Chapter 1

2. a. L/T^2
   b. L
4. a. $L/T \neq L^2/T^2$ thus the equation is not dimensionally correct
   b. Both sides of the equation have units L
6. ?
8. a. 3
   b. 4
   c. 3
   d. 2
10. a. 719
   b. 22
12. 1159 m
14. 982 cm
16. ***See the note at the bottom of page 9**
Assume 4.00×10^{16} m from Table 1.1 hence our answer will have 3 sig figs. 1.31×10^{17} ft

Unit Conversion Factors are found just inside the cover of your text.

18. a. 3.16×10^7 s
   b. 6.05×10^{10} yr
20. 10^6 m^2
22. a. 1000 kg
   b. $m_{cell} = 5.2 \times 10^{-16}$ kg
   $m_{kidney} = .27$ kg
   c. $m_{fly} = 1.26 \times 10^{-5}$
24. 6.71×10^8 mi/h
26. 2.57×10^6 m^3
28. 7300 balls (assumes? 81 games per season, 9 innings per game, 10 batters per inning!)
30. ? (assumes? 1 tuner per 10,000 residents and a population of ? million)
32. (2.05, 1.43)
34. r=2.24 m, θ= 26.6°
36. a. 3
   b. 3
   c. 4/5
   d. 4/5
   e. 4/3
38. 35.5°
40. a. 6.71 m
   b. .894
   c. .746
42. a. .677 g/cm^3
   b. 4.30×10^{16} m^2
44. 2×10^5 tons/yr (assumes? .5 oz of aluminum per can)
46. ?

Chapter 2

2. 1.26 h (75.5 min)
4. a. 52.9 km/h
   b. 90 km
6. 218 km
8. .182 mi west of the flagpole
10. a. 1.17 m/s
   b. 1.40 m/s
12. a. 6.00 m/s
   b. 8.00 m/s
14. a. 4.00 m/s
   b. -4.00 m/s
   c. 0 m/s
   d. 2.00 m/s
16. .75 m/s^2
18. -1500 m/s^2
20. a. 0, 1.60, .80 m/s^2
   b. 0, 1.60, 0 m/s^2
22. 3.73 s
24. a. 1.25 m/s^2
   b. 8.00 s
26. a. 107 m
   b. 1.49 m/s^2
28. a. -8 m/s^2
   b. 100 m
30. a. 3×10^{-10} s
   b. 1.26×10^{-4} m
32. 291 s
34. yes, the necessary acceleration is .032 m/s^2
36. a. 31.9 m
   b. 2.55 s
   c. 2.55 s
   d. 25 m/s
38. .82 m/s
40. a. 6.26 m/s
   b. 1.28 s
42. a. 2.33 s
   b. -32.9 m/s
44. a. 113.5 s
   b. -423 m/s
46. a. -3.5×10^5 m/s^2
   b. 2.86×10^{-4} s
48. a. -3 m/s^2
   b. 3 m/s^2
   c. 0 m/s^2
   d. -3, 3, 0 m/s^2
50. a. -29.4 m/s
   b. 939 m/s^2
   c. 3.13×10^{-2} s
52. 1.05 s
54. a. 5500 ft
   b. 367 ft/s
56. 96 m

Chapter 3

2. a. 205 m eastward
   b. 45 m westward
4. a. 5.2 m, 60° above the x-axis
   b. 3 m, 30° below the x-axis
   c. 3 m, 150° counter clockwise from the positive x-axis
   d. 5.2 m, 60° below the x-axis
6. 7.92 m, 4.34° north of west
8. 15.3 m, 58° south of east
10. 25 m
12. 240 m, 237°
14. 1320 mi, 17° north of east
16. 197 cm, 14.7° below the x-axis
18. 2.77 m from the base of the table. v_x=5 m/s
    v_y=5.42 m/s
20. 25.1 m
22. 5.05 m
24. a. 24.5 m from the base of the cliff
    b.1.53 s
26. a. -15 km/h
    b. 15 km/h
28. 61.4 s
30. a. .85 m/s
    b. v_{1w}=2.05 m/s
    v_{2w}=2.05 m/s
32. 249 ft upstream
34. a. v_{RC}= 57.7 km/h, 60° west of vertical
    b. v_{RE}=28.9 km/h,10°(?)
36. a. 16.4 m/s
    b. 11.5 m/s
38. 12 s
40. ≈ 2.3 m/s horizontal velocity
42. 37.2 m/s
44. 10,8 m
46. a. 1522 m
    b. 36.1 s
    c. 4045 m
48. a. 22.9 m/s
    b. 360 m from the base of the cliff
50. See class notes
52. a. (50, 86.6)
    b. (-64.3, 76.6)
    c. (-94.9, -34.2)
    d. (34.2, -94.0)
54. a. 131,8 cm, 69.6° male
    110.9 cm, 0° female
    b. 146.4 cm, 59.5° male
    132.0 cm, 70° female
    Δd = 2.24 cm, 65.9°
56. 1.97 m, 1.98 m, 83.6°

Chapter 4

2. a. 0 N
   b. 0 N
4. 3.71 N, 58.7 N, 2.27 kg
6. ?
8. 2.45 m/s²
10. 9.6 N
12. 1.59 m/s², 65.2° north of east
14. a. .20 m/s²
    b. 10.0 m
    c. 2.00 m/s
16. 1080 N at 204°
18. 75 N, 130 N
20. 171.4 N, 60.55°
22. 1.36 m
24. a. 14.3 m/s
    b. 589 m
26. 12.8 N down the incline
28. 154 N
30. 64 N
32. a. 7250 N
    b. 4.57 m/s²
34. a. 2150 N
    b. 645 N
    c. 645 N rear
    d. 10190 N, 15.9° left of vertical
36. 32.7 N, 6.53 m/s²
38. a. 39.2 N
    b. .78 m/s²
40. μ_s = .383,
    μ_k = .306
42. μ_k = .229
44. 894 N
46. a. μ_s = .404
    b. 45.8 lb
48. μ_k = .436
50. μ = .456
52. 4130 N
54. μ_s = .727
    μ_k = .577
56. 3.92 m/s²
58. 700, 700 N
60. 60.6 N, 35.0 N
62. a. 84.9 N vertically
    b. 84.9 N
64. 99.9 N
66. a. 3.35 m/s²
    b. 2.44 s
68. 50 m
70. a. 10.9 N
    b. 2.73 m/s²
72. 515 N
74. 1.155 Mg
    .5775 Mg
76. a. 50 N
    b. μ_s = .5
78. 1.77 m/s²
80. a. 1.78 m/s²
    b. μ_k=.368
    c. 2.67 m/s
82. .685 m/s²
84. a. 1.67 m/s², 16.7 N
    b. .687 m/s², 16.7 N
86. a. .682
    b. 3.2 m/s²
    c. 2.09 m/s
88.

$$a_1 = \frac{2F}{4m_1 + m_2}$$

$$a_2 = \frac{F}{4m_1 + m_2}$$

$$T = \frac{2m_1F}{4m_1 + m_2}$$

90. a. 1.02 m/s²
    b. 2.04, 3.06, 4.08 N
    c. F_{12} = 14 N
    F_{23} = 4 N
92. a. 78 N
    35.9 N
    b. μ = .655

Chapter 5

2. 700 J
4. .675 J
6. 8.75 m
8. a. -560 J
   b. 1.17 m
10. a. 5.14×10^3 J
   b. -5.14×10^3 J
   c. $\mu_k = .653$
12. 150 J fast
   96.0 J slower
14. .265 m/s
16. a. 90 J
   b. 180 J
18. a. 2 m/s
   b. 200 N
20. 1 m/s
22. 147 J
24. a. 2.59×10^5 J
   b. 2.59×10^5 J
26. a. 80 J
   b. 10.7 J
   c. 0 J
28. a. -30 J
   b. -51.2 J
   c. -42.4 J
   d. friction forces are non-conservative
30. .459 m
32. a. 20.4 m
   b. 14.1 m/s
34. a. $K_{Javelin} = 349$ J
   $K_{Discus} = 676$ J
   $K_{Shot} = 741$ J
   b. $K_{Javelin} = 175$ N
   $K_{Discus} = 338$ N
   $K_{Shot} = 371$ N
   c. Yes, if 371 N can be exerted on the shot, a similar force should be exerted on the others
36. 3.68 m/s
38. 2060 N
40. 104 m/s
42. a. .415 m
   b. -4.94 J
   c. 2.94 J, -6.51 J
44. 289 m
46. a. 2.39×10^4 W
   b. 4.77×10^4 W
48. .315 hp
50. a. 2.06×10^4 J
   b. .919 hp
52. 8.73 hp
54. 6.47×10^3 N
56. a. 7.5 J
   b. 15 J
   c. 7.5 J
   d. 30 J
58. 5.2m
60. 2.59×10^6 J
62. 5.33×10^3 hp
64. 563 lb
66. a. 2.34×10^3 N
   b. 469 N
68. $\mu_k = .306$
70. 2.5 m
72. .7 m/s
74. a. 51 J
   b. 69 J
76. 3914 J
78. a. 63.9 J
   b. -35.4 J
   c. -9.51 J
   d. 19 J
80. a. .588 J
   b. .588 J
   c. 2.42 m/s
   d. .196, .392 J

Chapter 6

2. a. doubled
   b. quadrupled
4. a. 0 kg•m/s
   b. 1.06 kg•m/s
6. 7.5×10^4 N
8. a. $-7.5\text{x}10^4$ N*s
   b. 375 N
10. a. 12 N•s
   b. 6 m/s
   c. 4 m/s
12. a. -6.3 kg•m/s
   b. -3150 N
14. 6530 N, down
16. a. .49 m/s
   b. $2.01\text{x}10^{-2}$ m/s
18. 2.34 cm
20. 62.1 s
22. $v_{Thrower} = 2.48$ m/s
   $v_{Catcher} = 2.25$ cm/s
24. .3 m/s
26. a. 1.8 m/s
   b. 2.16×10^4 J
28. a. -6.7 cm/s, 13.3 cm/s
   b. .889
30. 17.1, 22.1 cm/s
32. 3.4×10^3 m/s
34. a. 2.88 m/s, 32.3° with respect to the initial direction of the fullback.
   b. 783 J
36. $v_{White} = 7.07$ m/s
   $v_{Black} = 5.89$ m/s
38. a. .284
   b. $K_E = 1.13 \times 10^{-13}$ J
   $K_C = 4.54 \times 10^{-14}$ J
40. a. 60°
   b. 3.46 m/s, 2 m/s
42. -2.3 m
44. (0, -12) m
46. 4.67×10^6 m
48. (.333, 1.67) m
50. 14.8 kg•m/s opposite the initial velocity
52. .267 m/s east
54. a. 537 kg•m/s
   b. 380 kg•m/s
56. a. -1/5 m/s
   b. -8/3 m/s
58. 56.7 m
60. 91.2 m/s
62. .96 m
64. 2.78×10^3 N
66. a. .554 m/s
   b. 11.1 J
68. a. 12 N•s
   b. 8 N•s
   c. 8 m/s, 5.33 m/s
70. 152 m/s
72. 1.25×10^7 m/s at 41.8°
74. .4 N
76. $D = \frac{2v_o^2}{9\mu g} \cdot \frac{4d}{9}$

Chapter 7

2. 60°, 216°, 540°
4. 7.27 x 10^{-5} rad/s
6. a. 3.46 Rad/s
   b. 5.19 Rad
8. 1.67 rad, 95.7°
10. a. 5.24 s
   b. 27.4 rad
12. 41 rad/s^2
14. -12.7 rad/s^2, 3.14 s
16. 3.2 rad
18. 1.02 m
20. a. 7.5 x 10^{-3} rad/s^2
   b. 4.38 rad
22. 147 rev
24. 10.5 m/s, 218 m/s^2
26. 4.94 x 10^{-2} rad/s
28. a. 8 rad/s
   b. 2.4 m/s, 1.2 m/s^2
   c. 516° or 156° ccw from a horizontal reference line
30. The require tension is 1377 N. He does not make it.
32. 2.69 x 10^3 N, 56.9° from the vertical
34. 6.56 x 10^{15} rev/s
36. a. 18 m/s^2
   b. 900 N
   c. 1.84 > 1 not likely, so she will not stay on
38. a. ?
   b. 20.1°
40. a. 0 N
   b. 1287 N
   c. 2060 N
42. 321 N toward Earth
44. 1.05 x 10^{-10} N, 71.5° with respect to the x-axis
46. 6.01 x 10^{24} kg. The estimate is high since the moon actually orbits about the center of mass of the earth-moon system not the center of the earth.
48. .184 m/s^2
50. a. 5.58 x 10^3 m/s
   b. 240 min
   c. 1460 N
52. 1.9 x 10^{27} kg
54. ?
56. a. 2380 m/s (5300 mph)
   b. 4180 m/s (9350 mph)
   c. 6.02 x 10^4 m/s or 135,000 mph
58. a. 2.51 m/s
   b. 7.9 m/s^2
   c. 4 m/s
60. a. 7.76 x 10^3 m/s
   b. 5.36 x 10^3 s (89.3 min)
62. a. 31.4 rad/s
   b. 2.09 m/s
64. a. 2.34 x 10^{-10} N, in the negative-x direction
   b. 1 x 10^{-10} N, in the negative-x direction
66. μ = .218
68. 108.8 N (upper)
   56.5 N (lower)
70. a. $N = mg - \frac{mv^2}{r}$
   b. ?
72. ?
74.
$$v_{min} = \sqrt{R\frac{\tan\theta - \mu}{1 + \mu\tan\theta}}$$
$$v_{max} = \sqrt{R\frac{\tan\theta + \mu}{1 - \mu\tan\theta}}$$
   8.57 to 16.6 m/s

Chapter 8

2. 68.4 N•m, clockwise
4. 705 N•m, clockwise
6. τ_A = 207 N•m, clockwise
   τ_B = 145 N•m, clockwise
   τ_C = 95.7 N•m, cw
8. 1200 N
10. a. 400 N
   b. F_H = 346 N, right
   F_V = 0 N
12. T_1 = 501 N, T_2 = 672 N,
   T_3 = 384 N
14. a. $m_1g•x_1 + m_2g•x_2$ + ...
   b. $Mg•x_{cg}$
   c. ?
16. 209 N
18. T_{Left} = w/3, T_{Right} = 2w/3
20. 6.15 m
22. w/3 on each front tire, w/6 on each rear tire
24. 28.1 kg•m^2
26. a. 99 kg•m^2
   b. 44 kg•m^2
   c. 143 kg•m^2
28. 1.36 rad/s
30. -5.65 x 10^{-2} N•m
32. μ_k = .312
34. a. 5.35 m/s^2, downward
   b. 42.8 m
   c. 8.91 rad/s^2
36. 1.41 m/s^2
38. a. 1.27 N
   b. 3.18 N
40. 29 J
42. a. I = 92 kg•m^2, K = 184 J
   b. v_4 = 6 m/s, v_2 = 4 m/s,
   v_3 = 8 m/s, K = 184 J
44. 276 J
46. a. 500 J
   b. 250 J
   c. 750 J

Chapter 8 (continued)

48. $a_{Sphere} > a_{Cylinder} > a_{Ring}$
sphere wins, ring is last
50. 149 rad/s
52. 24.2 m
54. a. 7.08×10^{33} J•s
b. 2.66×10^{40} J•s
56. Days would be 4 times longer
58. 11.1%, KE has increased because she must do work to pull her arms in.
60. a. 1.91 rad/s
b. $K_i = 2.53$ J, $K_f = 6.44$ J
62. a. 3.58 rad/s
b. 539 J (Difference results from work done by man as he walks inward)
64. 5.99×10^{-2} J
66. $\Delta t_{Sphere} = .00144$ s
$\Delta t_{Disl} = .0018$ s
$\Delta t_{Shell} = .0036$ s
68. a. -3.32 rad/s^2
b. 29.2 rev
c. -1.31×10^{-3} s
70. .167 rev/s
72. 35.6 rad/s
74 $T_1 = 11.2$ N, $T_2 = 1.39$ N,
F = 7.23 N
76. 2000 N
78. $F_B = 6.47 \times 10^5$ N, to the right, horizontal
$F_A = 6.59 \times 10^5$ N, 78.9° to the left of vertical
80. 8 rev/s
82. ?
84. a. 3.24 J
b. 1.44 s
c. yes, 2.59 m is required
86. a. 4.5 m/s
b. 10.1 N
88. 3.22×10^3 W
(4.32 hp)
90. a. 3.12 m/s^2
b. $T_1 = 26.7$ N,
$T_2 = 9.37$ N
92. h = 2.7(R-r)
94. a. 1.09 m/s^2
b. $T_1 = 21.8$ N
$T_2 = 43.6$ N

Chapter 14

2. a. 24 N, 60 m/s^2
b. ?
4. 58.8 N/m
6. a. 575 N/m
b. 46 J
8. a. 2.12 m
b. 1.9 m/s
10. a. .938 cm
b. 1.25 J
12. a. 11 cm/s
b. 6.32 cm/s
c. 3 N
14. 2.61 m/s
16. a. 28 cm/s
b. 26 cm/s
c. 26 cm/s
d. 3.46 cm
18. 39.2 N
20. a. 126 N/m
b. 17,8 cm
22. a. 1.99Hz
b. .503 s
24. a. .628 m/s
b. .5 Hz
c. 3.14 rad/s
26. .627 s
28. 2.23 Hz
30. a. at t=0 s, x = .3 m
at t=.2 s, x=.293 m
b. .3 m
c. 1/6 Hz
d. 6 s
32. a. .5 s
b. 1 s
c. .75 s
34. 105 oscillations
36. .248 m
38. .0015
40. 58.8 s
42. 2.4 m/s
44. 31.9 cm
46. .8 m/s
48. 9.47×10^{15} m
50. 219 N
52. 2.61×10^{-1} kg
54. 586 m/s
56. 40 m/s
58. a. constructive interference yields A=.5 m
b. destructive interference yields A=.1 m
60. a. .25 m
b. .474 N/m
c. .232 m
d. .116 m/s
62. 7.07 m/s
64. .75 J
66. 12.2 cm/s
68. ?
70. 1.25 cm/s
72. ?
74. ?
76. a. 6.93 m/s
b. 1.14 m
78. 1.07 m/s