A1

PHY 111 Terms used in physics

___e_

___o___y

___e__r__i__

g_____y __r__

k__et__ ____g_

_r_ct___

_i_ __s_st____

m___ntu_

c_____p_t__ _____

p_t____a_ _n____

n_r__l __r__

t__q__

2

PHY 111 Definition of speed and unit conversion

Speed = _____

1. If you travel from Phoenix to LA (390 miles) in 6 hours, what is your average speed?

2. At a speed of 600 miles/hour, how long would it take to fly to the 5100 miles from Phoenix to London?

3. If 1.6 km is roughly equal to 1 mile, what is the essential value of $\frac{1.6\,\text{km}}{1\,\text{mile}}$?

4. Convert 50 $\frac{\text{miles}}{\text{hour}}$ to units of $\frac{\text{km}}{\text{hour}}$ using the ration of $\frac{1.6\,\text{km}}{1\,\text{mile}}$.

5. Convert 20 $\frac{\text{miles}}{\text{hour}}$ to units of $\frac{\text{m}}{\text{sec}}$ using 1 mile = 1609 meters and 1 hour = 3600 sec.

PHY 111 Definition of speed #2

$$\text{speed} = \frac{\text{distance traveled}}{\text{time it takes}} = \frac{\Delta x}{\Delta t}$$

1. On a road trip, a car traveled 300 miles in 5 hours. What was the average speed of the car in miles per hour?

2. A car starts at mile marker 50 and 45 minutes later is at mile marker 86. What was the average speed of the car in miles per hour during this time interval?

3. A track athlete runs 100 meters in 12 seconds. What is the average speed of the runner in meters per second?

Velocity of an object contains *two* pieces of information:

1. the speed of the object.

2. the direction of the object's motion.

Examples of velocity:

20 meters/second to the right

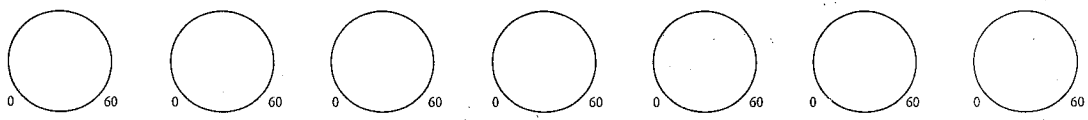
50 miles/hour to the north

+15 m/sec along the x axis

–15 m/sec along the x axis

An example of acceleration.

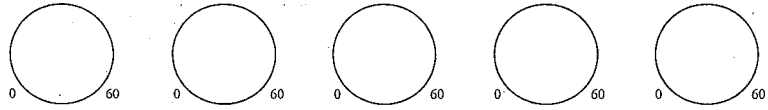
1. A car accelerates at a constant rate from 0 to 60 mph in 6 seconds. Draw the position of the speedometer needle at each one second interval.



$t = 0$ $t = 1$ $t = 2$ $t = 3$ $t = 4$ $t = 5$ $t = 6$

By how much does the car's velocity increase each second? Express the rate of increase of the car's velocity as a rate per second.

2. A car accelerates at a constant rate from 0 to 60 mph in 4 seconds. Draw the position of the speedometer needle at each one second interval.



$t = 0$ $t = 1$ $t = 2$ $t = 3$ $t = 4$

By how much does the car's velocity increase each second? Express the rate of increase of the car's velocity as a rate per second.

3. Use the definition $a = \Delta v / \Delta t$ to find the acceleration in the two cases above.

What is the acceleration of each moving object? Which object has the greatest acceleration? Which has the least?

*** Sprinter: 0 to 10 m/sec in 4 seconds.**

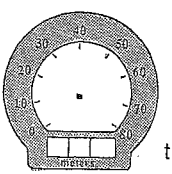
*** Train: 0 to 30 m/sec in 2 minutes.**

*** Corvette: Constant speed of 50 m/sec.**

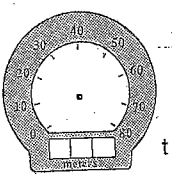
Follow up: What is the approximate speed in miles/hour of 10 m/sec? 30 m/sec? 50 m/sec?

Acceleration and speedometers

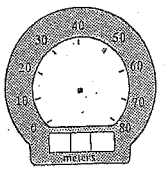
A car is initially traveling at a speed of 30 m/sec and begins to accelerate at a rate of 2 m/sec/sec. Indicate the velocity of the car at the times indicated.



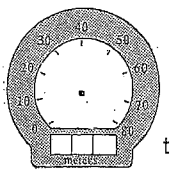
t = 0 s



t = 1 s

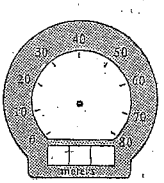


t = 2 s

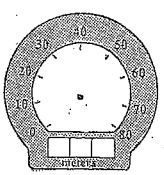


t = 3 s

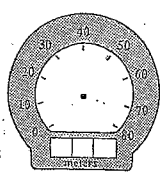
A car is initially traveling at a speed of 60 miles /hr and begins to decelerate at a rate of 5 miles /hr /sec. Indicate the velocity of the car at the times indicated.



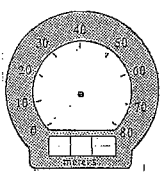
t = 0 s



t = 2 s

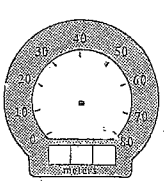


t = 4 s

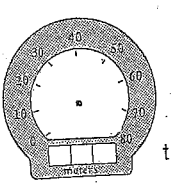


t = 6 s

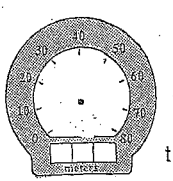
A car is initially traveling at a speed of 80 miles/hr and begins to decelerate at a steady rate, coming to a stop over a time of 20 seconds. Show the velocity of the car at the times indicated.



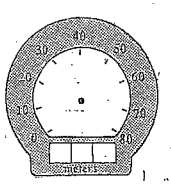
t = 0 s



t = 3 s



t = 6 s



t = 9 s

Motion Diagrams: 3 cases

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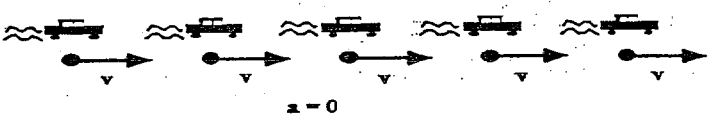

Fig. 1.3 The motion diagram for an object moving with a constant velocity. The acceleration is zero because the velocity is not changing.

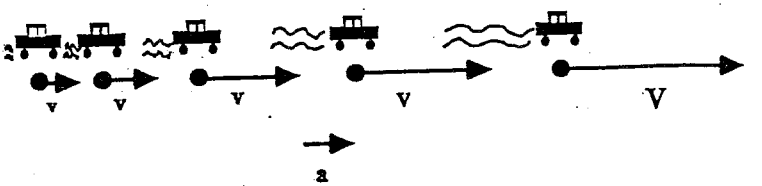

Fig. 1.4 A motion map for an object that is accelerating in the direction of its velocity. The velocity increases as time progresses.

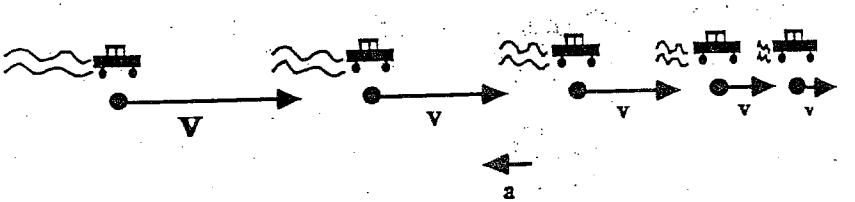

Fig. 1.5 A motion diagram for an object whose acceleration points opposite the velocity. The magnitude of the velocity decreases as time progresses.

PHY 111 Acceleration or velocity

1) Identify each as an expression velocity or acceleration
2) If the expression is an acceleration, (a) give an example of an object speeding up and (b) another example of an object slowing down. **Draw a motion diagram for each case.** You may choose the initial velocity. Assume all objects are moving to the right.

* 10 m/sec

* 5 m/sec^2

* 15 miles/hour

* 20 km/hour/sec

* 5 km/hour

* 6 miles/hour/sec

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PHY 111 **Acceleration practice**

1. At $t = 0$, a car is traveling at a speed of 45 miles/hour to the right. It is gaining speed (accelerating) at a rate of 4 miles/hour/second. (a) Give the speed of the car over the next 4 seconds.

$t = 0$ $t = 1$ $t = 2$ $t = 3$ $t = 4$
45 mph

b) Draw the motion diagram. (Draw severqal velocity vectors and an acceleration vector.)

c) At this same rate of acceleration, how many seconds will it take the car to reach a speed of 85 mph?

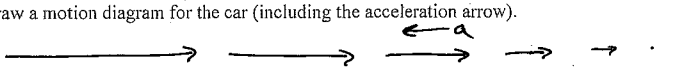
2. A ball has been thrown upward with a speed of 75 m/sec. It is *decelerating* at a rate of 10 m/sec/sec at is continues to move upward. (a) Draw a motion diagram for the ball in the margin of the paper. Include the acceleration arrow.

b) Give the speed of the ball over the next 4 seconds.

$t = 0$ $t = 1$ $t = 2$ $t = 3$ $t = 4$
75 m/sec

b) How many seconds will it take for the ball to reach the top of its trajectory? (Rephrase: How many seconds will it take for the ball to reach a speed of zero?)

3. A car has an initial velocity of 40 m/sec and takes 8 seconds to come to a stop.
a) Draw a motion diagram for the car (including the acceleration arrow).



b) Find the acceleration of the car.

$$a = \frac{\Delta v}{\Delta t} = \frac{-40\ m/s}{8s} = -5\ m/sec/sec$$

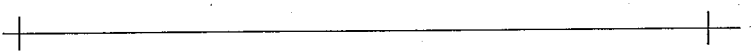
$$a = \frac{v_f - v_o}{t_f - t_o} = \frac{0 - 40}{8} = -5\ m/sec/sec$$

PHY 111 Find the distance traveled

1. A car travels at a constant speed of 30 m/sec for 6 seconds.

Draw a motion diagram (including the acceleration). Fill in the information.

$t_o = 0$ $t_f =$
$x_o = 0$ $x_f =$
$v_o =$ $v_f =$



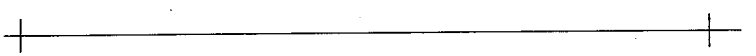
Average speed of car =

Distance traveled for that time interval =

2. A car goes from 0 to 20 m/sec in 4 seconds.

Draw a motion diagram (including the acceleration). Fill in the information.

$t_o = 0$ $t_f =$
$x_o = 0$ $x_f =$
$v_o =$ $v_f =$



Average speed of car =

Distance traveled for that time interval =

3. A car slows from 30 to 10 m/sec over a time interval of 5 seconds.

Draw a motion diagram (including the acceleration). Fill in the information.

$t_o = 0$ $t_f =$
$x_o = 0$ $x_f =$
$v_o =$ $v_f =$

Average speed of car =

Distance traveled for that time interval =

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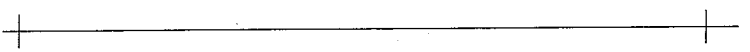
PHY 111 **Find the distance traveled: alternate formulas (#1)**

1. A car goes from 0 to 30 m/sec in 5 seconds.

Draw a motion diagram (including the acceleration). Fill in the information.

$t_o = 0$ $t_f =$
$x_o = 0$ $x_f =$
$v_o =$ $v_f =$



Average speed of car =

Find the distance traveled for that time interval using

a) $d = v_{ave} * t$

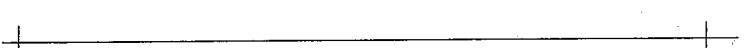
b) $2ad = v_f^2 - v_o^2$

c) $d = \frac{1}{2}at^2$

2. A car slows from 40 to 20 m/sec over a time interval of 10 seconds.

Draw a motion diagram (including the acceleration). Fill in the information.

$t_o = 0$ $t_f =$
$x_o = 0$ $x_f =$
$v_o =$ $v_f =$



Average speed of car =

Find the distance traveled for that time interval using

a) $d = v_{ave} * t$

b) $2ad = v_f^2 - v_o^2$

c) Try $d = \frac{1}{2}at^2$

Name _____ Date _____

CONCEPTUAL **Physics** PRACTICE SHEET

Chapter 2: Linear Motion

Free Fall

When you drop a rock from the top of a cliff it picks up speed as it falls. Pretend that a speedometer and odometer are attached to the rock to show readings of speed and distance at 1-second intervals. Both speed and distance are zero at time = zero (see sketch). Note that after falling 1 second the speed reading is 10 m/s and the distance fallen is 5 m. The speedometer and odometer readings for succeeding seconds of fall are not shown and are left for you as an exercise. So draw the position of the speedometer pointer and write in the correct odometer reading for each time. Use $g = 10\ m/s^2$ and neglect air resistance.

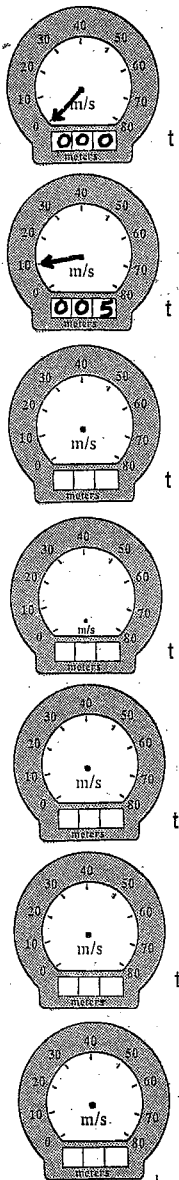
YOU NEED TO KNOW:

Instantaneous speed of fall from rest:

$$v = gt$$

Distance fallen from rest:

$$d = \frac{1}{2}gt^2$$



1. The speed reading increases by the same amount, _____m/s, each second. This increase in speed per second is called _____.

2. The distance fallen increases as the square of the _____.

3. If the rock takes 8 seconds to reach the ground, then its speed at impact is _____m/s, and its acceleration just before impact is _____m/s^2.

PHY 111 **Free fall questions:** $d = \frac{1}{2} gt^2$

1. What is the velocity of an object (initially at rest) that has fallen for 4.5 seconds?

2. What distance has the object fallen after 4.5 seconds?

3. How many seconds will it take a falling object to reach a speed of 60 m/sec?

4. How many seconds will it take a falling object to fall a distance of 60 m?

On Mars the acceleration of gravity us about 4 m/sec/sec.

5. On Mars, how many seconds would it take a falling object to reach a speed of 60 m/sec?

6. On Mars, how many seconds would it take a falling object to fall a distance of 60 m?

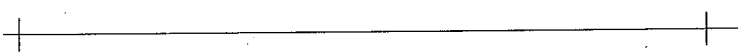
PHY 111 **Kinematics problems**

1. A ball, initially at rest, is dropped from a window 24 meters high.
a) How many seconds does it take the ball to reach the ground?
b) What is the speed of the ball just before it hits the ground? (Draw a motion diagram.)

2. What is the acceleration of a motorcycle if it starts from rest and is going 25 m/s after 10 seconds? How far does the motorcycle travel in that time? (Draw a motion diagram and fill in the known values.)

$t_0 =$
$x_0 =$
$v_0 =$

$t_f =$
$x_f =$
$v_f =$



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A car travels from stop light to stop light in the following way.

I. The car starts at rest and accelerates for 8 seconds at 3 m/sec^2 (from A to B).

II. The car travels at constant speed for 10 seconds (from B to C).

III. The car slows to a stop over a 6 second interval (from C to D).

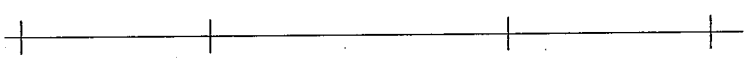
Find the velocity at points A, B, C, and D.

Find the distance traveled in each segment.

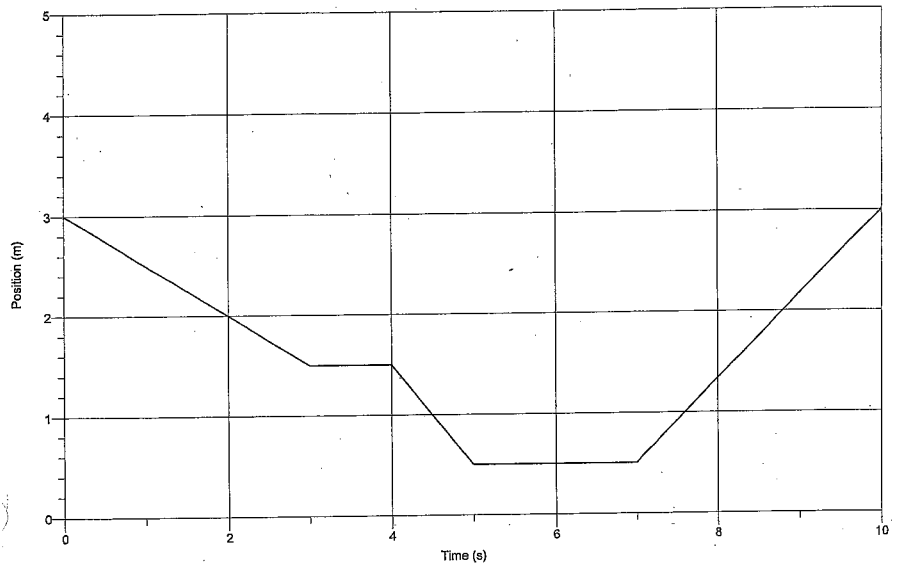
Find the cumulative distance traveled from the first stop light at each point.

Draw a motion diagram. Include an acceleration arrow for each segment of the trip. Fill in the information.

$t_A = 0$	$t_B =$	$t_C =$	$t_D =$
$x_A = 0$	$x_B =$	$x_C =$	$x_D =$
$v_A = 0$	$v_b =$	$v_C =$	$v_D =$



Find the velocity in each of the segments of the graph.
(Note: A student can attempt to match this graph on LoggerPro.)



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PHY 111 Vertical Motion: Acceleration due to gravity

A ball is thrown vertically upward from the ground with an initial velocity of 30 m/s. The ball will rise to its highest point and return to the ground.

Let the ground be $y = 0$ and upward be the positive direction. Assume $g = 10$ m/sec^2.

a) Draw a motion diagram for the motion.

b) Determine the position, velocity, and acceleration for the time indicated. Give the appropriate sign (+/–) for each value. Continue for time values until the ball returns to the ground.

time (sec)	position (m)	velocity (m/s)	acceleration (m/s^2)
$t = 0$			
$t = 1$			
$t = 2$			
$t = 3$			
$t = 4$			
$t = 5$			
$t = 6$			

c) Write equations for position and velocity vs. time.

$y(t) =$

$v(t) =$

d) Make sketches of these graphs on graph paper.