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 Motion in Two Dimensions

Lesson 4.1

Practice Problems (pp. 114, 117, 119)

1. (a) Scalar
(b) Vector
(c) Vector
(d) Scalar
2. B < C < A < D
3. (a) Increase
(b) 180 m
4. (a) Vector B
(b) Vector A
5. (a) 61.4 m; 43.0 m
(b) 31.7 m; 68.0 m
6. 36.4 m
7. (a) Decrease
(b) 8.13°
8. 3°
9. 17°

LessonCheck (p. 120)

10. Vectors specify direction; scalars do not.
11. Length
12. The sum of the squares of the components equals the vector's magnitude; $r^2 = r_x{}^2 + r_y{}^2$.
13. The result is two component vectors representing the original vector.
14. (a) The magnitude increases (it doubles).
(b) The angle stays the same.
15. 321 m
16. 3.8°
17. 620 m; 440 m
18. 12°

Lesson 4.2

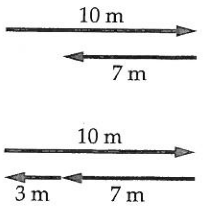
Practice Problem (p. 126)

19. (a) $\vec{D}$
(b) Less than

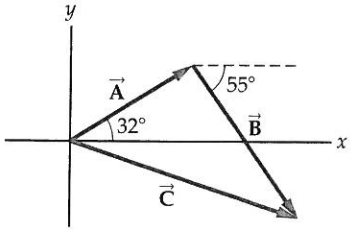
LessonCheck (p. 126)

20. Place the tail of one vector on the head of the other.
21. Add the two x components together; then add the two y components together.
22. Greater than
23. Less than

24.



25. The estimated length of vector C is 45 m; it points about 20° below the *x* axis.



26. 45 m; −19°

27. (a) 35 m; 160°
(b) 35 m; 20°
(c) 35 m; 200°

Lesson 4.3

Practice Problems (p. 130)

28. 5.8 m/s; −19°

29. 79° north of east

30. Decreasing the *y* component of $\vec{v}_{bw}$ so it is equal and opposite the 1.4 m/s velocity of the water $\vec{v}_{wg}$ moves the boat straight across the river.

LessonCheck (p. 130)

31. $v_{13} = v_{12} + v_{23}$

32. The wind speed relative to your body is greatest when you run against the wind. If you run at 4 m/s (relative to the ground) and the wind is 7 m/s relative to the ground, then the wind speed relative to your body is 11 m/s when you run into the wind and 3 m/s when you run with the wind.

33. The river current moves the boat in a direction that decreases the boat's angle with respect to the ground.

34. 6.3 m/s

35. 18°

Lesson 4.4

Practice Problems (pp. 133, 135, 138)

36. 0.505 s

37. 0.33 s

38. 15.5 m/s

39. −39.3°

40. 10.2 m/s

41. 5.1 m; 2.0 m

42. 10 m/s; 1.5 m/s

LessonCheck (p. 140)

43. Parabola

44. $\theta = 45°$ (when air resistance is zero)

45. Equal; the horizontal motion of Janet's ball does not affect its downward acceleration; both balls experience free fall.

46. (a) A < B < C
(b) C < B < A

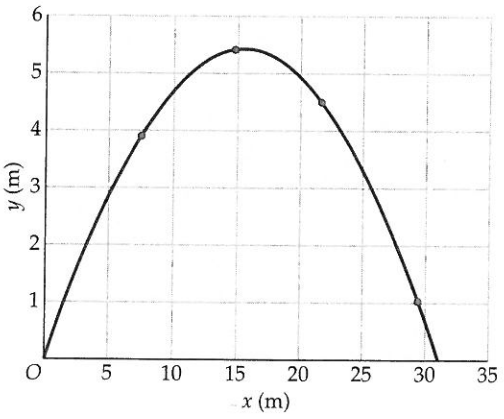
47. 18.6 m

48. 0.84 s

49. (a)

t (s)	*x* (m)	*y* (m)
0.50	7.4	3.9
1.0	15	5.4
1.5	22	4.5
2.0	29	1.0

(b)



50. 7.89 m/s

Chapter 4 Physics & You

Take It Further (p. 141)

1. Accept all reasonable answers. Students might describe, for example, how HUD systems could provide line-of-site information for exiting highways, thus minimizing distractions caused by searching for exit signs.

2. Answers will vary. Evaluate answers based on the quality of the argument (the position should be clearly stated, the pro/con stance well supported, and the ideas well organized).

Chapter 4 Assessment

Lesson by Lesson (p. 144)

51. Vectors $\vec{A}$, $\vec{G}$, and $\vec{J}$ are equal; vector $\vec{I}$ and $\vec{L}$ are equal.

52. (a) Equal to
(b) Opposite

53. No, because the vector's magnitude is equal to the square root of the sum of the squared components.

54. No, because a nonzero component would result in a non-zero magnitude.

55. (a) 38.7 m; 45°
(b) 27.4 m; 90°
(c) 0 m; 0°

56. (a) −34°
(b) 17 m
(c) −34°; 34 m

57. (a) 760 m
(b) About 30°
(c) 27°

58. (a) $\vec{A}$
(b) $\vec{B}$

59. $\vec{A}$: 29.7 m; 47.7° west of north
$\vec{B}$: 24.2 m; 65.6° west of north
$\vec{C}$: 29.7 m; 47.7° east of north
$\vec{D}$: 24.2 m; 65.6° east of north

60. (a) 51 m
(b) 140 m

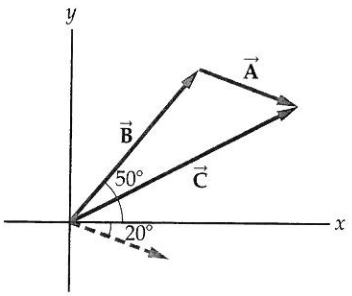
61. Yes

62. The two vectors $\vec{A}$ and $\vec{B}$ must be perpendicular to each other.

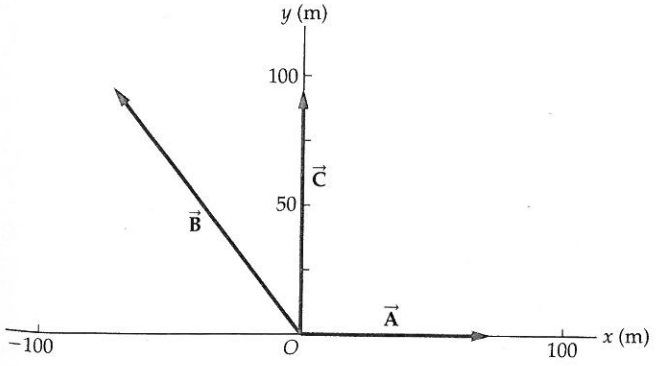
63. The vectors $\vec{A}$ and $\vec{B}$ must point in the same direction in order for their magnitudes to sum to the magnitude of *C*.

Lesson by Lesson (p. 145)

64.



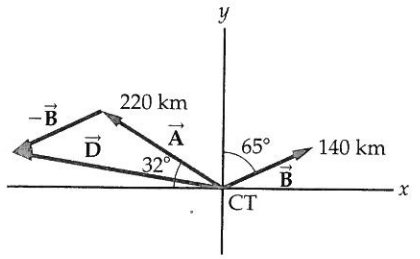
65. (a)



(b) About 120 m; about 120°

66. (a) 16 km
(b) 16 km
(c) 16 km

67. (a)



(b) 320 km; 10° north of west

68. (a) 20 m; 2°
(b) 20.2 m; 1.8°

69. From your perspective, the angled path of the raindrops is opposite the direction you are running. Tilt the umbrella forward to block rain drops that would otherwise follow an angled path under your umbrella and hit your body.

70. When sailing upwind, your speed relative to the air is greater than the speed of the wind itself. If you sail downwind, however, you move with the wind, and its speed relative to you is decreased.

71. (a) 125 m/s due east
(b) Zero

72. 15.3 m/s

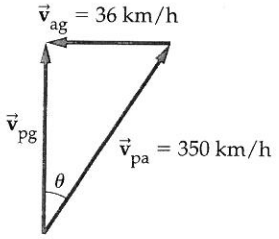
73. 25 s

74. 13 m/s

75. 43° west of north; 3.29 m/s

76. (a) 5.9° east of north

(b)



(c) Increase

77. 11 m/s

Lesson by Lesson (p. 146)

78. (a) 5.0 m/s
(b) Zero

79. (a) Straight downward
(b) Parabolic trajectory

80. 9.81 m/s^2 downward at all times

81. (a) A < B < C
(b) A = B = C

82. 60°

83. 0.786 m

84. 46.2 m/s

85. (a) 9.9 m
(b) 0.99 m

86. (a) 2.70 m/s
(b) −20.6 m/s

87. 2.6 m/s

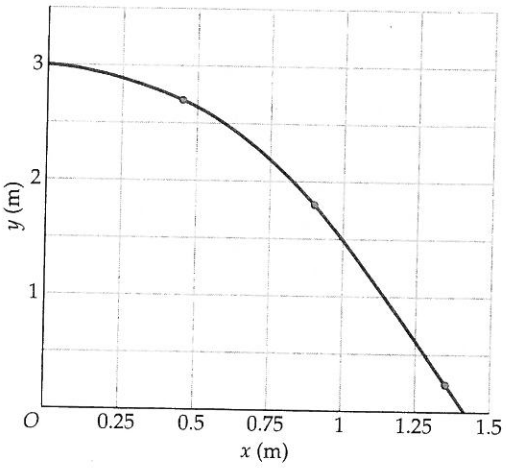
Lesson by Lesson (p. 147)

88. 111 m/s

89. (a)

t (s)	x (m)	y (m)
0.25	0.45	2.7
0.50	0.90	1.8
0.75	1.35	0.24

(b)



90. (a) 0.982 m/s
(b) 1.52 m

91. (a) 121 m
(b) 24.3 m/s

92. 24.8 m/s

Mixed Review (pp. 147–148)

93. (a) No; the acceleration is always vertically downward, but the fly ball is always moving at an angle to the vertical, never straight down.
(b) Yes; a projectile at the top of its trajectory has a velocity that is horizontal, while at the same time its acceleration is vertical.

94. Equal to

95. Less than

96. (a) Straight upward
(b) C

97. (a) Twice as much
(b) A

98. (a) Equal to
(b) Displacement 1: 7.8 cm; 158°; displacement 2: 7.8 cm; 63°

99. (a) 64.9°
(b) 21 m/s
(c) 1.8 s

Writing about Science (p. 148)

100. Answers will vary; see Solutions Manual.

101. At your feet; no; no. See Solutions Manual.

Read, Reason, and Respond (p. 148)

102. C

103. A

104. C

Standardized Test Prep (p. 149)

1. D **3.** B **5.** C **7.** C

2. A **4.** C **6.** D

8. The value can be read directly from the vertical displacement graph; at $t = 4$ s, vertical displacement is about 40 m. On the vertical velocity graph, the vertical displacement after 4 s is the area between the graph line and axis:

$$\text{Area} = \tfrac{1}{2}(3\text{ s})(30\text{ m/s}) + \tfrac{1}{2}(1\text{ s})(-10\text{ m/s}) = 40\text{ m}$$