Answers to problems from College Physics, OpenStax
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Chapter 1

1. (a) 27.8 m/s; (b) 62 mi/h
2. (a) 1.2×10^2 km/h; (b) faster than speed limit
4. 91.4 m
5. 377 ft x 2.8×10^2 ft; 4.53×10^3 in x 3.3×10^3 in
6. 1.85 m
7. 8.847 km
8. 1.23×10^3 km/h
9. (a) 1.3×10^{-9} m; (b) 40 km/My
10. (a) 20 km/s; (b) 2.0×10^4 m/s
11. 2 kg
12. 2.5×10^{-2} %
13. (a) 90.0 ± 4.5 km/h; (b) 53.1 to 58.7 mi/h
14. 4%
15. (a) 7.6×10^7 beats; (b) 7.57×10^7 beats; (c) 7.57×10^7 beats
16. 67 mL
17. (a) 3; (b) 3; (c) 3
18. (a) 99 has 2, 100 has 3 at most; (b) 1.0%, 1.00%; (c) percent uncertainties
19. (a) 2.2%; (b) 60 ± 1 km/h
20. (a) 2%; (b) 1 mm Hg
21. 80 ± 3 beats/min
22. 7.557 cm^2
23. 2.8 h
24. (a) 0.059%; (b) 0.01%; (c) 4.681 m/s; (d) 0.07% or 0.003 m/s
25. 11 ± 1 cm^3
26. (a) 0.02%; (b) 1×10^4 lbm
27. 12.06 ± 0.04 m^2
28. (a) 143.6 cm^3; (b) 0.1 cm^3
29. 2×10^9 heartbeats
30. 150 generations
31. 2×10^{31} times
32. 10^{11} atoms
33. 50 atoms
34. (a) 1/1000; (b) 1/1000
35. (a) 10^{12} cells/hummingbird; (b) 10^{16} cells/person
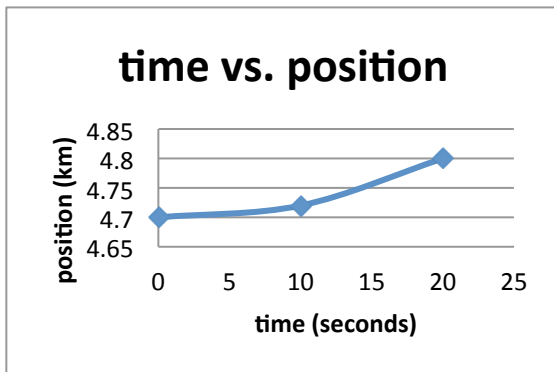36. 10^3 nerve impulses/s

Chapter 2

1. (a) 7 m; (b) 7 m; (c) + 7 m
2. (a) 5 m; (b) 5 m; (c) – 5 m
3. (a) 13 m; (b) 9 m; (c) + 9 m
4. (a) 8 m; (b) 4 m; (c) – 4 m
5. 3.0×10^4 m/s; (b) 0 m/s
6. (a) 52.4 m/s; (b) 0 m/s
7. 2×10^7 y
8. 10 million years
9. 124.88 km/h, 34.689 m/s
10. 100 million years
11. (a) 40.0 km/h; (b) 34.3 km/h, 25° S of E; (c) 3.20 km/h
12. 0.061 s
13. 384,000 km
14. (a) $v_1 = 6.00$ m/s, $v_2 = -1.71$ m/s, $v_3 = 4.04$ m/s; (b) 3.49 m/s
15. (a) 6.61×10^{15} rev/s; (b) 0 m/s
16. 4.29 m/s^2
17. (a) 56.4 m/s^2, 5.76g ; (b) – 201 m/s^2, 20.6g
18. (a) 1.43 s; (b) – 2.50 m/s^2
19. 108 m/s^2, 11.1g
20. (a) 10.8 m/s
21. 38.9 m/s
22. 502 m/s
23. (a) 16.5 s; (b) 13.5 s; (c) – 2.68 m/s^2
24. (c) 173 m; (d) 28.8 m/s
25. (a) 20.0 m; (b) – 1.00 m/s
26. (c) 0.120 s; (d) yes
27. 0.799 m
28. (a) 6.87 m/s^2; (b) 52.3 m
29. (a) 28.0 m/s; (b) 50.9 s; (c) 7.68×10^3 m, 713 m
30. (a) 7.69×10^{-3} s; (b) 8.45×10^3 m/s^2
31. (a) 51.4 m; (b) 17.1 s
32. (a) – 90.0 m/s^2, 9.18g; (b) 6.67×10^{-3} s; (c) –40.0 m/s^2, 4.08g
33. (a) – 80.4 m/s^2; (b) 9.33×10^{-2} s
34. – 486 m/s^2
35. (a) 7.7 m/s; (b) – 1.5×10^3 m/s^2
36. (a) 9.88 s; (b) 20.6 m/s; (c) 16.4 s; (d) 19.5 m/s
37. (a) 32.6 m/s^2; (b) 162 m/s
38. (a) 15.0 m/s; (b) 5.27 s; (c) 4.2 s, 63 m
39. 104 s
40. (a) 12.2 m/s, 4.07 m/s^2; (b) 11.2 m/s
41. (a) 6.28 m, 10.1 m/s; (b) 10.1 m, 5.20 m/s; (c) 11.5 m, 0.300 m/s; (d) 10.4 m, –4.60 m/s
42. (a) –8.23 m, –18.9 m/s ; (b) –18.9 m, –23.8 m/s; (c) –32.0 m, –28.7 m/s; (d) –47.6 m, –33.6 m/s; (e) –65.6 m, –38.5 m/s
43. 4.95 m/s
44. (b) 18 m
45. (b) 8.62 m; (c) 2.65 s
46. (a) 1.14 s; (b) 0.816 m; (c) – 7.16 m/s
47. (a) 8.26 m; (b) 0.717 s
48. 2.28 s
49. 1.91 s
50. (a) 7.00 m/s; (b) 0.714 s
51. (a) 94.0 m; (b) 3.13 s
52. (a) 4.90 m; (b) 38.3 m/s; (c) 33.5 m
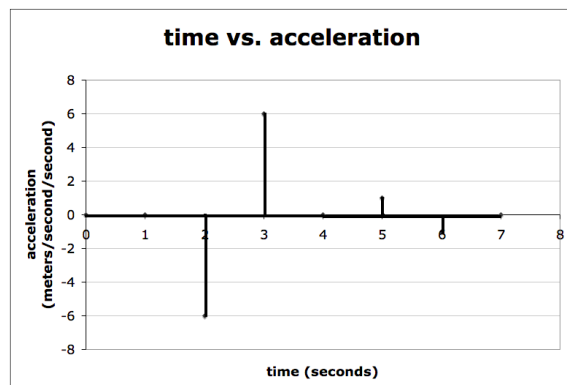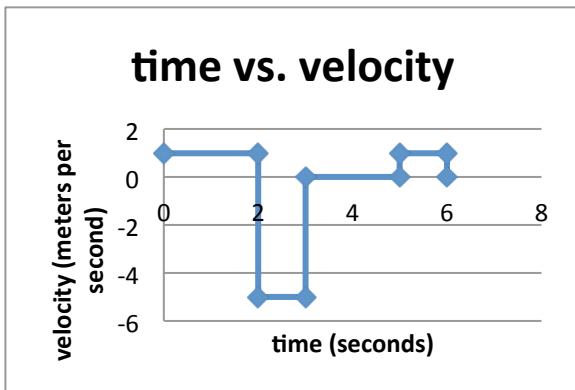53. (a) – 70.0 m/s; (b) 6.10 s
54. 14.5 m/s
55. (a) – 19.6 m; (b) 18.5 m

56. (a) – 5.42 m/s; (b) + 5.33 m/s; (c) 1.34 x 10^5 m/s^2; (d) 1.09 x 10^{-4} m

57. (a) 305 m; (b) 262 m, – 29.2 m/s; (c) 8.91 s

58. (a) – 5.42 m/s; (b) +4.64 m/s; (c) 2880 m/s^2; (d) 0.00511 m

63.

time vs. position

64. (a) 3.5 m/s; (b) – 3 m/s

65. (a) 6 m/s; (b) 12 m/s; (c) 3 m/s^2 ; (d) 10 s

66.

time vs. velocity

time vs. acceleration

Chapter 3

1. (a) 480 m; (b) 379 m, 18.4° E of N

2. (a) 1.20 km; (b) 379 m, 71.6° N of E

3. N-component: 3.21 km, E-component: 3.83 km

4. 30.8 m, 35.8° W of N

5. 19.5 m, 4.65° S of W

6. 19.5 m, 4.65° S of W

7. (a) 26.6 m, 65.1° N of E; (b) 26.6 m, 65.1° S of W

9. 52.9 m, 90.1° w.r.t. + x-axis

10. v_A = 3.45 m/s, v_B = 3.94 m/s

11. v_x = 4.41 m/s, v_y = 5.07 m/s

12. v_x = 6.35 m/s, v_y = 2.19 m/s

13. (a) 1.56 x 10^3 m; (b) 120 m, East

14. (a) 1.56 km; (b) 646 m, 21.8° N of E

15. N-component: 87.0 km, E-component: 87.0 km

16. 30.8 m, 35.8° W of N

17. 30.8 m, 35.8° W of N

18. (a) D_E = 1.94 km, D_N = 7.24 km

19. (a) 30.8 m, 54.2° S of W; (b) 30.8 m, 54.2° N of E

20. 92.3 m, 53.7° S of W

21. (a) D_S = 18.4 km, D_W = 26.2 km; (b) D_{SW} = 31.5 km, D_{NW} = 5.56 km

22. 2.97 km, 22.2° W of S

23. 7.34 km, 63.5° S of E

24. 64.8 km, 40.9° N of E

25. 1.3 x 10^2 m, 30.9 m

26. (a) 20 m/s; (b) 2.45 s; (c) 7.35 m

27. (a) 3.50 s; (b) 28.6 m/s; (c) – 34.3 m/s; (d) 44.7 m/s, 50.2° below x-axis

28. (a) 7 buses

29. (a) 18.4° ; (b) 6.23 m

30. (a) 14.2° ; (b) 75.8° ; (c) 0.60 s

31. 91.8 m, 163 m, 255 m

32. 128 m, 255 m

33. (a) 560 m/s; (b) 8.00 x 10^3 m; (c) 80 m

34. (a) 27.0 m; (b) 36.0 m; (c) 20 m/s

35. 1.5 m

36. 9.21 m

37. 6.1°, the ball lands 5.3 m from the net

38. (a) 15.2 m/s; (b) 1.31 s; (c) 2.11 m

39. (a) – 0.486 m

40. 10.3 m/s, 73.1° below horizontal

41. 4.23 m

42. 18.2 m/s

43. 91.8 m

44. 30.4° or 67.2°

45. 15.0 m/s

46. (a) 3.83 m/s; (b) 1.96 m

47. (a) 24.2 m/s; (b) 57.4 m

48. $a = \tan\theta$, $b = \dfrac{-g}{2(v_0\cos\theta)^2}$

52. (a) 35.8 km, 45° S of E; (b) 5.53 m/s, 45° S of E; (c) 56.1 km, 45° S of E

53. (a) – 4.00 m/s; (b) 7 min and 42 s

54. (a) 0.70 m/s; (b) The second runner will win; (c) 4.17 m

55. 144 m

56. 17.0 m/s, 22.1°

57. 8.05 m/s, 81.8° N of E

58. (a) 230 m/s, 8.0° S of W

59. (a) 9.45° W of N; (b) 7.87 m/s

60. (a) 63.5 m/s; (b) 29.6 m/s

61. (a) 17.1 m straight down; (b) 17.2 m/s, 84.2° below horizontal and to the south

62. 6.68 m/s, 53.3° S of W

63. (a) – 2300 km/s, 0, 2200 km/s, 5030 km/s, 8900 km/s; (b) – 11,200 km/s, – 8900 km/s, – 6700 km/s, – 3870 km/s, 0

64. (a) 1.59×10^{-18} s^{-1}, 1.55×10^{-18} s^{-1}, 1.57×10^{-18} s^{-1}, 1.57×10^{-18} s^{-1}, 14.9 km/s/Mly ; (b) 20.2 billion years

65. 0.94 m/s

66. 1.72 m/s, 42.3° N of E

67. 74.0°

68. (a) 27 km/s

69. (a) 556 m/s; (b) 278 m/s, 10.0° S of E

Chapter 4

1. 265 N

2. 9.26 s

3. 13.3 m/s^2

4. (a) 56.0 kg

5. 75 N, 1.1 m

6. 4.12×10^5 N

7. (a) 12.0 m/s^2

8. 253 m/s^2
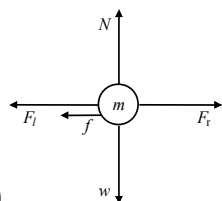
9. (a) child plus wagon; (b) (c) 0.130 m/s^2 in the direction of the second child's push; (d) 0 m/s^2

10. 1.26×10^3 N

11. (a) 3.68×10^3 N, 5.00 times greater than weight; (b) 3750 N, 11.3° from horizontal

12. (a) $– 1.51 \times 10^4$ N, 20.5 times greater than weight; (b) 1.51×10^4 N, 2.79° from horiz.

13. 1.5×10^3 N

14. (a) 1.33 m/s^2

15. 2.64×10^7 N

16. (a) 692 N; (b) 932 N

17. (a) 0.11 m/s^2; (b) 1.2×10^4 N

18. 779 N

19. (a) 7.84×10^{-4} N; (b) 1.89×10^{-3} N, 2.41 times the tension in the vertical strand

20. (a) 588 N; (b) 678 N

22. (a) 5.6 kg; (b) 55 N; (c) 60 N

23. 6.20 m/s^2

24. 1.03×10^3 kg

25. 3.43×10^3 N

26. 3.14×10^3 N

27. (a) 4.41×10^5 N; (b) 1.50×10^5 N

28. (a) 9.89×10^4 kg; (b) 1.70×10^4 N

29. (a) 910 N; (b) 1.11×10^3 N

30. (a) $F_2 = 11$ N, $F_1 = 16$ N; (c) $F_2' = 5.2$ N, $F_1' = 17$ N

31. 0.14 m/s^2, 12.37°

32. (a) 838 N; (b) 3.44×10^3 N

33. 12.9 N

34. (b) 1.42×10^3 N; (c) 539 N

35. (b) 73 N

38. (a) – 260 N

39. (a) – 8.47 m/s^2

40. 10.2 m/s^2, 4.67° from vertical

41. 376 N

42. $T_1 = 736$ N, $T_2 = 194$ N

43. –68.5 N

44. (a) 7.43 m/s; (b) 2.97 m

45. (a) 7.70 m/s^2; (b) 4.33 s

46. (a) 4.20 m/s; (b) 29.4 m/s^2; (c) 4.31×10^3 N

47. (a) 46.4 m/s; (b) 2.40×10^3 m/s^2; (c) 245

48. (a) 47.2 m/s; (b) 2.47×10^3 m/s^2; (c) 6.18×10^3 N, 252

49. (a) 1.87×10^4 N; (b) 1.67×10^4 N; (c) 1.56×10^4 N; (d) 19.4 m

50. (a) – 6.11 m/s

51. (a) 1860 N, 2.53

52. (a) 10^{-13}; (b) 10^{-11}

53. (a) 10^{-38}; (b) 10^{-25}; (c) 10^{-36}

54. 10^2

Chapter 5

1. 5.00 N

2. (a) 1.00×10^3 N; (b) 30.0 N

3. (a) 10 N; (b) 97.0 N

4. (a) 588 N; (b) 1.96 m/s^2

5. (a) 4.90 m/s^2; (b) will not slip; (c) will slip

6. (a) 3.29 m/s^2; (b) 3.52 m/s^2; (c) 980 N, 945 N

7. (a) 32.3 N, 35.2°; (b) zero; (c) 0.301 m/s^2 in the direction of F_{net}

10. 1.83 m/s^2

11. (a) 0.737 m/s^2; (b) 5.71°

13. (a) 10.8 m/s^2; (b) 7.85 m/s^2; (c) 2.00 m/s^2

14. (a) 4.20 m/s^2; (b) 2.74 m/s^2; (c) -0.195 m/s^2

15. (a) 9.09 m/s^2; (b) 6.16 m/s^2; (c) 0.294 m/s^2

16. (a) 1.03×10^6 N; (b) 3.48×10^5 N

17. (a) 272 N; (b) 0.268

18. (a) 51.0 N; (b) 0.720 m/s^2

19. (a) 46.5 N; (b) 0.629 m/s^2

20. 115 m/s, 414 km/h

21. 49.2 s, assuming an area of 0.14 m^2

22. 25.1 m/s, 9.90 m/s

23. (a) 44.8 N, 91.5 N; (b) 357 N, 729 N

24. 1.04%

25. (a) 313 m/s; (b) 6.57 m/s

27. 2.38×10^{-6} m/s

28. 0.76 kg/m·s

29. 1.90×10^{-3} cm

30. 4.5×10^{-5} m

31. (a) 1 mm

32. 0.190 mm

33. (a) 9 cm

34. 0.57 mm

35. 8.59 mm

36. 706 N

37. 1.49×10^{-7} m

38. 3.34×10^{-6} m

39. (a) 3.99×10^{-7} m; (b) 9.67×10^{-8} m

40. (a) 2.9×10^{-5} m; (b) 5.8×10^{-6} m

41. 4×10^2 N/cm^2

42. (a) 2.0×10^4 N/cm^2

43. 1.44 cm

44. (a) 1.1 mm; (b) 6.6 mm to the right; (c) 1.11×10^5 N

Chapter 6

1. 723 km

2. 0.1 rps, 0.63 rad/s

3. $5. \times 10^7$ rotations

4. (a) 86400 s; (b) 7.3×10^{-5} rad/s; (c) 470 m/s

5. 117 rad/s

6. 39.0 m/s

7. 728 rpm

8. (a) 33.3 rad/s; (b) 500 N; (c) 40.8 m

10. 12.9 rev/min

11. 2.5 m/s^2

12. 4×10^{21} m

13. (a) 126 rad/s; (b) 145 m/s; (c) 1.82×10^4 m/s^2, $1.85 \times 10^3 g$

14. (a) 3.47×10^4 m/s^2, $3.55 \times 10^3 g$; (b) 51.1 m/s

15. (a) 3.95×10^3 rad/s^2; (b) 126 m/s, 36.9% the speed of sound

16. (a) 31.4 rad/s; (b) 118 m/s^2; (c) 384 m/s^2

17. 91% less at position 2

18. (a) 0.524 km/s; (b) 29.7 km/s

19. 0.313 rad/s

20. (a) 1.35×10^3 rpm; (b) 8.47×10^3 m/s^2; (c) 8.47×10^{-12} N; (d) 865

21. (a) 16.6 m/s; (b) 19.6 m/s^2; (d) 1.76×10^3 N, 3.00 times the weight

22. (a) 40.5 m/s^2; 905 N

23. (a) 483 N; (b) 17.4 N; (c) 2.24, 0.0807

24. 3.9×10^3 N

25. 4.14°

26. 18.9 m/s

27. (a) 24.6 m; (b) 36.6 m/s^2; (c) $3.73g$

28. (b) 26.1°

29. (a) 2.56 rad/s; (b) 5.71°

30. (a) 16.2 m/s; (b) 0.234

31. (a) 14.8 m/s; (b) 11.3 m; (c) 7.35×10^4 J

32. (a) 1.84

33. (a) 5.979×10^{24} kg

34. (a) 3.33×10^{-5} m/s^2; (b) 5.93×10^{-3} m/s^2; (c) 178

35. (a) 1.62 m/s^2; (b) 3.75 m/s^2

36. (a) 274 m/s^2; (b) 28.0 times

37. (a) 3.42×10^{-5} m/s^2; (b) 3.34×10^{-5} m/s^2

38. 2.72×10^{-3} m/s^2

39. (a) 7.01×10^{-7} N; (b) 1.35×10^{-6} N, 0.521

40. (a) 4.6×10^{-14} m/s^2; (b) 2.0×10^4

41. (a) 1.66×10^{-10} m/s^2; (b) 2.17×10^5 m/s

42. (a) 2.94×10^{17} kg; (b) 4.91×10^{-8}

43. 4.23×10^4 km

44. 1.98×10^{30} kg

45. 1.89×10^{27} kg

46. 316

47. (a) 2.62×10^8 y; (b) 2×10^{13} solar masses

48. (a) 2.11×10^4 m/s; (b) 2.98×10^4 m/s; (c) 1.01×10^{-7} s; (d) 1.48×10^8 N; (e) 2.22×10^5 J

49. (a) 5.08×10^3 km

Chapter 7

1. 3.00 J, 7.17×10^{-4} kcal

2. 1.84×10^3 J

3. (a) 5.92×10^5 J; (b) -5.88×10^5 J

4. (a) 6.7×10^2 N; (b) 1.9 gal

5. 3.14×10^3 J

6. 1.30×10^3 J

7. (a) -700 J; (b) 0 J ; (c) 700 J; (d) 38.6 N; (e) 0 J

8. (a) -1320 J; (b) -2.16×10^4 J; (c) 2.29×10^4 J; (d) 0 J

9. 9.34×10^6 J, 2.33×10^9 J, 1/250

10. (a) 1.47 m/s

11. 1.1×10^{10} J

12. (a) -2470 N; (b) -1.48×10^5 N, 60.0

13. -2.8×10^3 N

14. (a) 4.67×10^3 N; (b) 1.75×10^4 N

15. 102 N

16. (a) 1.96×10^{16} J; (b) 0.52

17. (a) 3×10^{12} J; (b) 2×10^5

18. (a) 1.8 J; (b) 8.6 J

19. 15.7

20. 0.687 m/s

21. (a) 26.2 m/s, 5.35 s; (b) 26.3 m/s, 4.86 s

22. 7.81×10^5 N/m

23. 0.459 m

24. 9.46 m/s

25. (a) 47.6 m; (b) 1.89×10^5 J; (c) 375 N

26. 4×10^4 molecules

27. 24.8 m/s

28. 1×10^4 bombs

29. (a) 2.5×10^7 years

30. 2×10^{-10} W

31. (a) 1×10^8

32. (a) 40 people; (b) 8 million people

33. $2.37

34. $149

35. (a) 208 W; (b) 6.57×10^9 J

36. (a) 208 W; (b) 141 s

37. 4.80×10^5 W, 643 hp

38. (a) 3.20 s; (b) 4.04 s

39. (a) 7.81×10^4 W; (b) $7.03/h = $0.00195/s

40. (a) 9.46×10^7 J; (b) 2.54 y

41. (a) 223 s; (b) 24.8 MW; (c) 150 km, 49.6 kN

42. 2.77×10^4 W

43. (a) 1.41 kW/m^2; (b) 28.8 km^2, USA: 1.28×10^6 km^2, AU: 6.6×10^3 km^2, CHN: 7.7×10^4 km^2

44. (a) 9.5 min; (b) 69 flights

45. (a) 1.17×10^3 W, 1.56 hp

46. 0.860 hp

47. (a) 0.100; (b) 2.51×10^2 kcal

48. 31 g

49. 3.8×10^3 kcal

50. 14.3%

51. (a) 24 W; (b) 24.5 min; (c) 1.14×10^6 J

52. (a) 3.21×10^4 N; (b) 2.35×10^3 N; (c) 41.0, 3.00

53. (a) 1.63×10^4 N; (b) 22.2

54. (a) 108 kJ; (b) 599 W

55. 5.87×10^3 kcal

56. (a) 144 J; (b) 288 W

57. (a) 5.88×10^3 L; (b) 8.82×10^5 J; (c) 4.93×10^7 J, 1.79%

58. (a) 2.50×10^{12} J; (b) 2.52%; (c) 1.4×10^4 kg

59. (a) 32 min

60. (a) 294 N; (b) 118 J; (c) 49.0 W

61. (a) 127 W; (b) 63.5 N; (c) 15.6 s

62. (a) 0.500 m/s^2; (b) 62.5 N

63. (a) – 21. 0 N; (b) 7.50 m; (c) 5.77° or 84.23°; (d) 1.50 m

64. (a) 1.61×10^4 N; (b) 3.22×10^5 J; (c) 5.66 m/s; (d) 4.00 kJ

65. (a) 75%

66. (a) 4.65×10^3 kcal; (b) 38.8 kcal/min

69. (a) 4.32 m/s; (b) 3.47×10^3 N; (c) 8.93 kW

Chapter 8

1. (a) 1.50×10^4 kg m/s; (b) 625; (c) 6.66×10^2 kg m/s

2. (a) 1.20×10^8 kg; (b) 1.32×10^6 kg m/s, 1.21×10^3

3. (a) 8.00×10^4 m/s; (b) 1.20×10^6 kg m/s; (c) – 0.0100 m/s

4. (a) 3.60×10^5 kg m/s; (b) 4.50×10^4 m/s

5. 54 s

6. 1.78×10^{29} kg m/s

7. 9.00×10^3 N

8. 2690 N

9. (a) 2.40×10^3 N toward the leg

10. (a) 150 kg m/s; (b) 1.43 m/s; (c) 15.0 m/s

11. (a) – 800 kg m/s; (b) – 1.20 m/s

12. 6.67×10^6 N

13. (a) – 1.50×10^6 N; (b) – 1.00×10^5 N

14. (a) – 12.0 m/s; (b) – 360 N; (c) – 2.40×10^3 N, 0.300

15. 16.0 s, 4.69×10^5 N in the direction the ship was originally traveling

16. 968 kg m/s, 0.80 m/s

17. 2.10×10^3 N

18. (a) 2.86×10^{-3} s; (b) 1.10×10^3 N

19. $KE = p^2/2m$

20. $(10 \text{ m/s})m$ (in kg)

21. 60.0 g

22. 21.8 m/s, 61.8° above horizontal

23. 0.122 m/s

24. 0.272 m/s

25. 2690 N

26. 27.4 m/s

27. 22.4 m/s

29. 0.25 m/s

30. – 34.9 m/s, 0.150 m/s

31. (a) – 86.4 N; (b) – 0.389 J; (c) 64.0%

32. (a) 1.78 m/s; (b) – 267 J

33. (a) 8.06 m/s; (b) – 59.0 J; (c) 7.88 m/s, – 223 J

34. (a) – 1.05×10^{-2} m/s; (b) 1.818×10^8 J

35. (a) 0.163 m/s; (b) – 81.6 J; (c) – 0.0870 m/s, – 81.5 J

36. (a) 0.182 m/s; (b) 8.52×10^3 J

37. 0.704 m/s, – 2.25 m/s

38. (a) 4.58 m/s; (b) 31.5 J; (c) – 0.491 m/s; (d) 3.38 J

39. (a) 2.68×10^5 m/s; (b) 1.41×10^{-14} J

40. (a) 1.02×10^{-6} m/s; (b) – 5.63×10^{20} J

41. 0.798 m/s

42. 24. 8 m/s

43. 1.07 m/s

44. (a) 4.00 kg; (b) 210 J

45. (a) 3.00 m/s in a direction 90° opposite that of the incoming puck; (b) $KE_i/KE_f = 1.00$

47. (a) – 2.26 m/s; (b) 7.63×10^3 J

48. (a) 9.10 m/s, – 14.7°; (b) $KE_i/KE_f = 0.689$

49. (a) $v_1' = 1.50 \times 10^7$ m/s, $v_2' = 5.36 \times 10^5$ m/s, $\theta_2 = – 29.5°$; (b) 7.52×10^{-13} J

50. (a) 8.46 m/s, 33.6°; (b) 161,225 J, – 8.78×10^4 J

52. – 7.50×10^{-2} m/s, 2.50 cm

53. 39.2 m/s^2

54. 1.92 m/s^2

55. 4.16×10^3 m/s

56. (a) 1.60×10^4 m/s; (b) 1.80×10^{-3} m/s^2

58. (a) 2.45×10^3 kg/s

59. 145 m/s

60. 2.63×10^3 kg

61. (a) – 0.526 m/s, – 0.421 m/s; (b) – 0.236 J

62. (a) 21.4 m/s; (b) 0.832

Chapter 9

1. (a) 46.8 N m

2. (a) 23.1 N m; (b) 17.0 ft lb

3. 23.3 N m

4. 568 N

5. (a) 1.36 m; (b) 686 N

6. 1.43×10^3 N

7. 1.80 m

8. (a) 2.55×10^3 N, 16.3° to the left of vertical; (b) 0.292

9. 196 N, 392 N

10. 2.12×10^4 N

11. (a) 11.0 N; (b) 0.450

12. (a) 1/6 of the weight supported by the opposite shore;
    (b) 2.0×10^4 N up

13. (a) 7.20×10^3 N; (b) 65.2°

14. (a) 21.6 N; (b) 21.6 N (acting horizontally)

15. (a) 0.551; (b) 39.2 N

16. 1.11×10^3 N upward along each leg (18.4° above horizontal)

17. top = 126 N, bottom = 751 N

18. (a) 140 N; (b) 189 N

19. (a) 25.0; (b) 50.0 N

20. 1.78 m

21. (a) 18.5; (b) 29.1 N; (c) 510 N

22. 0.0400

23. 1.30×10^3 N

24. (a) 564 N; (b) 1690 N

25. (a) 299 N; (b) 897 N

26. 407 N

27. 376 N

28. 1.1×10^3 N, 190° ccw from the positive x-axis

29. 1.72×10^3 N

30. 97 N, 59°

31. 470 N

32. (a) 25 N downward; (b) 75 N upward

33. (a) 2.21×10^3 N upward; (b) 2.94×10^3 N downward

34. 2.25×10^3 N

35. (a) 1.2×10^2 N upward; (b) 84 N downward

36. (a) 6.5 cm; (b) 426 N

37. (a) 147 N; (b) 1680 N, 6.86; (c) 118 J; (d) 49.0 J

38. (a) 250 N; (b) 2500 N

39. (a) 2.33 m

Chapter 10

1. 0.737 rev/s

2. (a) 87.3 rad/s^2; (b) 8.29 m/s^2; (c) 1.04×10^7 m/s^2, $1.06 \times 10^6 g$

3. (a) – 0.26 rad/s^2; (b) 27 rev

4. (a) 200 rad/s

5. (a) 80 rad/s^2; (b) 1.0 rev

6. 405 m

7. (a) 45.7 s; (b) 116 rev

8. (a) – 25.0 rad/s^2; (b) 28.7 rev; (c) 3.80 s; (d) 50.7 m;
    (e) 26.6 m/s

9. (a) 600 rad/s^2; (b) 450 rad/s; (c) 21.0 m/s

10. (a) 0.338 s; (b) 0.0403 rev; (c) 0.313 s

11. (a) 0.363 kg m^2; (b) 2.34 kg m^2

12. 0.500 kg m^2

13. 1.18×10^3 N

14. (a) 50.4 N m; (b) 17.1 rad/s^2; (c) 17.0 rad/s^2

15. (a) 1.124 kg m^2, 97.9 rad/s^2; (b) 32.3 m/s; (c) 0.817 s

16. 3.96×10^{18} s or 1.25×10^{11} y

17. (a) 148 ft lb; (b) 64.4 rad/s^2

18. $ml^2/12$

19. (a) 1.0 ms

20. (a) 1.84×10^3 rad/s = 17,500 rpm

21. (a) 185 J; (b) 0.0785 rev; (c) 9.81 N

22. 7.00 m/s

23. (a) 2.57×10^{29} J; (b) 2.65×10^{33} J

24. 8.09×10^3 J

25. 434 J

26. (a) 9.66 rad/s; (b) 10.1 m/s

27. (a) 128 rad/s; (b) 19.9 m

28. (a) 2.18 m; (b) 3.27 m

29. (a) 10.4 rad/s^2; (b) 6.11 J

30. (a) 41.1 rad/s^2; (b) 15.7 J

31. (b) 1.22

32. $(4/45)MR^2$ or $0.0889MR^2$

33. (a) 50.7 m; (b) 3.07×10^4 J

34. (a) 674 J; (b) 1.04×10^4 N

36. (a) 2.66×10^{40} kg m^2/s; (b) 7.07×10^{33} kg m^2/s

37. (a) 2.89×10^{34} kg m^2/s; (b) 2.37×10^{29} kg m^2/s

38. 22.5 kg m^2/s

39. 2.30 rad/s

40. 25.3 rpm

41. (a) 15.1 kg m^2/s; (b) 1.92 kg m^2; (c) – 0.503 N m

43. (a) 0.156 rad/s; (b) 22.5 J, 1.17×10^{-2} J; (c) 1.50 kg m/s,
    0.188 kg m/s

44. (a) 1.74 rad/s; (b) 22.5 J, 1.57 J; (c) 1.50 kg m/s, 2.20 kg m/s

45. (a) 3.13 rad/s; (b) 438 J, 438 J

46. (a) 5.34×10^{-2} m/s; (b) 0.916 rad/s; (c) 28.1 J, 1.64 J

47. (a) 1.70 rad/s; (b) 22.5 J, 2.04 J; (c) 1.50 kg m/s

48. (a) 5.64×10^{33} kg m^2/s; (b) 1.38×10^{22} N m; (c) 2.17×10^{15} N