Motion in One Dimension **Name:** _____

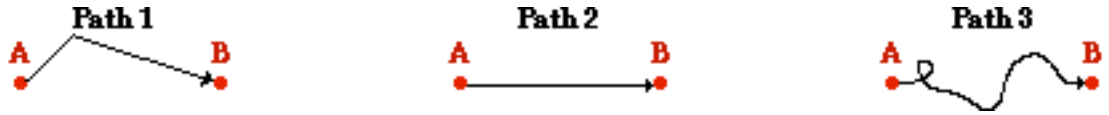
Describing Motion Verbally with Distance and Displacement

Motion can be described using words, diagrams, numerical information, equations, and graphs. Using words to describe the motion of objects involves an understanding of such concepts as position, displacement, distance, rate, speed, velocity, and acceleration.

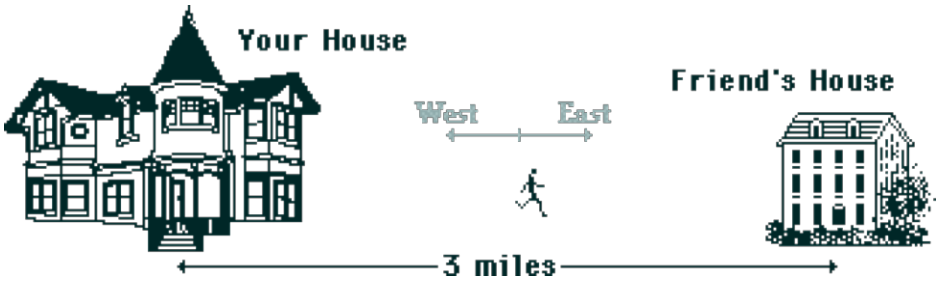
Distance vs. Displacement

As an object moves, its location undergoes change. There are two quantities that are used to describe the changing location. One quantity - **distance** - accumulates the amount of total change of location over the course of a motion. Distance is the amount of ground that is covered. The second quantity - **displacement** - only concerns itself with the initial and final position of the object. Displacement is the overall change in position of the object from start to finish and does not concern itself with the accumulation of distance traveled during the path from start to finish.

1. Suppose that you run along three different paths from location A to location B. Along which path(s) would your distance traveled be different than your displacement? _____



2. You run from your house to a friend's house that is 3 miles away. You then walk home.



a. What distance did you travel? _____

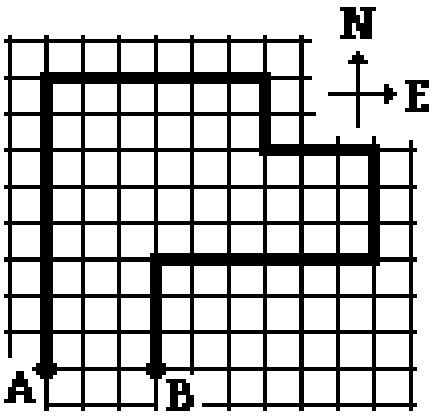
b. What was the displacement for the entire trip? _____ __

Observe the diagram below. A person starts at A, walks along the bold path and finishes at B. Each square is 1 km along its edge. Use the diagram in answering the next two questions.

3. This person walks a distance of _____ km.

4. This person has a displacement of _____.

a. 0 km
b. 3 km
c. 3 km, E
d. 3 km, W
e. 5 km
f. 5 km, N
g. 5 km, S
h. 6 km 6 km, E
i. 6 km, W
j. 31 km
k. 31 km, E
l. 31 km, W
m. None of these.



Motion **Name:** _____

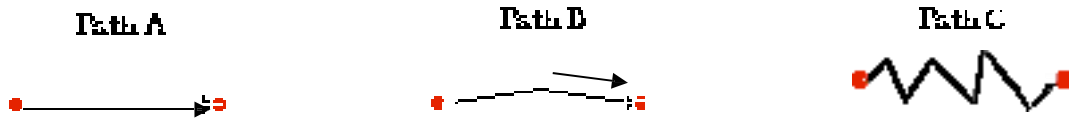
Speed vs. Velocity

Speed and velocity are two quantities in Physics that seem at first glance to have the same meaning. While related, they have distinctly different definitions. Knowing their definitions is critical to understanding the difference between them.

Speed is a quantity that describes how fast or how slow an object is moving.

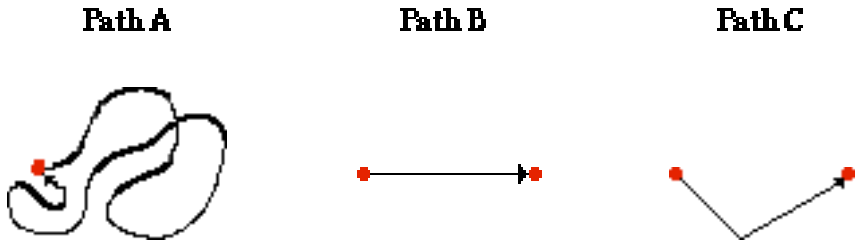
Velocity is a quantity that is defined as the rate at which an object's position changes.

1. Suppose you are considering three different paths (A, B and C) between the same two locations.



Along which path would you have to move with the greatest speed to arrive at the destination in the same amount of time? _____ Explain.

2. Suppose that you run for 10 seconds along three different paths.



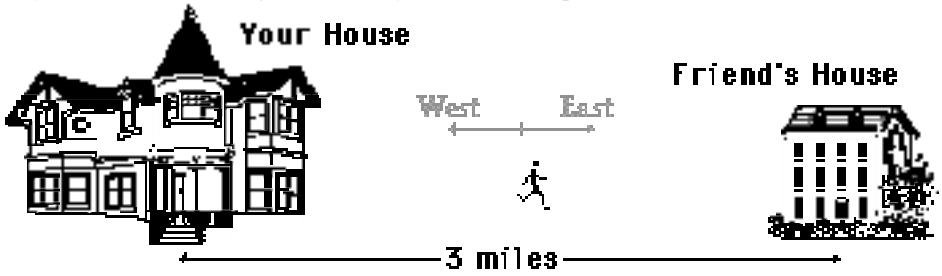
Rank the three paths from the lowest average speed to the greatest average speed. _____
Rank the three paths from the lowest average velocity to the greatest average velocity. _____

Calculating Average Speed and Average Velocity

The average speed of an object is the rate at which an object covers distance. The average velocity of an object is the rate at which an object changes its position. Thus,

$$\text{Ave. Speed} = \frac{\text{distance}}{\text{time}}$$

3. You run from your house to a friend's house that is 3 miles away in 30 minutes. You then immediately walk home, taking 1 hour on your return trip.



a. What was the average speed (in mi/hr) for the entire trip? __ _____

b. What was the average velocity (in mi/hr) for the entire trip? _____

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 b. extremely c. with constant
   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.

Motion in One Dimension **Name:** _____

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.

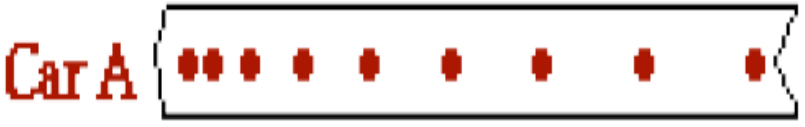
1. Motion diagrams for an amusement park ride are shown. The diagrams indicate the positions of the car at regular time intervals. For each of these diagrams, indicate whether the car is accelerating or moving with constant velocity. If accelerating, indicate the direction (right or left) of acceleration.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

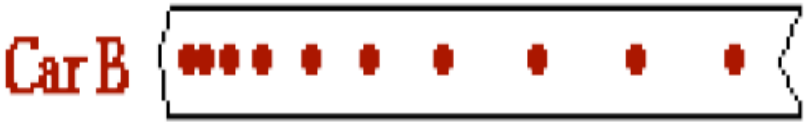
	Acceleration: Y/N	Acceleration: Dir'n
a.  Reason: _____		
b.  Reason: _____		
c.  Reason: _____		
d.  Reason: _____		
e.  Reason: _____		

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.

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.





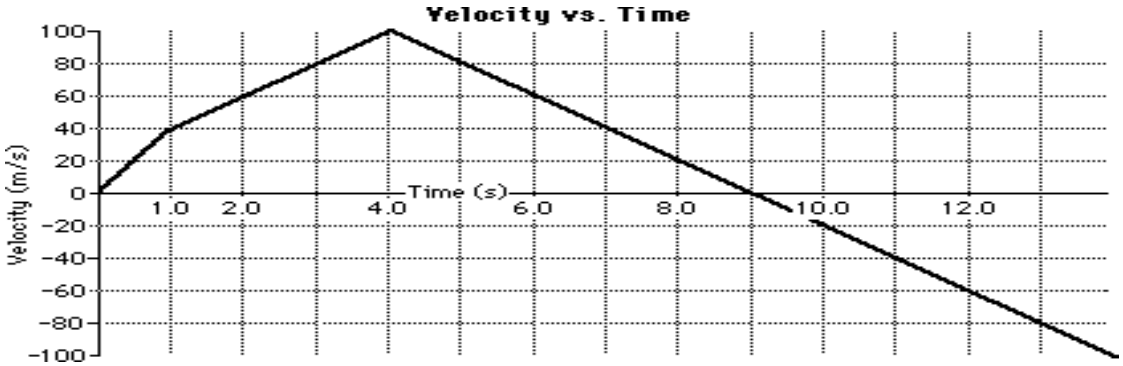
Motion can be described using words, diagrams, numerical information, equations, and graphs.

Describing motion with numbers can involve a variety of skills. On the next page, we will focus on the use tabular (data in tables) data to describe the motion of object

 Name: _____

Interpreting Velocity-Time Graphs

The motion of a two-stage rocket is portrayed by the following velocity-time graph.



Several students analyze the graph and make the following statements. Indicate whether the statements are correct or incorrect. Justify your answers by referring to specific features about the graph.

Student Statement	**Correct? Yes or No**
1. After 4 seconds, the rocket is moving in the negative direction (i.e., down).	_____
Justification:	
2. The rocket is traveling with a greater speed during the time interval from 0 to 1 second than the time interval from 1 to 4 seconds.	_____
Justification:	
3. The rocket changes its direction after the fourth second.	_____
Justification:	
4. During the time interval from 4 to 9 seconds, the rocket is moving in the positive direction (up) and slowing down.	_____
Justification:	
5. At nine seconds, the rocket has returned to its initial starting position.	_____
Justification:	