Key 1-2

Describing Motion Verbally with Distance and Displacement

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

http://www.physicsclassroom.com/Class/1DKin/U1L1a.cfm
http://www.physicsclassroom.com/Class/1DKin/U1L1b.cfm
http://www.physicsclassroom.com/Class/1DKin/U1L1c.cfm

MOP Connection: Kinematic Concepts: sublevels 1 and 2

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.

Vectors vs. Scalars

1. Most of the quantities used to describe motion can be categorized as either vectors or scalars. *A vector is a quantity that is fully described by both magnitude and direction. A scalar is a quantity that is fully described by magnitude alone.* Categorize the following quantities by placing them under one of the two column headings.

displacement, distance, speed, velocity, acceleration

Scalars	Vectors
distance	displacement
speed	velocity
	acceleration

2. A quantity that is *ignorant of direction* is referred to as a scalar quantity.
   a. scalar quantity b. vector quantity

3. A quantity that is *conscious of direction* is referred to as a vector quantity.
   a. scalar quantity b. vector quantity

Distance vs. Displacement

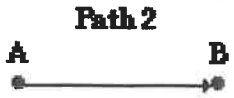
As an object moves, its location undergoes change. There are two quantities that are used to describe the changing location. One quantity - **distance** - accumulates the amount of total change of location over the course of a motion. Distance is the amount of ground that is covered. The second quantity - **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.

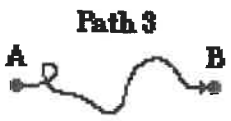
4. True or False: An object can be moving for 10 seconds and still have zero displacement.
   a. True b. False

5. If the above statement is true, then describe an example of such a motion. If the above statement is false, then explain why it is false.

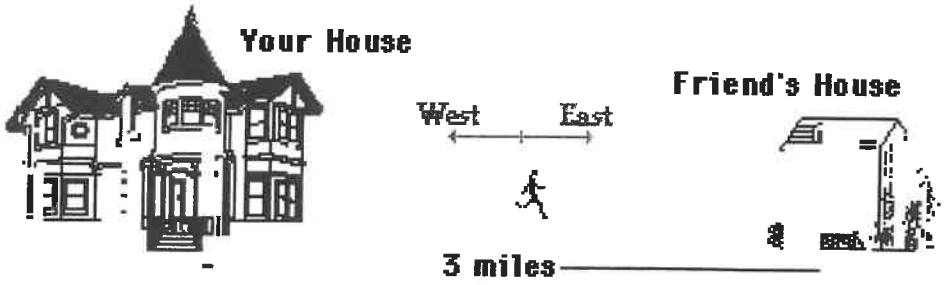
   If an object somehow turns or curves around and finishes at the starting point, then there is zero displacement. For instance, if a physics teacher starts on one corner of a table and walks all around the table and back to the starting point, then her displacement is zero. She is not out of place.

6. 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? Path 1 and Path 3





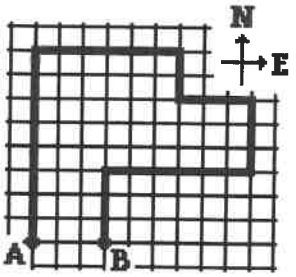
7. You run from your house to a friend's house that is 3 miles away. You then walk home.



a. What distance did you travel? 6 miles (3 miles to your friend's + 3 miles back home)

b. What was the displacement for the entire trip? 0 miles (You finish where you started)

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.



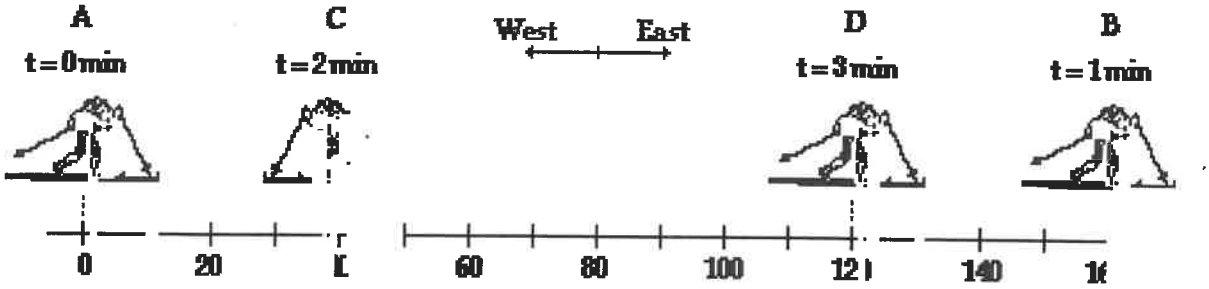
8. This person walks a distance of 31 km. (Measure the path's length.)

9. This person has a displacement of 3 km, E.

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
i. 6 km, E	j. 6 km, W	k. 31 km	l. 31 km, E
m. 31 km, W		n. None of these.	

(Measure from the starting point to the ending point; indicate the direction.)

10. A cross-country skier moves from location A to location B to location C to location D. Each *leg* of the back-and-forth motion takes 1 minute to complete; the total time is 3 minutes. (The unit is *meters*.)



It helps to draw arrows from A to B to C to D to indicate the sequence of movements made by the skier. Then determine the lengths of each segment. Record on the diagram the length of the segment and the direction of motion. Direction will be ignored for any distance questions but considered for all displacement questions.

a. What is the distance traveled by the skier during the three minutes of recreation? 360 m

Add the lengths of the three segments - 160 m + 120 m + 80 m.

b. What is the net displacement of the skier during the three minutes of recreation? 120 m, East

Measure from the starting point (A) to the ending point (D); include direction since displacement is a vector.

c. What is the displacement during the second minute (from 1 min. to 2 min.)? 120 m, West

The second minute corresponds to a movement from B to C. Measure from the starting point (B) to the ending point (C); include direction since displacement is a vector.

d. What is the displacement during the third minute (from 2 min. to 3 min.)? 80 m, East

The third minute corresponds to a movement from C to D. Measure from the starting point (C) to the ending point (D); include direction since displacement is a vector.