Answers

This appendix lists answers to Practice Problems, LessonCheck problems, Take It Further problems, Assessment problems, and Appendix B: Additional Problems. For worked-out solutions, refer to the Solutions Manual, which is available in the Instructor Resources of MasteringPhysics. For answers and sample data for Inquiry Labs and Physics Labs, refer to the Lab Teacher Notes in the Instructor Resources of MasteringPhysics.

1 Introduction to Physics

Lesson 1.1

LessonCheck (p. 9)

1. Hypotheses are verified by experiments.
2. A few relatively simple laws and principles describe the behavior of individual objects. When these objects interact, very complex phenomena can be observed.
3. The laws of physics form the foundation of the other sciences such as biology, chemistry, and Earth science. Student examples will vary.
4. $m = \frac{E}{c^2}$

Lesson 1.2

LessonCheck (p. 14)

5. The metric system uses units that are related to one another by multiples of 10.
6. A bias is a preference for a point of view due to personal, not scientific, reasons. Bias should be avoided because it may ignore scientific facts.
7. Peer review means that a report is sent to several experts in the field to look for errors, biases, and oversights.
8. 15,000 m
9. 12 km

Lesson 1.3

Practice Problems (pp. 19, 21)

10. 5×10^{-9} km
11. (a) 33.2 kilodollars; (b) 0.0332 megadollars
12. 5 ms
13. 620 m^3
14. 1200 mL
15. 0.23 lb

LessonCheck (p. 22)

16. Kilogram; meter; second.
17. *Kilo* (k) means "one thousand." The course is 1.45 km.
18. The dimensions must be the same, as it does not make sense to add any dimension to a dissimilar one.
19. A dimension identifies the physical quantity being measured, such as time or length. A unit identifies the specific metric used to measure the dimension, such as mm or km.
20. 3×10^8 m/s
21. (a) Greater than; (b) 105 km/h
22. $v_f = v_i + at$

$$\frac{\text{length}}{\text{time}} = \frac{\text{length}}{\text{time}} + \frac{\text{length}}{\text{time}^2}\left(\cancel{\text{time}}\right)$$

$$\frac{\text{length}}{\text{time}} = \frac{\text{length}}{\text{time}}$$

Lesson 1.4

Practice Problems (pp. 27, 28, 29)

23. 6.8 s
24. 512.3 m^2
25. 13 m^2
26. 13.1 kg
27. 86.6 cm
28. (a) Two; (b) Four
29. 1.414

LessonCheck (p. 32)

30. Examples include length, speed, acceleration, time duration, force, electric charge.
31. Two significant figures.
32. 1.00×10^2 m/s
33. Velocity is a vector with a magnitude and a direction, whereas speed is a scalar having only magnitude.
34. Two significant figures.
35. 3.00×10^8 m/s
36. 7.4 m/s
37. (a) Two; (b) 1.5×10^3 cm^2
38. (a) 383.9 m; (b) 6877 m^2

Chapter 1 Physics & You

Take It Further (p. 35)

1. Reasons will vary but might include that weather is a very complex process and that current computer models might not be analyzing all of the relevant factors. Accept all reasonable ideas.
2. Yes. Without proper units, weather data is meaningless. For example, "winds of 45" has no meaning unless the units, such as meters per second, are also given. Furthermore, the units for each type of data must be consistent in order for the computer model to yield the most accurate results.

Chapter 1 Assessment

Lesson by Lesson (p. 38)

39. Inference: a logical interpretation of your observations; hypothesis: a testable scientific explanation for a set of observations.

40. A conserved quantity does not change.

41. A force causes a change in motion. Motion itself does not require a force.

42. The "power of ten"-based metric system allows the use of convenient prefixes to modify base units.

43. Though a peer reviewed report should meet the certain quality and scholarship standards, it does not guarantee the conclusions of the report are correct.

44. The area of a circle must have dimensions of (length)^2; the correct expression is πr^2.

45. You cannot add a time to a length; $T + d$ does not make sense. You can divide quantities that have different dimensions; d/T makes sense physically.

46. (a) No; (b) Yes

47. A, B, and D

48. B and D

49. (a) 0.114 gigadollars
(b) 1.14×10^{-4} teradollars

50. 83 km/h

51. 1.4×10^{13} cm^3

52. 160 μs

53. 3.3×10^4 mm

54. (a) 7.0×10^{-5} m
(b) 7.0×10^{-8} km

55. 1.368×10^8 calculations/μs

56. (a) 3.33×10^{-11} s
(b) 1.80×10^{12} jiffy

57. 2.0×10^6 m^2

58. 981 cm/s^2

59. $p = 1$

60. $p = -2$

61. (a) 10^7 s/y
(b) 10^4 s/game
(c) 10^0 s/beat
(d) 10^{16} s
(e) 10^8 s

62. (a) 10^0 m
(b) 10^{-2} m
(c) 10^0 m
(d) 10^1 m
(e) 10^6 m

Lesson by Lesson (p. 39)

63. (a) 3.14
(b) 3.1416

64. 618.5 m^2

65. 10^5 seats

66. (a) 10^{10} gal/y
(b) 10^9 lb/y

67. (a) 10^3 km/h
(b) 10^4 km
(c) 10^4 km

Mixed Review (pp. 39–40)

68. A and D

69. B, C, and D

70. (a) 6.75×10^{-4} mm
(b) 6.75×10^{-7} m

71. 2.7×10^{-3} km/h

72. (a) 3.63×10^4 beats/min
(b) 15,194,433 cycles/beat

73. 3.05 m; 5.14 m/s

74. (a) 504 km/h
(b) 0.70 m

75. (a) 2.3 g/day
(b) 3.3 d

76. (a) 56 complete revolutions
(b) 2.7 m/rev

77. $p = -1$

78. $q = -\frac{1}{2}; p = \frac{1}{2}$

Writing about Science (p. 40)

79. Answers will vary; see Solutions Manual.

80. Answers will vary; see Solutions Manual.

Read, Reason, and Respond (p. 40)

81. D

82. C

83. C

84. C

Standardized Test Prep (p. 41)

1. B
2. B
3. C
4. C
5. D
6. D
7. B
8. A
9. C

10. (a) 12 cm
(b) The measurement recorded as 12 cm forces the rounding of the average to the nearest whole number even though the other values are measured with a greater number of significant figures.

Introduction to Motion

Lesson 2.1

Practice Problem (pp. 45, 47)

1. 12.8 km
2. −8.0 m; 20 m

LessonCheck (p. 47)

3. (a) Positive
   (b) Zero
4. Distance
5. Yes; examples will vary.
6. (a) Yes, because you and the dog are the same distance from the starting point.
   (b) No, because the side trips make the total distance covered by the dog greater.
7. (a) 7.4 m
   (b) 5.0 m
8. (a) 51.5 cm
   (b) −7.5 cm
9. (a) Greater than
   (b) 9.7 km
   (c) 2.1 km

Lesson 2.2

Practice Problems (pp. 49, 52)

10. 6.4 m
11. 1200 m = 1.2 km
12. (a) 3.5 km
    (b) 14 s
13. 6.5 m/s
14. 33.3 s
15. No; the velocities are in opposite directions.
16. (a) 20.9 km/h
    (b) 0
17. $v_{av,C} < v_{av,B} < v_{av,A} < v_{av,D}$

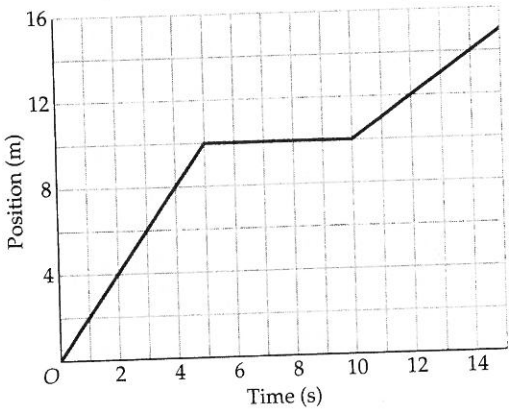
LessonCheck (p. 53)

18. Velocity describes rate and direction; speed only describes rate.
19. Meters per second (m/s)
20. Yes; the speed at a given instant can be −20 m/s while the average speed is +20 m/s.
21. The average speed is greater than the avearage velocity because average speed depends on distance whereas average velocity depends on displacement.
22. 10.4 m/s; 37.6 km/h
23. 2.56 s
24. (a) Less than
    (b) 24 m/s
25. 15 km/h

Lesson 2.3

Practice Problem (p. 56)

26. (a)



(b) 4.0 m; 11 m

LessonCheck (p. 57)

27. Position is plotted on the vertical axis; time is plotted on the horizontal axis.
28. The slope gives the speed of the object.
29. The graph is a straight line whose slope equals the speed of the object.
30. (a) Speed: C < A < B
    (b) Velocity: A < C < B
31. (a) Speed: C < B < A < D
    (b) Velocity: D < C < B < A
32. −0.20 m/s
33. (a) Portion B
    (b) 1.5 m/s
34. 1.14 m/s

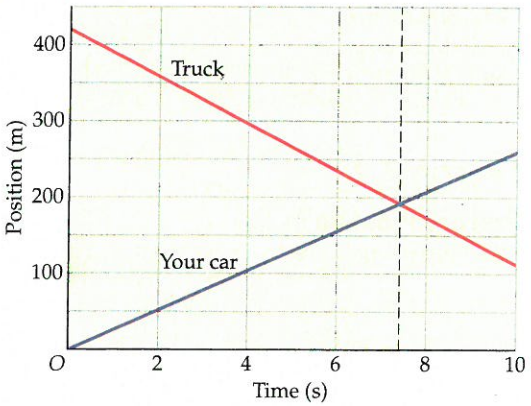
Lesson 2.4

Practice Problems (pp. 59, 60, 62)

35. (a) 8.3 m
    (b) 2.2 m/s
36. (a) $x_f = (1.6\text{ m}) + (2.0\text{ m/s})t$
    (b) 3.5 s
37. (a) Less than
    (b) Greater than
    (c) Ahead of
38. 3.1 s

39. (a) (26 m/s)t; (420 m) + (−31 m/s)t

(b)



(c) 7.4 s

LessonCheck (p. 62)

40. Object's initial position; object's velocity; time of object's final position

41. The slope represents the object's velocity; the y-intercept represents the object's initial position.

42. Bicycle 2

43. 10.7 m; 4.7 m

44. −4.5 m

45. (a) Bumper car 2
(b) 3.2 s

Chapter 2 Physics & You

Take It Further (p. 63)

1. Students should infer that the computer models rely on data such as temperature, time, pressure, humidity, cloud cover, season, etc.—many of the basic weather properties that students are familiar with from TV meteorologists.

2. A climate model might predict a rising ocean level and flooding to low-lying islands and coastal areas. Knowledge of the potential rise in ocean level and the time period over which it will occur could help a country determine a timeframe for a response plan. Such a plan might include ideas on how to protect affected areas, or ideas on how to relocate resources and services.

3. Many basic physics principles affect the weather, including thermodynamics, Newton's laws, electromagnetic waves, etc. Climate modelers understand these principles and use them when building climate models and planning for necessary data inputs.

Chapter 2 Assessment

Lesson by Lesson (p. 66)

46. Yes; an example is walking in a circle.

47. No

48. Your displacement is greater; the displacement of the astronaut is zero.

49. Greater than

50. Positive displacment: you; negative displacement: your friend

51. (a) 1.95 km
(b) 0.75 km

52. (a) 2.65 km
(b) −0.75 km

53. 10.7 m

54. −0.8 m

55. 30 m

56. −19 m

57. (a) 5 m; 5 m
(b) 2 m; −2 m

58. (a) 15 m
(b) 10 m

59. (a) 130 m; 100 m
(b) 260 m; 0 m

Lesson by Lesson (p. 67)

60. The displacement must be zero, otherwise the average velocity would be positive or negative.

61. Your average velocity is greater; the average velocity of the astronaut is zero.

62. Yes

63. No

64. (a) Less than
(b) A

65. (a) Equal to
(b) C

66. 1.883 m/s; 4.212 mi/h

67. 0.099 m/s

68. 66 m

69. 0.30 s

70. 64 km/h

71. 11 m

72. (a) Equal to 25.0 m/s
(b) 25.0 m/s

73. (a) Less than 25.0 m/s
(b) 24.0 m/s

74. (a) Yes; a horizontal line indicates zero velocity.
(b) No; a vertical line implies the object is in more than one place at the same time, which is not possible.

75. Positive; the positive slope indicates a positive velocity.

76. Positive; speed is a magnitude and cannot be negative.

77. Negative; the slope of the tangent line gives the instantaneous velocity at the given point.

Lesson by Lesson (p. 68)

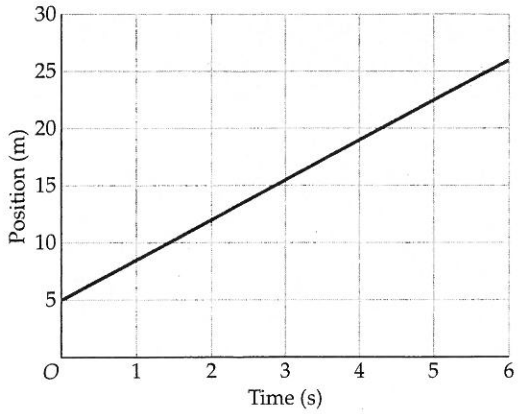
78. (a) Cases B and C
(b) Cases A and C
(c) Case B

79. (a) Positive velocity: A: Trains 1 and 2; B: train 2; C: train 1
(b) Negative velocity: A: Neither train; B: train 1; C: train 2

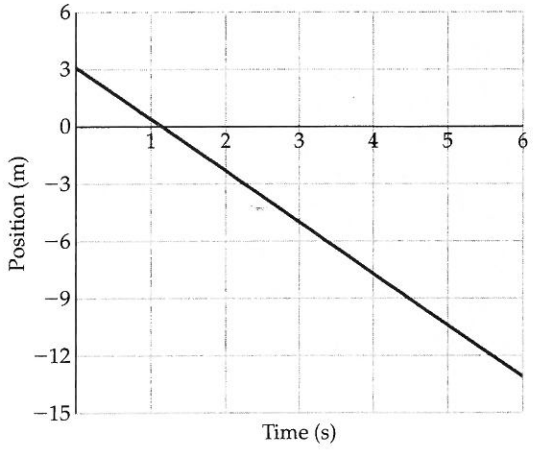
80. (a) Positive
(b) Zero
(c) Positive
(d) Negative

81. (a) 2.0 m/s
(b) 0.0 m/s
(c) 1.0 m/s
(d) −1.5 m/s

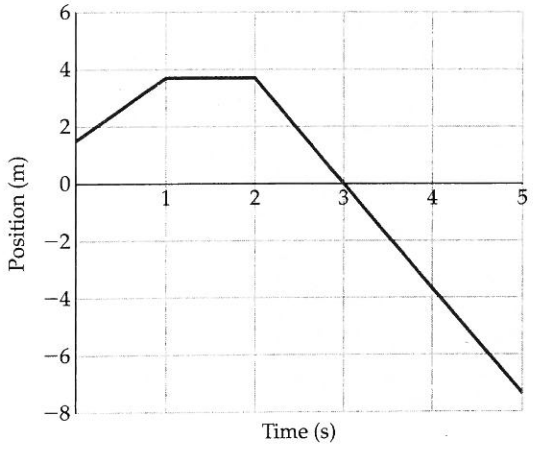
82.



83.



84.



85. (a) 35 m
(b) 10 m

Lesson by Lesson (p. 69)

86. (a) 8.6 m/s
(b) 4.3 m/s

87. 0.50 m/s

88. Yes

89. Yes

90. The intercept changes; the slope does not. Changing the initial position does not change the velocity, thus it does not change the slope.

91. The slope changes; the intercept does not. The slope changes because it is directly related to the velocity.

92. Fish 2

93. (a) Person 2
(b) Person 1

94. $x_{f,A} = (35\text{ m}) - (8.6\text{ m/s})t$

95. $x_{f,B} = (10\text{ m}) + (4.3\text{ m/s})t$

96. $x_f = (8.1\text{ m}) + (-1.6\text{ m/s})t$

97. (a) 15.0 m
(b) 4.0 s

98. (a) −4.0 m
(b) 6.1 s

99. (a) −3.8 m
(b) 2.9 s

100. (a) Football player 1
(b) 1.1 s

101. (a) Soccer player 2
(b) 3.0 s
(c) 4.4 m

Mixed Review (pp. 69–70)

102. Equal to

103. Yes

104. (a) Dragonfly 2
(b) Dragonfly 1

105. 10^{-3} m/s

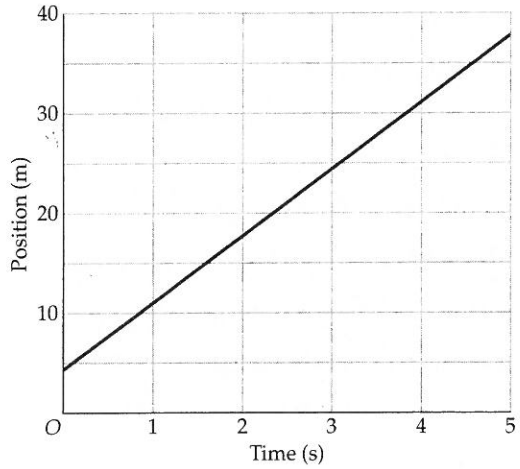
106. 0.010 s

107. Object 1

108. 3.5 m

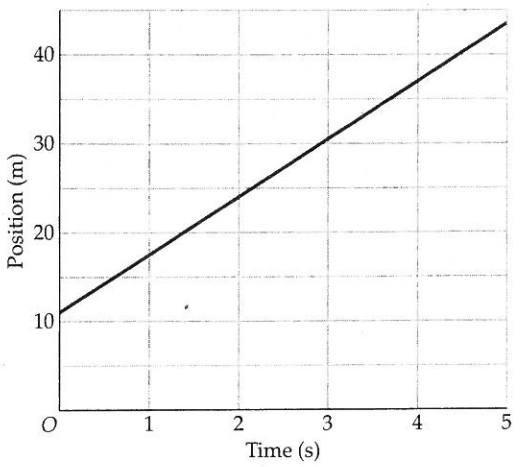
109. (a) −0.92 m/s
(b) 0.92 m/s

110. (a)



(b) $x_f = x_i + vt$
$x_f = (4.3\text{ m}) + (6.7\text{ m/s})t$

111. (a)

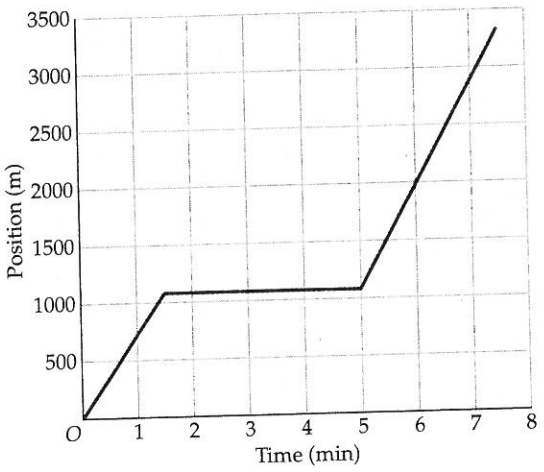


(b) 3.2 s

Chapter 2 Assessment *(continued)*

112. (a) 14 m; 9.0 m
(b) Increase
(c) Decrease
(d) 28 m; zero

113. (a)



(b) 7.4 m/s

114. (a) 0.77 s
(b) 6.4 m

115. (a) 14 m/s
(b) 22 m

116. 56.0 km/h

Writing about Science (p. 70)

117. Answers will vary; see Solutions Manual.

118. Answers will vary; see Solutions Manual.

Read, Reason, and Respond (p. 70)

119. B

120. A

121. B

122. A

Standardized Test Prep (p. 71)

1. C **3.** D **5.** A **7.** D
2. B **4.** B **6.** D **8.** C

9. (a) 7 km
(b) 5 km northwest of camp
(c) Distance is the total length traveled, whereas displacement is distance from the starting point.

3 Acceleration and Accelerated Motion

Lesson 3.1

Practice Problems (pp. 76, 78, 79, 81)

1. $a_{av,3} < a_{av,1} < a_{av,2}$

2. 4.62 s

3. 4.0 m/s

4. 9.4 s

5. $-1.9\ m/s^2$

6. 10.3 m/s

7. (a) Cars 1, 2, and 4 are slowing down; their plotted lines approach the $v = 0$ line.
(b) Car 3 is speeding up; its plotted line moves away from the $v = 0$ line.

8. $-0.63\ m/s^2$

9. 3.6 s

10. 3.9 m/s

LessonCheck (p. 81)

11. Yes, if its direction changes.

12. The graph is a straight line.

13. No (example: a car with negative acceleration moving in the negative direction speeds up); no (example: a car with positive acceleration moving in the negative direction slows down).

14. Increase; decreased elapsed time results in increased average acceleration.

15. D < A < B < C

16. Yes; acceleration is independent of the magnitude of the velocity.

17. (a) 29 m/s north
(b) 7.5 m/s north

18. (a) $2.0\ m/s^2$
(b) $0.0\ m/s^2$
(c) $-0.50\ m/s^2$

19. 7.44 m/s

Lesson 3.2

Practice Problems (pp. 83, 85, 88, 90)

20. (a) 1 m/s
(b) $-0.5\ ms^2$

21. 7.6 m/s

22. (a) $v_{f,2} < v_{f,3} < v_{f,1}$
(b) $v_{f,1} < v_{f,3} < v_{f,2}$

23. (a) 13 m/s
(b) 19 m

24. 4.2 m/s

25. 1.2 s

26. 1.16 s

27. 19 m

28. 4D; the distance covered is $\Delta x = \frac{1}{2}at^2$, so if the time is doubled, the distance traveled quadruples.

29. 18.8 m
30. 3.00 s
31. 3.8×10^4 m/s^2
32. 26 m/s
33. -2.1 m/s^2

LessonCheck (p. 91)

34. The average velocity equals the average of the initial and final velocities.
35. 5 m
36. Increase; increasing the acceleration increases the rate at which velocity increases.
37. (a) The time required to stop doubles.
(b) The distance required to stop quadruples.
38. 6.0 m/s
39. (a) -5.3 m/s^2
(b) 3.2 m
40. 6.8 m/s
41. (a) 2.0 m
(b) 6.25 m

Lesson 3.3

Practice Problems (pp. 93, 95)

42. (a) A < D < C < B
(b) D < C < B < A
(c) C < B < D < A
43. 36.4 m/s; $2v_{speeder}$
44. (a) Less than
(b) 7.28 s
45. (a) Car 1: $0 + (20.0 \text{ m/s})t + (1.25 \text{ m/s}^2)t^2$
Car 2: $1000 \text{ m} - (30.0 \text{ m/s})t + (1.6 \text{ m/s}^2)t^2$
(b) 24 s

LessonCheck (p. 96)

46. (a) The parabola
(b) The graph has an initial upward curvature, then becomes a straight line, and then curves downward.
(c) Graph 1: A and B have constant velocity; A is moving faster than B. Graph 2: A is accelerating; B has constant velocity. Graph 3: A and B have the same initial velocity and accelerate in the positive direction; A has a larger acceleration than B. Graph 4: A and B have the same, positive initial velocity; A accelerates in the positive direction; B accelerates in the negative direction.
47. The sharpness of the curvature increases.
48. $(1.5 \text{ m}) + (3.0 \text{ m/s})t - (4.9 \text{ m/s}^2)t^2$
49. (a) 6.3 s
(b) 22 m
(c) 10 m/s
50. (a) Motorcycle 1
(b) 115 m
(c) 2.30 m/s^2
(d) 23.0 m/s

Lesson 3.4

Practice Problems (p. 100)

51. 7.67 m/s
52. 14.0 m/s
53. $\sqrt{2V}$
54. 11 m

LessonCheck (p. 101)

55. They are equal.
56. Freefall is motion influenced only by gravity. Because a large drag force acts on parachute, the motion is not freefall.
57. They are influenced only by gravity and acceleration downward at 9.81 m/s^2.
58. The accelerations are equal; both are in freefall.
59. 4.5 m/s
60. 17 m/s
61. (a) 8.4 m/s
(b) -1.4m/s
62. Bernardo: $x_f = (3.0 \text{ m}) - (4.9 \text{ m/s}^2)t^2$
Michi: $x_f = (1.0 \text{ m}) + (4.2 \text{ m/s})t - (4.9 \text{ m/s}^2)t^2$

Chapter 3 Physics & You

Take It Further (p. 102)

1. Evaporative cooling of rainfall in relatively dry air causes the cold air column to form. The greater density of this colder air causes it to accelerate downward.
2. Review recent microburst events and research prior to reviewing student posters or reports. Evaluate student work based on currency and effective communication.
3. An airplane caught in the main cold air downdraft will be forced downward. A plane caught in the splash region of a microburst might experience strong upward air currents.

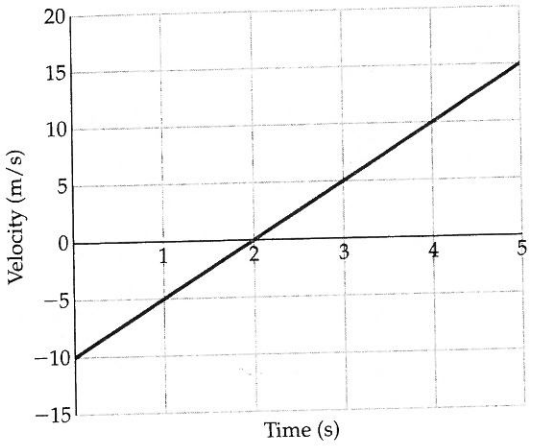
Chapter 3 Assessment

Lesson by Lesson (p. 105)

63. Acceleration is the change in velocity (m/s) per second (s), or m/s^2.
64. Constant speed: yes; constant velocity: no. A change in direction does not affect speed, but it does cause a change in velocity.
65. The time doubles.
66. Yes; a ball thrown straight up momentarily comes to stop, all while accelerating 9.81 m/s^2 downward.
67. Yes; a ball thrown straight up has a positive (upward) velocity and a negative (downward) acceleration.
68. Zero; a straight line on a position-time graph indicates zero acceleration

Chapter 3 Assessment *(continued)*

69. Sample answer:



70. 8.85 m/s^2; west

71. 3.8 m/s

72. 6.1 sec

73. −2.7 m/s^2

74. −3.4 m/s^2

75. (a) 1.0 m/s^2
(b) −1.0 m/s^2
(c) 0.0 m/s^2

76. (a) 0.20 m/s^2
(b) 0.80 m/s^2
(c) −0.40 m/s^2

77. (a) Factor of 2
(b) 3.8 s
(c) 7.6 s

78. Average acceleration occurs over a period of time; instantaneous acceleration occurs at an instant in time.

79. Truck 2

Lesson by Lesson (p. 106)

80. Less than; truck 2 has a higher velocity than truck 1 and travels 10 m in less time, which means truck 2 changes its velocity more rapidly.

81. The graph is a straigtht line because the velocity changes equally in each time interval.

82. Car 1 < car 4 < car 2 < car 3

83. (a) Less than
(b) C; the arrow from bow 1 accelerates over a greater distance.

84. 3.53 m/s^2; north

85. 9.1 m/s^2

86. 2.8×10^5 m/s^2

87. 32 m/s^2

88. 410g

89. (a) 10 m
(b) 20 m
(c) 40 m

90. (a) Factor of 4
(b) 33 m
(c) 131 m

91. (a) 21 m
(b) Greater than 6.0 m/s; 8.49 m/s

Lesson by Lesson (p. 107)

92. 180g

93. The graph is a downward curving parabola because the negative acceleration results in a position that becomes increasingly negative over time.

94. The intercept is the initial position. The initial slope is the initial velocity.

95. Zero; the straight line means velocity is constant.

96. Initial velocity is positive; acceleration is negative. A negative acceleration is required to change the slope from positive to negative.

97. Initial velocity is zero; acceleration is positive. A positive acceleration is required to change the slope from zero to a positive value.

98. 13.1 m

99. −8.2 m

100. (a) 8.3 m/s
(b) 5.2 m/s^2

101. 79.8 m

102. (a) 1.6 m
(b) 0 m/s
(c) 3.4 m/s^2
(d) 34.5 m

103. (a) (1.2 m/s^2)t^2
(b) 1.0 m
(c) 4.8 m

104. (a) Fishing boat: 40.8 m + (3.4 m/s)t
Speedboat: (2.8 m/s)t + (0.85 m/s^2)t^2
(b) 7.3 s

105. The object's motion is influenced only by gravitational acceleration.

106. Yes

107. Less than; the object gains speed as it falls and covers a greater distance each second.

108. (a) No
(b) No

109. Greater than; ball 1 experiences freefall for a longer period of time and gains more speed.

110. 120 m

111. 59 m/s

112. The statement is accurate.

Lesson by Lesson (p. 108)

113. (a) 2.8 m
(b) 7.4 m/s

114. −0.98 m/s^2

115. 0.10 s

116. (a) 58 m/s
(b) 5.9 s

117. (a) More than 2.0 m
(b) 8 m

118. (a) 3.1 s
(b) −23 m/s

119. (a) 2.8 s
(b) −30 m/s

Mixed Review (pp. 108–110)

120. (a) 40 m
(b) 5 m

121. 23.3 m/s

122. (a) Graph 3
(b) Graph 2

123. (a) 0.61 s
(b) 1.22 s

124. (a) Greater than
(b) C; the hammer spends more time dropping past window 1.

125. (a) Equal to
(b) B; the windows are equally tall.

126. (a) 0.49 s
(b) 4.8 m/s

127. (a) 5.0 s
(b) 8.0 m/s
(c) $v_f = v_i + at$
$= 16 \text{ m/s} + (-3.2 \text{ m/s}^2)(2.5 \text{ s})$
$= 8.0 \text{ m/s}$

128. (a) 5.7 s
(b) -0.18 m/s^2
(c) More than 2.1 m/s

129. 2.6 m/s

130. (a) 3.0 m
(b) 3.0 m
(c) 1.5 m

131. (a) 3.8 m/s^2
(b) 15 m/s

132. 11.3 m

Writing about Science (p. 110)

133. Answers will vary; see Solutions Manual.

134. Astronauts experience no acceleration relative to their spacecraft and feel "weightless." You feel weightless if the elevator cable breaks because you and the elevator accelerate downward at the same rate.

Read, Reason, and Respond (p. 110)

135. A

136. B

Standardized Test Prep (p. 111)

1. D **3.** A **5.** C **7.** D
2. A **4.** D **6.** D

8. The speed and acceleration of the ball are the same as the ball passes the limb on the way up and on the way down. The velocity has the same magnitude in both directions but opposite sign.

4

Les

Prac

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