Name Date

Section 8.1 Summary

The Language of Motion

Textbook pages 344–361

Before You Read

What does the term "uniform" mean to you? If motion is uniform, how does it behave? Write your ideas in the lines below.

_____

_____

Make Flash Cards

Create flash cards for the measurements described in this section. Write a measurement on the front of the card and what it measures on the back. Quiz yourself until you can define each measurement.

Reading Check

1. Measurements of motion can be placed in either of two categories. Name these categories.

_____

_____

How is motion measured?

Motion involves a change in location. There are different ways of measuring motion. These can be placed in two categories:

1. Scalar quantity: A scalar quantity or **scalar** describes the size of a measurement or the amount (number) being counted, a factor known as *magnitude*. A scalar quantity has magnitude only. It does not include direction. Example: You walk 4 km/h.

2. Vector quantity: A vector quantity or **vector** has both magnitude and direction. Example: You walk 4 km/h [E].

The table below summarizes some of the measurements used to describe motion.

Measurement	What does it measure?	Scalar or vector?	SI unit	Example
distance (d)	the length of a path between two points	scalar	m, km	If you skateboard 10 km [E] of your home, you travelled a *distance* of 10 km.
position ($\vec{d}$)	a specific point relative to a point of origin	vector	m, km	If you skateboard 10 km [E] and return home in a straight line along the same route, your *position* upon returning is 0 km because you are back at your point of origin.

time (t)	when an event occurs	scalar	s, h	You pass a fire hydrant 2 s after you leave your point of origin.
time interval ($\triangle t$)	the duration of an event; final time minus the initial time	scalar	s, h	You pass a fire hydrant 2 s after you leave your point of origin. Then, 5 s after you leave your point of origin, you pass a road sign. The *time interval* between these two events is 3 s.
displacement ($\triangle \vec{d}$)	the straight-line distance and direction from one point to another; final position minus the initial position	vector	m, km	At 2 s, you pass the fire hydrant 2 m [E] of your point of origin. At 5 s, you pass the sign at 7 m [E]. Your *displacement* is 5 m [E] during this 3 s time interval.

Why are signs important when using vectors?

Directions are designated as positive or negative when using vectors. North, east, up, and right are positive (+) and south, west, down, and left are negative (–). If a skater travelled from 9 m east of a hydrant to 5 m west of the hydrant, to calculate her displacement, 9 m [E] becomes + 9 m and 5 m [W] becomes –5 m.

$$\triangle \vec{d} = \vec{d}_f - \vec{d}_i$$

$$\triangle \vec{d} = -5 \text{ m} - (+9 \text{ m})$$
$$= -14 \text{ m}$$

Since the negative sign (–) represents west, the skater's displacement is 14 m [W]. ✔

✔ *Reading Check*

2. Why are signs important when using vectors?

What is uniform motion and how is it represented?

An object in **uniform motion** travels equal displacements in equal time intervals. It does not change speed or direction. A **position-time graph** (like the ones on the next page) shows how an object's position changes over time, allowing its motion to be analyzed. These graphs have the following characteristics:

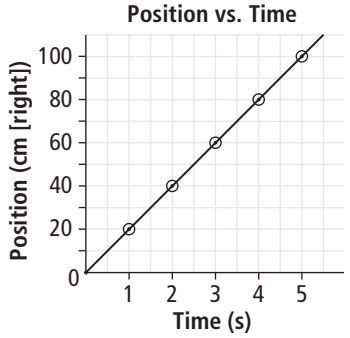
- Time is plotted on the horizontal axis (x-axis) and position is plotted on the vertical axis (y-axis).
- Uniform motion is shown as a straight line.
- Real motion is not perfectly uniform. It is useful to use a **best-fit line**, a smooth curve or straight line that most closely fits the general shape outlined by the points, to graph real motion.

- Positions and times not given as data can be estimated by finding the location corresponding to a specific time and position on the best-fit line. The line can also be extended beyond the first and last points to indicate what might happen beyond the measured data.

What does the slope of a position-time graph tell you?

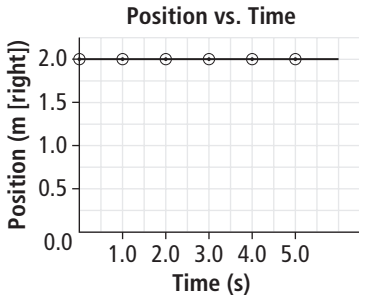
The **slope** of a graph refers to whether a line is horizontal or goes up or down at an angle. There are three types of slope on a position-time graph:

1. Positive slope: A **positive slope** slants up to the right, indicating that an object's position, from the origin, is increasing with respect to time.



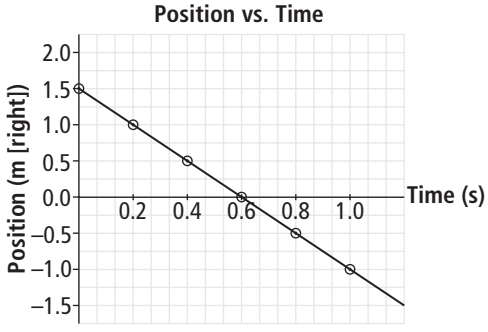
A positive slope

2. Zero slope: **Zero slope** is a straight, horizontal line. It represents an object at rest.



A zero slope

3. Negative slope: A **negative slope** slants down to the right, indicating an object is moving in a negative direction—left, down, west, or south.



A negative slope

Use with textbook pages 344–347.

Scalars versus vectors

1. Define the following terms.

a) scalar _____

b) vector _____

c) magnitude _____

d) reference point _____

2. Complete the following table.

Quantity	Symbol	SI Unit	Scalar or Vector
time			
time interval			
distance			
position			
displacement			

3. Identify whether the statement is describing a scalar or a vector. Place an "S" for scalar and a "V" for vector in the space provided.

a) _____ A squirrel runs 7 m east of a tree.

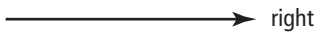
b) _____ The school is 5 km from the airport.

c) _____ It took the class 30 minutes to complete the motion lab.

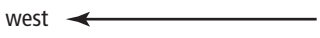
d) _____ A little girl pulls her wagon 10 m west of the tree house.

4. Indicate whether the direction is positive (+) or negative (–).

a) _____



b) _____



c) _____

d) _____

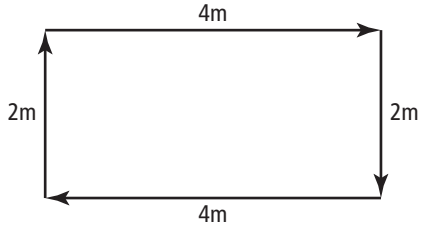
Use with textbook pages 346–349.

Distance, position, and displacement

1. Complete the following table by filling in the blank boxes. In the last column of the table, circle the appropriate word from each pair.

t_i (s)	t_f (s)	$\triangle t$ (s)	d_i (m)	d_f (m)	$\triangle d_i$ (m)	Direction of Motion
6.0	7.5		+18.4	+22.6		left/right
	8.5	2.8	+24.3		+5.8	up/down
20.2		18.2		+24.8	–14.3	north/south
12.4	18.8			+46.2	–8.6	east/west

2. Use the following diagram to answer the questions below.

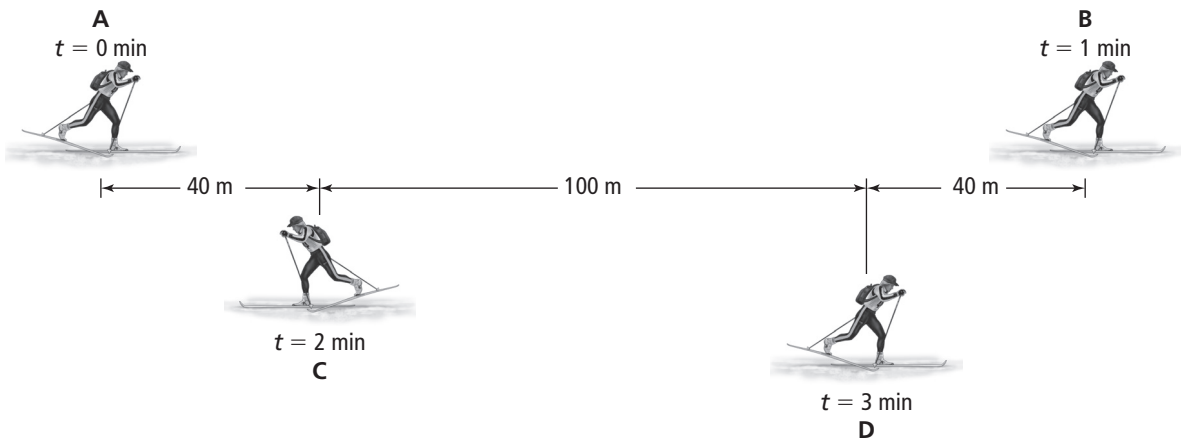


A girl walks 2 m [N], 4 m [E], 2 m [S] and then 4 m [W].

a) What is the total distance the girl travelled? _____

b) What is the displacement of the girl? _____

3. Use the following diagram of a cross-country skier to answer the questions below.



A cross-country skier moves toward the east, then toward the west, and then toward the east again. In other words, the skier moves from position A to B to C to D in 3 minutes.

a) Complete the following tables.

Time	Position
0 min	0 m
1 min	
2 min	40 m [E]
3 min	

Time Interval	Distance Travelled	Displacement
0 min–1 min	180 m	
1 min–2 min		
2 min–3 min		100 m [E]

b) What is the total distance travelled after 3 min? _____

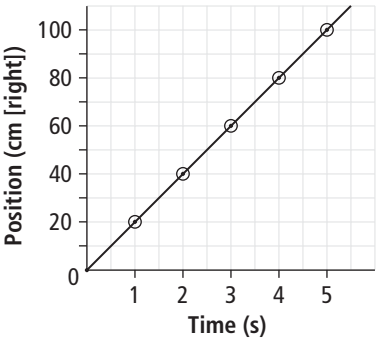
c) What is the skier's displacement at 3 min?_____

Use with textbook page 353–354.

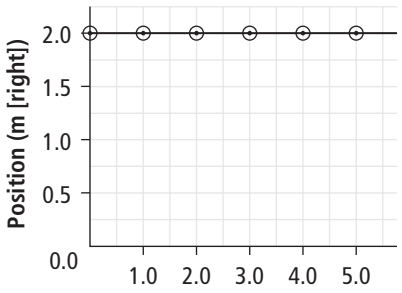
Positive, negative, and zero slopes

Use the following position-time graphs to answer the questions below.

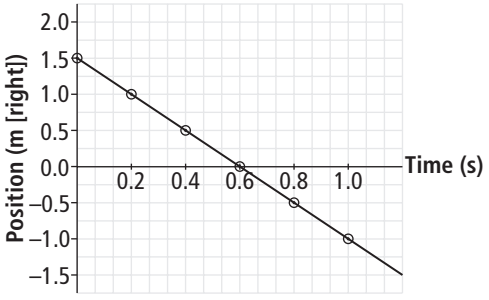
Graph A



Graph B



Graph C



Match the Description below with the corresponding Graph shown above. Each Graph can be used as often as necessary. Write the correct letter in the space provided.

1. _____ a line with a zero slope

2. _____ a line with a positive slope

3. _____ a line with a negative slope

4. _____ a line that represents uniform motion

5. _____ the motion of an object at rest (not moving)

6. _____ the motion of an object moving to the left of the reference point

7. _____ the motion of an object moving to the right of the reference point

Use with textbook page 350.

Uniform motion

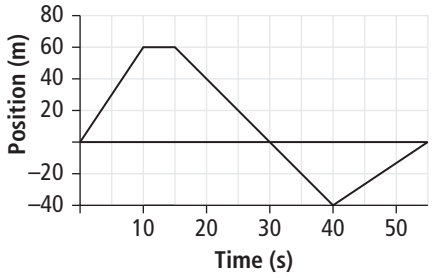
1. Identify each of the situations below as either uniform motion or non-uniform motion.

a) a snowball rolls down a hill _____

b) a man sits on bench watching pigeons _____

c) a woman walks through a crowded mall during the Christmas season _____

Use the following position-time graph showing the motion of an object, initially moving to the right, to answer the questions below 2 to 4.



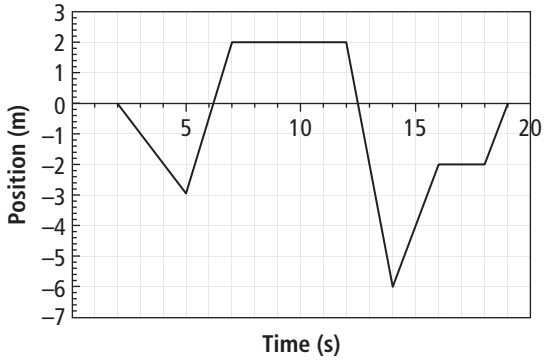
2. For each time interval, describe the slope of the line (positive, negative, or zero) and the motion of the object.

Time Interval	Slope of Line	Description of Motion
0 s–10 s	positive	The object is moving to the right of the origin with uniform motion.
10 s–15 s		
15 s–30 s		
30 s–40 s		
40 s–55 s		

3. During which time interval did the object travel the shortest distance? _____

4. During which time interval did the object travel the longest distance? _____

A student is waiting at a bus stop and starts to pace back and forth. Use the following position-time graph showing the student's motion to answer questions 5 to 11.



5. During which time intervals is the student standing still?

_____

6. Describe the motion of the student during the time interval 2 s to 5 s.

_____

7. Describe the motion of the student during the time interval 14 s to 16 s.

_____

8. What is the student's position at 7 s? _____

9. What is the student's displacement between 12 s and 14 s? _____

10. What is the total distance covered by the student during the first 16 s? _____

11. What is the student's displacement during the time interval 0 s to 20 s? _____

Use with textbook pages 340–351.

The language of motion

Match the Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.	
Term	**Descriptor**
1. _____ distance **2.** _____ position **3.** _____ magnitude **4.** _____ displacement **5.** _____ time interval **6.** _____ location **7.** _____ Greek letter delta, Δ	**A.** also known as the origin **B.** the size of a measurement **C.** "change in" or "difference" **D.** a specific point or location relative to a reference point **E.** the total length of a path between two points **F.** the difference between the initial time and the final time **G.** the straight line distance and direction from one point to another

Circle the letter of the best answer.

8. Which of the following units is associated with Δt?

A. s

B. m

C. km

D. m/s

9. Which of the following describes a scalar quantity?

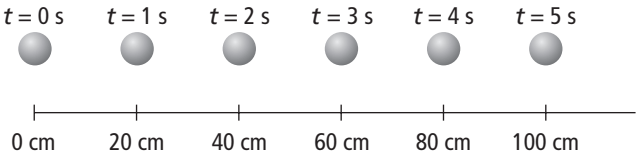
A. it has direction only

B. it has magnitude only

C. it is the size of a quantity

D. it has both direction and magnitude

Use the following motion diagram representing a ball moving across a horizontal table to answer question 10.



10. Which of the following statements are descriptions of the motion of the ball?

I.	The ball is in uniform motion.
II.	The ball is moving from left to right.
III.	The displacement between t_1 and t_2 is the same as the displacement between t_2 and t_4.

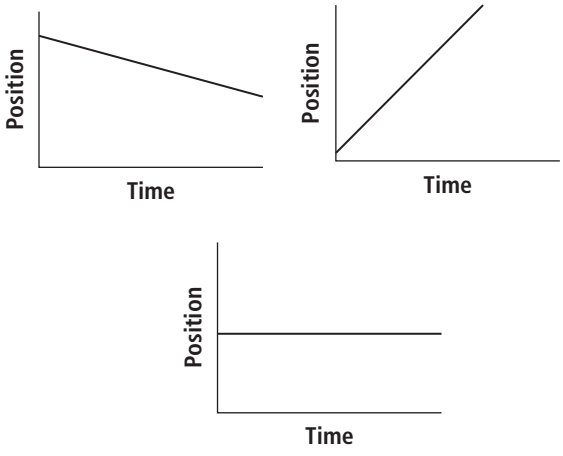
A. I and II only

B. I and III only

C. II and III only

D. I, II, and III

Use the following position-time graphs to answer question 11.



11. Which of the graphs above show uniform motion?

A. I and II only

B. I and III only

C. II and III only

D. I, II, and III