CHAPTER 1 REVIEW

Understanding Concepts

1. Which statement about distance, displacement, and position is true?
a) The position of an object includes a direction and a reference point.
b) The displacement of an object is the path of the length travelled.
c) The distance travelled by an object is equal to its change in position.
d) The position of an object is exactly the same as its displacement.
e) The distance an object travels can be less than its displacement.

Refer to Figure 1.58 for questions 2, 3, and 4. The graph shows the motion of a speeding car and a police car going the same direction in a 50 km/h zone. The speeding car passes the police car at time $t = 0$ and continues at a constant velocity. The police car immediately accelerates at a constant rate to catch the speeding car.

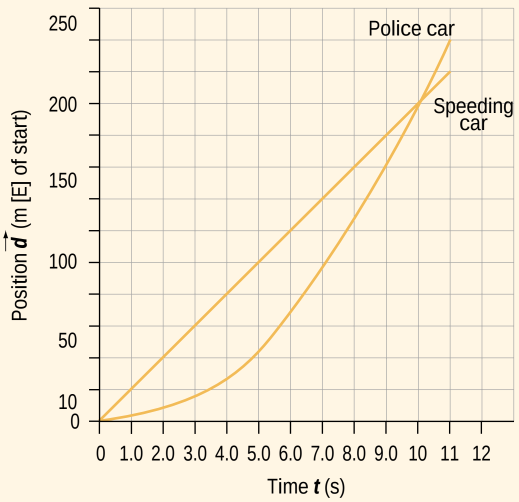

FIGURE 1.58

2. The speeding car is exceeding the speed limit by
a) 22 km/h b) 28 km/h c) 50 km/h
d) 60 km/h e) 72 km/h

3. What is the velocity of the police car at the instant it overtakes the speeding car?
a) 10 m/s [E] b) 20 m/s [E] c) 30 m/s [E]
d) 40 m/s [E] e) 50 m/s [E]

4. What is the constant acceleration of the police car?
a) 2.0 m/s^2 [E] b) 4.0 m/s^2 [E] c) 8.0 m/s^2 [E]
d) 20 m/s^2 [E] e) 40 m/s^2 [E]

Use Figure 1.59 to answer questions 5 and 6. The graph shows eight seconds of the velocity–time graph of a marble rolling down a ramp of constant slope.

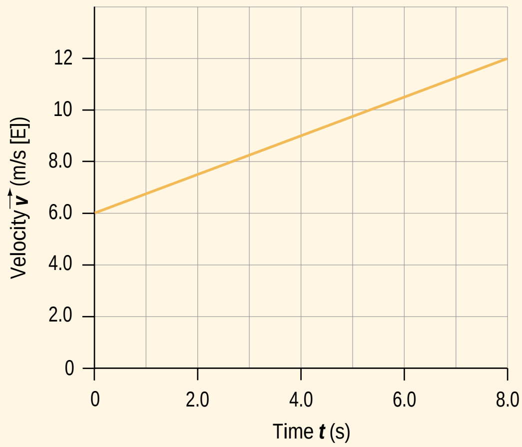

FIGURE 1.59

5. What was the average velocity of the marble during this time?
a) 12 m/s [E] b) 9.0 m/s [E] c) 6.0 m/s [E]
d) 1.5 m/s [E] e) 0.75 m/s [E]

6. What displacement did the marble travel during the 8.0-s interval?
a) 96 m [E] b) 72 m [E] c) 48 m [E]
d) 24 m [E] e) 12 m [E]

7. Explain, using examples, why there are many equivalent displacements but only one position.

8. A student claims that the distance and displacement of a moving object may or may not be equal after a specific time interval. Is she correct? Why?

9. Explain why you get the same resultant displacement if two displacements are added in the reverse order. Include diagrams to support your answer.

10. What is the difference between adding scalar quantities and adding non-collinear vector quantities? Include an example.

11. Derive the conversion factor between m/s and km/h. Include an example and show your work.

12. The minute hand of a clock makes one complete revolution in 1 min. Is the tip of the hand in uniform motion? Discuss.

13. a) Describe in words what a position–time graph would look like for an object moving toward the reference point at constant velocity.
b) Explain how to find, using the graph, the value of velocity in part a).

14. a) Use sketches to explain the differences between a position–time graph for a one-way trip and a round trip.
b) You have the position–time graph for a round trip. Explain how to calculate the average speed and the average velocity for the trip from the graph.

15. For uniformly accelerated motion, the average acceleration is equal to the constant acceleration. Explain why.

16. Describe a situation where both the velocity of a squirrel and its acceleration are negative.

17. Can the position–time graph for uniform motion have the same shape as the velocity–time graph for uniform acceleration? Explain.

18. Draw an acceleration–time graph for constant acceleration. Show that the area beneath an acceleration–time graph for an interval is the change in velocity for the interval.

19. The equation $\Delta\vec{d} = \vec{v}_2\Delta t - 1/2\,\vec{a}(\Delta t)^2$ can be used if you are given final velocity and need to find displacement. What does $1/2\,\vec{a}(\Delta t)^2$ represent?

20. Calculate the change in velocity of an eagle that accelerates downward at 4.6 m/s^2 for a time of 5.0 s.

21. A snow avalanche moving with a velocity of 8.0 m/s [S] undergoes an acceleration of 1.5 m/s^2 [S] for 6.0 s. What is the final velocity of the avalanche?

22. A curling stone travels 28 m in 22 s. Assuming uniform deceleration, calculate
a) the initial velocity of the stone
b) the deceleration of the stone

23. A competitor is aiming to complete a 1500-m wheelchair race in less than 4.0 min. After moving at a constant speed for exactly 3.5 min, there were still 240 m to go. What must his acceleration be for the remaining distance if he is to finish the race on time?

24. Find the resultant of the following displacements: 40 m [S], then 50 m [W] followed by 30 m [N 45° E].

25. Sketch a velocity–time graph for a deer starting from rest, $\vec{v}_1 = 0$, and undergoing a constant positive acceleration. Use the graph to derive:
a) the equation for the displacement $\Delta\vec{d}$ of the deer in terms of only the acceleration $\vec{a}$ and the elapsed time Δt
b) the equation for the acceleration $\vec{a}$ of the deer in terms of only the final velocity $\vec{v}_2$ and the elapsed time Δt
c) the equation for the average velocity $\vec{v}_{av}$ of the deer in terms of only the final velocity $\vec{v}_2$

Applying Inquiry/ Communication Skills

26. Suppose you are walking downtown in a large city where all the streets run north–south and all the avenues run east–west. The blocks are rectangles with the street sides being longer than the avenue sides. You have to walk from a corner bus stop to a corner store several blocks away.
a) Is it shorter to walk along a street first and then along an avenue, or does it matter? Use a diagram in your explanation.
b) Should you zigzag along the streets and avenues, or go as far as you have to in one direction before walking in the other direction? Does it matter? Explain using a diagram.

27. Can three or more displacement vectors with unequal magnitudes be added together using the tail-to-tip strategy so that their vector sum is zero? Use an example to explain your answer.

28. Sketch a position–time graph of a person who walks one city block at a slow constant velocity, waits for the light to change, walks across the intersection at a fast constant velocity, continues for another city block at a moderate velocity, and returns home at a very fast constant velocity. Assume the two blocks are the same length and that the intersection is one-tenth of a city block.

29. Superwoman is flying at 108 km/h [N]. She decelerates at a constant rate to 36 km/h [N] in 8.0 s, then travels at 36 km/h [N] for 10 s, and finally accelerates at a constant rate of 9.0 km/h/s [N] to a final speed of 90 km/h [N].
a) Draw the position–time graph.
b) How far in metres did Superwoman travel during the first 8.0 s?
c) What is Superwoman's initial acceleration during the first 8.0 s in km/h/s?

Making Connections

30. On some major highways lines are painted at regular intervals, and drivers are instructed to leave a space between cars equal to the space between two consecutive sets of lines. Explain why these lines should be farther apart on highways with a 100 km/h speed limit than on highways with an 80 km/h speed limit.

31. Highway 407 is an Express Toll Route (ETR) located across the north perimeter of Toronto. When cars enter and exit the highway photographs are taken of the licence plate. The entrance and exit locations and times are also recorded. Research how police could use the information to monitor and charge speeders for violating the traffic act.

32. Look up data for two of your favourite cars by researching in the library or on the Internet. Use the kinematics data to help you decide which car you would rather buy. Submit a report which includes the criteria used in reaching your decision.

ANSWERS TO NUMERICAL QUESTIONS

UNIT 1

Chapter 1

Section 1.1

Example 2 Practice Problems

1. 7 km [W]

2. 2 km [S 45° W]

Example 3 Practice Problems

1. 3.2 km [S 72° W]

2. 540 m [S 5° E]

Section 1.1 Review

2. [S 40° W]

6. a) 75 km
b) 69 km
c) 69 km [S 66° E] of the start

Section 1.2

Example 4 Practice Problems

1. 7.1 km/h [S 53° W]

2. 13 km/h [N 18° E]

Section 1.2 Review

4. 80 km/h [E]

5. 5.1 m/s [home to second base]

Section 1.3 Review

4. 125 m

5. 60.0 s to 110 s

6. 5.00 m/s, 1.25 m/s, 0 m/s, −1.67 m/s, 0 m/s, −2.50 m/s

7. −0.50 m/s

8. 181 s

Section 1.4

Example 5 Practice Problems

1. a) 7.1 m/s^2 [forward]

b) 1.3 m/s^2 [forward]

2. a) 6.0 km/h/s [forward] or −1.7 m/s^2 [forward]

Section 1.4 Review

5. 1.1 m/s^2 [N]

6. 2.0 m/s^2 [N]

Section 1.5

Example 6 Practice Problems

1. 18 m/s [down]

2. 10 m/s [down]

Example 7 Practice Problems

1. 4.0 m/s [down]

2. 2.9 m/s^2 [forward]

Example 8 Practice Problems

1. 32 m [down]

2. 53 m [forward]

Example 9 Practice Problems

1. 19 km/h/s [forward]

2. −56 km/h/s [forward]

3. 1.9×10^2 m [forward]

Section 1.5 Review

6. a) 1.0 m/s [W], 2.5 m/s [W], 0 m/s

7. a) 4.0 m/s^2 [W], 1.5 m/s^2 [W], 0 m/s, −4.5 m/s^2 [W]

b) 8 m [W], 60 m [W], 54 m [W], 36 m [W]

c) 168 m [W]

Section 1.6

Example 10 Practice Problems

1. 26 km/h [E]

2. 3.0 m/s [S]

Example 11 Practice Problems

1. 50 m [W]

2. 10 m [down ramp] from start

Example 12 Practice Problems

1. 15 m/s [E]

2. 7.5 s

3. 10 s

Example 13 Practice Problems

1. 66 m [down]

2. 9.5×10^2 m [up]

Section 1.6 Review

4. a) 22 m/s [E]
b) 3.0 s
c) 1.5 s
d) 66 m [E]

5. a) 78 m [S]
b) 4.3 m/s^2 [S]
c) 13 m/s [S]
d) 3.0 s

6. a) 4.0 m/s [W]
b) 22 m/s [W]
c) 3.0 s

Chapter 1 Review

1. a **2.** a **3.** d **4.** b **5.** b **6.** b

20. 23 m/s [down]

21. 17 m/s [S]

22. a) 2.5 m/s [forward]
b) 0.12 m/s^2 [forward]

23. 0.13 m/s^2

24. 34 m [S 57° W]

29. b) 1.6×10^2 m [N]
c) 9.0 km/h/s [S]

Chapter 2

Section 2.1

Example 2 Practice Problems

1. 2.0×10^3 N [up]

2. 16 N [left]

Example 3 Practice Problems

1. 12 N [N 36° E]

2. 2.80×10^2 N [S 75° E]

Section 2.1 Review

4. b) 300 N [forward]

5. b) 2 N [E]

7. b) 45 N[W 1° S]

Section 2.2

Example 6 Practice Problems

1. 2.0×10^{20} N

2. 2.0×10^8 kg

Section 2.2 Review

3. a) $\frac{1}{4}$ F

b) $\frac{2}{4}$ F $= \frac{1}{2}$ F

4. a) On the Moon: $F_G = 1.62 \times 10^2$ N
b) On Earth: $F_G = 9.80 \times 10^2$ N
Comparison:
$F_{Moon}/F_{Earth} = 0.165/1$

Section 2.3

Example 7 Practice Problems

1. 1.2×10^2 kg

2. 1.1×10^4N

Example 8 Practice Problems

1. a) 4
b) 6.1×10^{-1} N/kg [down]

2. 16 N [down]