 Name: ______________________

Acceleration

Read from **Lesson 1** of the **1-D Kinematics** chapter at **The Physics Classroom:**

http://www.physicsclassroom.com/Class/1DKin/U1L1e.html

MOP Connection: Kinematic Concepts: sublevels 4 and 7

Review:

The instantaneous velocity of an object is the ____________ of the object with a ____________.

The Concept of Acceleration

1. Accelerating objects are objects that are changing their velocity. Name the three controls on an automobile that cause it to accelerate.

2. An object is accelerating if it is moving _____. Circle all that apply.
   a. with changing speed b. extremely fast c. with constant velocity
   d. in a circle e. downward f. none of these

3. If an object is NOT accelerating, then one knows for sure that it is ______.
   a. at rest b. moving with a constant speed
   c. slowing down d. maintaining a constant velocity

Acceleration as a Rate Quantity

Acceleration is the rate at which an object's velocity changes. The velocity of an object refers to how fast it moves and in what direction. The acceleration of an object refers to how fast an object changes its speed or its direction. Objects with a high acceleration are rapidly changing their speed or their direction. As a rate quantity, acceleration is expressed by the equation:

$$\text{acceleration} = \frac{\Delta \text{ Velocity}}{\text{time}} = \frac{v_{final} - v_{original}}{\text{time}}$$

4. An object with an acceleration of 10 m/s^2 will ____. Circle all that apply.
   a. move 10 meters in 1 second b. change its velocity by 10 m/s in 1 s
   c. move 100 meters in 10 seconds d. have a velocity of 100 m/s after 10 s

5. Ima Speedin puts the pedal to the metal and increases her speed as follows: 0 mi/hr at 0 seconds; 10 mi/hr at 1 second; 20 mi/hr at 2 seconds; 30 mi/hr at 3 seconds; and 40 mi/hr at 4 seconds. What is the acceleration of Ima's car?

6. Mr. Henderson's (imaginary) Porsche accelerates from 0 to 60 mi/hr in 4 seconds. Its acceleration is _____.
   a. 60 mi/hr b. 15 m/s/s c. 15 mi/hr/s d. -15 mi/hr/s e. none of these

7. A car speeds up from rest to +16 m/s in 4 s. Calculate the acceleration.

8. A car slows down from +32 m/s to +8 m/s in 4 s. Calculate the acceleration.

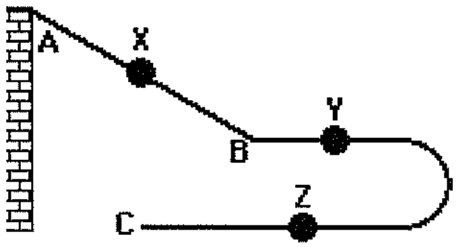
Acceleration as a Vector Quantity

Acceleration, like velocity, is a vector quantity. To fully describe the acceleration of an object, one must describe the direction of the acceleration vector. A **general rule of thumb** is that if an object is moving in a straight line and slowing down, then the direction of the acceleration is opposite the direction the object is moving. If the object is speeding up, the acceleration direction is the same as the direction of motion.

9. Read the following statements and indicate the direction (up, down, east, west, north or south) of the acceleration vector.

	Description of Motion	**Dir'n of Acceleration**
a.	A car is moving eastward along Lake Avenue and increasing its speed from 25 mph to 45 mph.	
b.	A northbound car skids to a stop to avoid a reckless driver.	
c.	An Olympic diver slows down after splashing into the water.	
d.	A southward-bound free quick delivered by the opposing team is slowed down and stopped by the goalie.	
e.	A downward falling parachutist pulls the chord and rapidly slows down.	
f.	A rightward-moving Hot Wheels car slows to a stop.	
g.	A falling bungee-jumper slows down as she nears the concrete sidewalk below.	

10. The diagram at the right portrays a Hot Wheels track designed for a phun physics lab. The car starts at point A, descends the hill (continually speeding up from A to B); after a short straight section of track, the car rounds the curve and finishes its *run* at point C. The car continuously slows down from point B to point C. Use this information to complete the following table.



Point	Direction of Velocity of Vector	Direction of Acceleration Vector
X	____________ Reason: ____________ ____________	____________ Reason: ____________ ____________
Y	____________ Reason: ____________ ____________	____________ Reason: ____________ ____________
Z	____________ Reason: ____________ ____________	____________ Reason: ____________ ____________

Name: ______________________

Describing Motion with Diagrams

Read from **Lesson 2** of the **1-D Kinematics** chapter at **The Physics Classroom:**

http://www.physicsclassroom.com/Class/1DKin/U1L2a.html
http://www.physicsclassroom.com/Class/1DKin/U1L2b.html
http://www.physicsclassroom.com/Class/1DKin/U1L2c.html

MOP Connection: Kinematic Concepts: sublevel 5

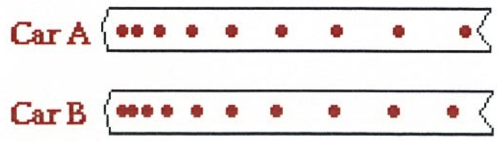
Motion can be described using words, diagrams, numerical information, equations, and graphs. Using diagrams to describe the motion of objects involves depicting the location or position of an object at regular time intervals.

1. Motion diagrams for an amusement park ride are shown. The diagrams indicate the positions of the car at regular time intervals. For each of these diagrams, indicate whether the car is accelerating or moving with constant velocity. If accelerating, indicate the direction (right or left) of acceleration. Support your answer with reasoning.

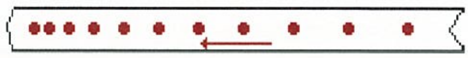
	Acceleration:	
	Y/N	**Dir'n**
a.  Reason: ______________________		
b.  Reason: ______________________		
c.  Reason: ______________________		
d.  Reason: ______________________		
e.  Reason: ______________________		

2. Suppose that in diagram D (above) the cars were moving leftward (and traveling backwards). What would be the direction of the acceleration? ______________ Explain your answer fully.

3. Based on the oil drop pattern for Car A and Car B, which of the following statements are true? Circle all that apply.
   a. Both cars have a constant velocity.
   b. Both cars have an accelerated motion.
   c. Car A is accelerating; Car B is not.
   d. Car B is accelerating; Car A is not.
   e. Car A has a greater acceleration than Car B.
   f. Car B has a greater acceleration than Car A.



4. An object is moving from right to left. It's motion is represented by the oil drop diagram below. This object has a _______ velocity and a _______ acceleration.



a. rightward, rightward	b. rightward, leftward
c. leftward, rightward	d. leftward, leftward
e. rightward, zero	f. leftward, zero

5. Renatta Oyle's car has an oil leak and leaves a trace of oil drops on the streets as she drives through Glenview. A study of Glenview's streets reveals the following traces. Match the trace with the verbal descriptions given below. For each match, verify your reasoning.

Diagram A: 

Diagram B:

Diagram C: 

	Verbal Description	Diagram
i.	Renatta was driving with a slow constant speed, decelerated to rest, remained at rest for 30 s, and then drove very slowly at a constant speed. Reasoning: ______________________________	
ii.	Renatta rapidly decelerated from a high speed to a rest position, and then slowly accelerated to a moderate speed. Reasoning: ______________________________	
iii.	Renatta was driving at a moderate speed and slowly accelerated. Reasoning: ______________________________	

Name: ______________________________

Describing Motion Numerically

Read from **Lesson 1** of the **1-D Kinematics** chapter at **The Physics Classroom:**

http://www.physicsclassroom.com/Class/1DKin/U1L1d.html
http://www.physicsclassroom.com/Class/1DKin/U1L1e.html

MOP Connection: Kinematic Concepts: sublevel 8

Motion can be described using words, diagrams, numerical information, equations, and graphs. Describing motion with numbers can involve a variety of skills. On this page, we will focus on the use tabular data to describe the motion of objects.

1. Position-time information for a giant sea turtle, a cheetah, and the continent of North America are shown in the data tables below. Assume that the motion is uniform for these three objects and fill in the blanks of the table. Then record the speed of these three objects (include units).

Giant Sea Turtle

Time (hr)	Position (mi)
0	0
1	0.23
2	0.46
3	________
4	0.92
5	________
6	_____

Speed = __________

Cheetah

Time (s)	Position (m)
0	0
0.5	12.5
1	________
1.5	________
2	________
2.5	________
3	75.0

Speed = __________

North America

Time (yr)	Position (cm)
0	0
0.25	________
0.50	0.50
0.75	0.75
1.0	________
1.25	________
1.50	1.50

Speed = __________

2 Motion information for a snail, a Honda Accord, and a peregrine falcon are shown in the tables below. Fill in the blanks of the table. Then record the acceleration of the three objects (include the appropriate units). Pay careful attention to column headings.

Snail

Time (day)	Position (ft)
0	0
1	11
2	________
3	________
4	44
5	________
6	66

Acceleration = _________

Honda Accord

Time (s)	Velocity (mi/hr)
0	60, E
0.5	54, E
1	________
1.5	42, E
2	________
2.5	________
3	24, E

Acceleration = _________

Peregrine Falcon

Time (s)	Velocity (m/s)
0	0
0.25	________
0.50	18, down
0.75	27, down
1.0	________
1.25	________
1.5	54, down

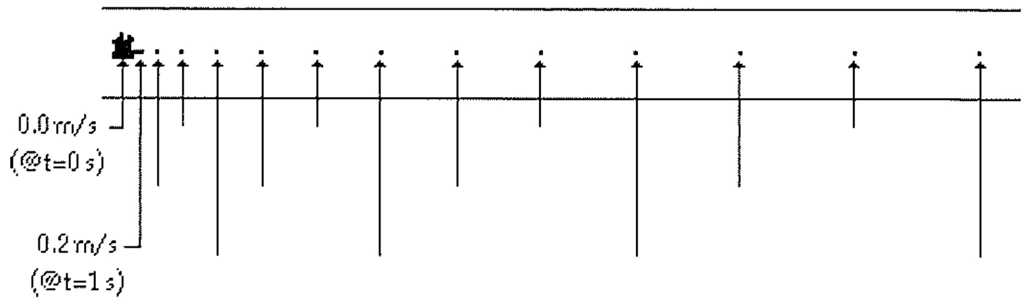
Acceleration = _________

3. Use the following equality to form a conversion factor in order to convert the speed of the cheetah (from question #1) into units of miles/hour. **(1 m/s = 2.24 mi/hr) PSYW**

4. Use the following equalities to convert the speed of the snail (from question #2) to units of miles per hour. Show your conversion factors.

GIVEN: **2.83×10^5 ft/day = 1 m/s** **1 m/s = 2.24 mi/hr**

5. Lisa Carr is stopped at the corner of Willow and Phingsten Roads. Lisa's borrowed car has an oil leak; it leaves a trace of oil drops on the roadway at regular time intervals. As the light turns green, Lisa accelerates from rest at a rate of 0.20 m/s^2. The diagram shows the trace left by Lisa's car as she accelerates. Assume that Lisa's car drips one drop every second. Indicate on the diagram the instantaneous velocities of Lisa's car at the end of each 1-s time interval.



6. Determine the acceleration of the objects whose motion is depicted by the following data.

Data Set A

t(s)	v(m/s)
0	32
1	28
2	24
3	20
4	16
5	12
6	8

a = ________ m/s/s

Data Set B

t(s)	v(m/s)
0	12
0.5	10
1.0	8
1.5	6
2.0	4
2.5	2
3.0	0

a = ________ m/s/s

Data Set C

t(s)	v(m/s)
0	24
1	21
2	18
3	15
4	12
5	9
6	6

a = ________ m/s/s

Data Set D

t(s)	v(m/s)
0	32
0.5	28
1.0	24
1.5	20
2.0	16
2.5	12
3.0	8

a = ________ m/s/s