t = 7.045\,s$

$V = \frac{d}{t}$
$= \frac{1000\,m}{7.045\,s}$

$\frac{142\,m}{s} \times \frac{1\,mi}{1609\,m} \times \frac{3600\,s}{1\,h} = 317\,mi/h$

Answer: a. 142 m/s

Answer: b. 317 mi/h

3. According to the World Flying Disk Federation, on April 8, 2000, Jennifer Griffin of Fredericksburg, Virginia threw a Frisbee for a distance of 138.56 m to capture the women's record. If the Frisbee was thrown horizontally with a speed of 13.0 m/s, how long did the Frisbee remain aloft?

$V = 13\,m/s$
$d = 138.56\,m$

$t = \frac{d}{V}$
$= \frac{138.56\,m}{13\,m/s}$

Answer: 10.6 s

4. It is now 10:50 a.m., but when the bell rings at 10:51 a.m. Suzette will be late for French class for the third time this week. She must get from one side of the school to the other by hurrying down three different hallways. She runs down the first hallway, a distance of 35.0 m, at a speed of 3.50 m/s. The second hallway is filled with students, and she covers its 48.0-m length at an average speed of 1.20 m/s. The final hallway is empty, and Suzette sprints its 60.0-m length at a speed of 5.00 m/s. a) Does Suzette make it to class on time or does she get detention for being late again? b) How early or late was she?

1st hallway:

$t = \frac{d}{v}$

$= \frac{35.0\text{m}}{3.5\text{m/s}}$

10s

2nd hallway:

$t = \frac{d}{v}$

$= \frac{48.0\text{m}}{1.20\text{m/s}}$

40s

3rd hallway:

$t = \frac{d}{v}$

$= \frac{60\text{m}}{5.00\text{m/s}}$

12s

Answer: a. detention

Answer: b. 2s

5. A jumbo jet taxiing down the runway receives word that it must return to the gate to pick up an important passenger who was late to his connecting flight. The jet is traveling at 45.0 m/s when the pilot receives the message. What is the acceleration of the plane if it takes the pilot 5.00 s to bring the plane to a halt?

$a = \frac{v_f - v_o}{t}$

$= \frac{0\text{m/s} - 45\text{m/s}}{5\text{s}}$

$= \frac{-45\text{m/s}}{5\text{s}} =$

Answer: -9m/s^2

6. While driving his sports car at 20.0 m/s down a four-lane highway, Eddie comes up behind a slow-moving dump truck and decides to pass it in the left-hand lane. If Eddie can accelerate at 5.00 m/s^2, how long will it take for him to reach a speed of 30.0 m/s?

$$t = \frac{V_f - V_0}{a}$$

$$= \frac{30\,m/s - 20\,m/s}{5.00\,m/s^2} = \frac{10\,m/s}{5\,m/s^2}$$

Answer: 2 s

7. Vivian is walking to the hairdresser's at 1.3 m/s when she glances at her watch and realizes that she is going to be late for her appointment. Vivian gradually quickens her pace at a rate of 0.090 m/s^2. What is Vivian's speed after 10.0 s?

$$V_f = V_0 + at$$

$$= 1.3\,m/s + (.090\,m/s^2)(10s)$$

$$= 1.3\,m/s + .9\,m/s$$

Answer: 2.2 m/s

8. Billy, a mountain goat, is rock climbing on his favorite slope one sunny spring morning when a rock comes hurtling toward him from a ledge 40.0 m above. Billy ducks and avoids injury. a) How fast is the rock traveling when it passes Billy? b) How does the speed compare to that of a car traveling down the highway at the speed limit of 25 m/s (equivalent to 55 mi/h)?

$d = 40\ m$ $\quad V_0 = 0\ m/s$

$g = 9.8\ m/s^2$

a. $V_f = \sqrt{V_0^{2\,0} + 2gd}$

$= \sqrt{2(9.8\ m/s^2)(40\ m)}$

$= \sqrt{784\ m^2/s^2}$

Answer: a. 28 m/s

Answer: b. faster

9. Reverend Northwick climbs to the church belfry one morning to determine the height of the church. From an outside balcony he drops a book and observes that it takes 2.00 s to strike the ground below. a) How high is the balcony of the church belfry? b) Why would it be difficult to determine the height of the belfry balcony if the Reverend dropped only one page out of the book?

$t = 2\ s$

$V_0 = 0\ m/s$

$g = 9.8\ m/s^2$

$d = V_0^{\,0}t + \frac{1}{2}gt^2$

$= \frac{1}{2}(9.8\ m/s^2)(4\ s^2)$

$= 19.6\ m$

Answer: a 19.6 m

Answer: b It would float

10. How long is Tina, a ballerina, in the air when she leaps straight up with a speed of 1.8 m/s?

$V_o = -1.8\ m/s$

$V_f = 0\ m/s$

$$t = \frac{V_f - V_o}{g}$$

$$= \frac{0\ m/s - (-1.8\ m/s)}{9.8\ m/s^2}$$

$$= \frac{1.8\ m/s}{9.8\ m/s^2} = .18\ s \times 2 = .36\ s$$

Answer: .36 s

11. In order to open the clam it catches, a seagull will drop the clam repeatedly onto a hard surface from high in the air until the shell cracks. If a seagull flies to a height of 25 m, how long will the clam take to fall?

$d = 25\ m$

$$t = \sqrt{\frac{2d}{g}}$$

$$= \sqrt{\frac{50\ m}{9.8\ m/s^2}} = \sqrt{5.1\ s^2}$$

Answer: 2.3 s

12. At Six Flags Great Adventure, a popular ride known as "Free Fall" carries passengers up to a height of 33.5 m and drops them to the ground inside a small cage. How fast are the passengers going at the bottom of this exhilarating journey?

$d = 33.5$

$V_o = 0$

$$V_f = \sqrt{V_o^2 + 2gd}$$

$$= \sqrt{2(9.8\ m/s^2)(33.5\ m)}$$

$$V_f = \sqrt{656.6\ m^2/s^2}$$

$$V_f = 25.6\ m/s$$

Answer: 25.6 m/s

13. A unique type of basketball is played on the planet Zarth. During the game, a player flies above the basket and drops the ball in from a height of 10 m. If the ball takes 5.0 s to fall, find the acceleration due to gravity on Zarth.

$$g = \frac{2d}{t^2}$$

$$= \frac{20m}{25s^2}$$

$$= .8\ m/s^2$$

Answer: $.8\ m/s^2$

14. A torpedo fired from a submerged submarine is propelled through the water with a speed of 20.00 m/s and explodes upon impact with a target 2000 m away. If the sound of the impact is heard 101.4 s after the torpedo was fired, what is the speed of sound in water? (Because the torpedo is held at a constant speed by its propeller, the effect of water resistance can be neglected.)

Torpedo: $t = \frac{d}{v}$

$$= \frac{2000m}{20m/s} = 100\ s$$

$$101.4s - 100\ s = 1.4s$$

$$v = \frac{d}{t} = \frac{2000m}{1.4s} = 1428\ m/s$$

Answer: _____