Linear Motion and Freefall
Physics First Honors 2012/13

Name __K E y__

## Linear Motion Review

A 1. On a distance vs. time graph, a straight horizontal line indicates ____ motion.

    a. no   b. increasing   c. decreasing   d. acceleration

d 2. On a velocity vs. time graph, a straight diagonal line with an upward slope indicates _____ .

    a. no motion   b. increasing motion   c. decreasing motion   d. acceleration

b 3. On a velocity vs. time graph, the motion of a car traveling along a straight road with a uniform acceleration of 2 m/s^2 would appear as a _____.

    a. horizontal straight-line   b. straight line sloping up to the right
    c. straight line sloping up to the left   d. curved line whose upwardslope
                                              increases with time

C 4. A bicycle travels 12 km for 40 minutes its average speed is _____km/hr. $S = \frac{\Delta d}{\Delta t} = \frac{12}{2/3}$

    a. 0.30   b. 8.0   c. 18.0   d. 48

C 5. A car travels 40 km/hr for 2.0 hr and 50 km/hr for 1.0 hr and 20 km/hr for 0.5 hr. The cars average speed is _____km/hr.

    a. 31   b. 45   c. 40   d. 55 $S = \frac{\Delta d}{\Delta t} = \frac{80+50+10}{2+1+.5}$

A 6. How long does a car with an acceleration of 2.0 m/s^2 take to go from 10 m/s to 30 m/s?

    a. 10 s   b. 20 s   c. 40 s   d. 400 s   Equation #1

A 7. A car undergoes a constant acceleration of 6.0 m/s^2, starting from rest. In the first second it travels _____m

                                                  Equation 3

    a. 3   b. 6   c. 18   d. 36 m

C 8. An airplane requires 20 s and 400. m of runway to become airborne, starting from rest. Its velocity when it leaves the ground is _____ m/s.

                                                  Equation 2

    a. 20   b. 32   c. 40   d. 80

d 9. A car has an initial velocity of 15 m/s and an acceleration of 1.0 m/s^2. In the first 10 s after the acceleration begins, the car travels _____m.

                                                  Equation 3

    a. 50   b. 150   c. 155   d. 200

C 10. A car has an initial velocity of 15 m/s and an acceleration of -1.0 m/s^2. In the first 10 s after the acceleration begins, the car travels _____m.

                                     Equation 3

    a. 25   b. 50   c. 100   d. 145

A 11. A ball thrown vertically upward at 25 m/s continues to rise for approximately ___s.

    a. 2.5   b. 5.0   c. 7.5   d. 10

_b_ 12. In question #11, how much time will pass before the ball strikes the ground.

    a. 2.5 s   b. 5.0 s   c. 7.5 s   d. 10 s

**Use the graph to the right to answer questions 14 - 17**

_B_ 13. Which section indicates the object is not moving?

_C_ 14. Which section indicates the object is moving back toward the original position?

_A_ 15. Which section indicates the object is moving forward?

___ 16. What is the velocity of segment "A"?
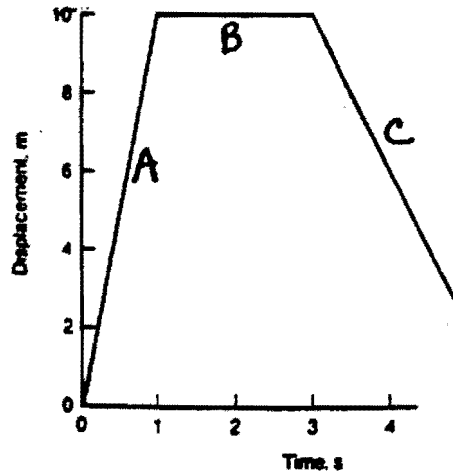
$$\frac{10}{1} = 10 \, m/s$$

Use the graph to the right to answer questions 18–19

___ 17. What is the acceleration of the object at 25.0 s?

___ 18. When does the object turn around and head back?
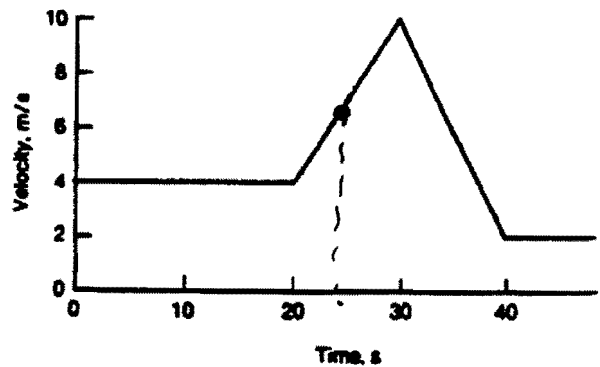
17) $V_f - V_i = 10 - 4 = 6 \, m/s$

$a = \frac{\Delta V}{\Delta t} = \frac{6}{10} = 0.6 \, m/s^2$
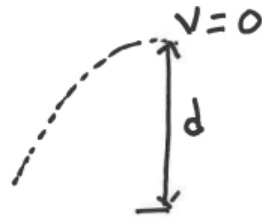
18) Never Velocity is > 0 Everywhere

Written Problems:
(work on a separate sheet of paper)

1.   A batter hits a ball into the air and it takes 9 seconds to return to the ground. How high does the ball go?

$V = 0$

Look @ Going
from The Bottom
to The Top

TIME TO the top
$= \frac{1}{2}(\text{Total time})$

$V_i = *$
$V_f = 0$ @ top
$d = ?$
$a -9.8$
$t = 9 \div 2 = 4.5$ sec

$d = V_i t - \frac{1}{2}at^2$

$d = -\frac{1}{2}(-9.8)(4.5)^2 = \boxed{99.2m}$

2.   A rocket is shot off at 75 m/s, how long does it take to reach its highest point?

$V = 0$ @ TOP

$V_i = 75 m/s$
$V_f : 0$
$d : *$
$a : -9.8$
$t : ?$

$V_f = V_i + at$
$0 = 75 - 9.8t$
$9.8t = 75$
$t = 75/9.8 = \boxed{7.65\ Sec}$

3.   A Kangaroo rat can jump as high as 9 feet (2.75 meters), what is its hang time?

$y = 0$ @ top

$V_i *$
$V_f = 0$
$d = 2.75$
$a = -9.8$
$t = ?$

$d = V_f t - \frac{1}{2}at^2$
$2.75 = -\frac{1}{2}(-9.8)t^2$
$2.75 = 4.9\ t^2$
$\dfrac{2.75}{4.9} = \dfrac{4.9}{4.9}$
$t = \sqrt{0.561} = \boxed{0.749\ Sec}$

Hang time is 2 x the time to the top = 1.5 seconds

        What is its initial velocity?

Find V_i

$V_f = V_i + at$

$0 = V_i - 9.8(.749)$

$V_i = 7.34 \text{ sec}$

Use a blank sheet of paper to answer the following questions.
  Remember for full credit show, Givens – Drawing – Formula – Substitution - Answer

1.   a. Explain the difference between instantaneous and average speed.

> *Average speed is the speed over a specific range of time while instantaneous speed as a speed at a specific time. Average speed is calculated as total distance traveled divided by the total time. Instantaneous speed is the slope of a line at a specific point.*

   b. What is velocity?

> *Velocity is a vector quantity representing the change in distance in a specified amount of time. V = Δd / Δt*

   c. What is acceleration?

> *Acceleration is a vector quantity representing the change in velocity in a specified amount of time. a = Δv / Δt*

   d. What equation would be used to find the acceleration of something that changes its velocity in some uniform way over a given time interval?

> *a = Δv / Δt*

   e. Why would a piece of paper and a tennis ball fall at different rates if dropped in the classroom? How could you get them to fall at the same rate?

> *They fall at different rates because air resistance affects the paper more than the ball. You can get them to fall at the same rate by placing them in a vacuum.*

2.   a. What is the difference between speed and velocity?

> *Speed is a scalar quantity which just means how fast is something going. Velocity is a vector which means it has both size (how fast) and direction. 10 m's is a scalar, 10 m/s up is a vector. Vectors are used when direction is an important thing to know.*

   b. If you move at a constant speed can you be accelerating? Explain and give an example.

> *You can be accelerating if you are moving at a constant speed because your direction could be changing. By changing your direction, you are changing your velocity and acceleration is Δv / Δt*

3.   a. What is the average speed of a driver who accelerates from 10 mph to 82 mph in 4.2 seconds?

$$V_{avg} = \frac{V_f + V_i}{2} = \frac{10 + 82}{2} = 46 \text{ mph}$$

b. What is his acceleration?

$$a = \frac{\Delta V}{\Delta t} = \frac{82 - 10}{4.2} = \frac{17 \text{mph}}{\text{sec}}$$

c. What is the driver's instantaneous speed after 4.2 second? $V_f = 82 \text{ mph}$

4.   a. Ignoring air resistance, if a rock is dropped from a cliff that is 50 m tall, how long would it take to hit the ground?

$V_i = 0$ $d = \frac{1}{2}at^2$ $t^2 = \frac{50}{4.9} = 10.2$
V_f *
$d = 50$ $50 = \frac{1}{2}(9.8)t^2$ $t = \sqrt{10.2}$ ⟨3.19 sec⟩
a -9.8
t t $50 = 4.9 t^2$

b. How fast would that rock hit the ground?

$$V_f = V_i + at = 9.8(3.19) = \boxed{31.3 \text{ m/s}}$$

c. What acceleration would the rock experience? -9.8 m/s^2

5.   Ignoring air resistance, if Keith "The Pop-Up King" Moreland hits a baseball straight up at a speed of 45 m/s.
       a. What will be the ball's velocity at the peak of the hit? $V = 0$

       b What will be the ball's acceleration at the peak of the hit? $a = -9.8 \text{ m/s}^2$

       c. What will be the ball's velocity as it hits the ground? -45 m/s
       d. how long will the ball be in the air?

$V_i = 45$ $V_f = V_i + at$
$V_f = 0$
$d =$ * $0 = 45 - 9.8t$ $t = \frac{45}{9.8} = $ ⟨4.59 sec⟩   4.59 seconds is the time to
$a = -9.8$ the top, you need to multiply
$t = $? $9.8t = 45$ by 2 to get the total time:

       e. How high will the ball go?   Time = 4.59 x 2 = 9.18 sec.

$$d = \frac{1}{2}at^2 = \frac{1}{2}(9.8)(4.59)^2 = \boxed{103 \text{ m}}$$