Numerical Answers to Applying the Concepts

1.2

4. a) 3.34×10^{13} vibrations
   b) 2.48×10^{5} λ

1.3

2. a) 4
   b) 5
   c) 7
   d) 1
   e) 4
   f) 6
3. a) 3.1 m
   b) 3.2 m
   c) 3.4 m
   d) 3.6 m
   e) 3.4 m
4. a) 3.745 m
   b) 309.6 m
   c) 120 s
   d) 671.6 s
   e) 461.7 s
5. a) 4.0 m
   b) 3.3 m
   c) 3.3333
   d) 0
   e) 0

1.4

1. a) i) 1.50×10^{-4} months (assuming 30 d/month)
   ii) 6.48 min
   iii) 1.25×10^{-5} a
   iv) 3.89×10^{8} μs
   b) i) 60 months
   ii) 2.6×10^{6} min
   iii) 1.8×10^{3} d
   iv) 1.6×10^{8} s

2.1

1. i) 10 m/s, 30 m
   ii) 15 m/s, 67.5 m

2.4

1. a) 1.6×10^{2} m/s
   b) 3200 m
2. a) -14.6 m/s^2
   b) 4.56 s
   c) 152 m
3. a) 943.1 m/s
   b) 471.5 m
   c) 78.59 m/s^2
   d) 2.6×10^{2} m/s
4. a) $7.22
   b) 97 km/h
   d) 83 km/h
   e) $2.62

3.1

1. a) x: 10 km y: −17 km
   b) x: −20 km y: 35 km
   c) x: 1.7 km y: 9.8 km
   d) x: −2.0 km y: −4.6 km
   e) x: −8.5 km y: 8.5 km
   f) x: 10 km y: 0 km
2. 230 m [W23°N]

3.3

1. a) 4.52 s
   b) 5.6 s
   c) 3.6 s
   d) i) 23 m
   ii) 28 m
   iii) 18 m
2. a) $t = 1.08$ s
   b) $\Delta d_y = 0.539$ m
   c) $t = 0.33$ s
   d) 32 m
   e) 22.9 m/s [S82°E]
3. a) 192 m
   b) 1.7 m
   c) i) 200 m
   ii) 0.34 m
4. 63°

3.4

2. a) 59.84 m/s [N22°E]
   b) 50.86 m/s [N24°W]
   c) 52.30 m/s [E86°N]

3.5

2. a) 94 m/s^2 [W45°N]
   b) 112 m/s^2 [W33°N]
   c) 103 m/s^2 [W29°N]

4.3

1. a) 0 b) 0 c) +
   d) − e) $F_{net_y} = 0$, a_x = +
2. a) 1.0 m/s^2
   b) 0.33 m/s^2
   c) −0.33 m/s^2
   d) 0.50 m/s^2

4.4

1. a) 1.7×10^{5} N [N45°E]
   b) 2.1×10^{5} N [E]
   c) 2.3×10^{5} N [N85°E]
   d) i) 1.4×10^{5} N [N30°E]
   ii) 1.6×10^{5} N [E]
   iii) 1.8×10^{5} N [N84°E]

5.3

1. a) 1.18×10^{5} N
   b) 9.82×10^{4} N
   c) 6.00×10^{5} N
   d) 1.94×10^{4} N

5.4

1. a) 6.9×10^{2} N
   b) 6.9×10^{2} N
   c) 5.5×10^{2} N
   d) 0 N

5.5

3. a) 1.5×10^{2} N
   b) 100 N
   c) 0.34
   d) 314 N
   i) 1.6×10^{2} N
   ii) 100 N
   iii) 0.32
   e) i) 1.4×10^{2} N
   ii) 100 N
   iii) 0.36

5.6

2. a) 8.3×10^{2} N/m
   b) 1.7 N
   c) 6.7 m
   d) 4.9×10^{2} N/m

6.1

1. a) 3.3×10^{2} kg·m/s
   b) 1.2×10^{6} kg·m/s
   c) 6.8×10^{10} kg·m/s

6.2

3. i) 3.4 N·s
   ii) 14 N·s
4. a) 60 kg·m/s
   b) −60 kg·m/s
   c) 0 kg·m/s
5. b) 156 s

6.3

1. a) 3.0 m/s
   b) 1.7 m/s

c) 0.88 m/s
d) 0.17 m/s

7.2

3. a) 80 J
b) 96 J
c) 2.2×10^3 J

7.3

1. 4.8×10^2 J/s
2. 0 J

7.4

1. a) $kg \cdot m^2/s^2$
b) N·m
3. a) l6 J
b) 31 J
c) 12 J
d) 100 J
e) 10 m/s

7.5

1. a) 2.4×10^2 J
b) 18.8 J
c) 1.32×10^4 J
3. 2.45×10^5 MJ

7.7

1. a) 1.1×10^3 J
b) 7.7×10^3 J
c) 8.7×10^3 J
d) 8.7×10^3 J
e) 39 m/s
f) 52 m/s
g) 136 m
3. 18 m/s

8.4

3. gold 5.5×10^3 J
iron 1.9×10^4 J
silver 9.7×10^3 J

8.5

2. 3.08×10^{-2} L

8.6

2. 8.2×10^4 J
3. 3.3×10^5 J/kg
4. i) 2.9×10^8 J
ii) 67 h

8.7

2. 29.9°C

9.3

4. a) 1.9 a
b) 2278 kg
c) 11 m

9.4

10. a) 660 m
b) 43 m
c) 3.5×10^{-5} s
d) 1.0×10^4 m

9.5

1. 3.2
2. 0.866*c*

10.1

1. a) 4.5×10^3 s
b) 0.67 s
c) 1.8 s
d) 0.95 s
2. a) 60 Hz b) 0.75 Hz
c) 9.3×10^{-3} Hz d) 1.4 Hz
3. i) a) 2.2×10^{-4} Hz
b) 1.5 Hz c) 0.55 Hz
d) 1.05 Hz
ii) a) 0.017 s b) 1.3 s
c) 1.08 s d) 0.71 s

10.2

1. a) 4.69×10^{14} Hz
b) 2.50×10^8 Hz
c) 1.50×10^{17} Hz
2. a) 2.0×10^{-5} m
b) 0.15 m
c) 1.0×10^{-14} m

10.3

1. a) 2.1×10^{-3}
b) 5.5×10^{-2}
2. a) 0.15 m
b) 0.042 $h_i = 0.18$ m

10.8

1. a) $d_i = 20$ cm	$m = -0.67$
b) 24 cm	−1
c) 36 cm	−2
d) 0 cm	0
e) −12 cm	2
2. a) −8.6 cm	0.29
b) −8.0 cm	0.33
c) −7.2 cm	0.40
d) 0 cm	0
e) −4.0 cm	0.67

11.2

1. a) 2.26×10^8 m/s
b) 1.24×10^8 m/s
c) 1.99×10^8 m/s
2. a) 1.43 b) 2 c) 1.27

11.3

1. a) 18.5°
b) 10.1°
c) 16.3°
2. a) more dense
b) 1.76
c) 1.70×10^8 m/s
d) less dense 1.08 2.78×10^8 m/s

11.5

2. a)

case 1	$n_1 = 1.2$	$n_2 = 2.3$
case 2	1.2	1.52
case 3	1.2	1.65
case 4	1.52	1.65
case 5	1.52	2.3
case 6	1.65	2.3

b) 31.4°, 41.4°, 45.8°, 46.7°, 52.1°, 67.1°

12.1

1. 32.6 m/s
3. a) 2.00×10^7 m/s
b) red shift
c) moving away
d) $\vec{v}_r = -1.88 \times 10^7$ m/s

12.4

2. a) 26°
b) 0.63°
3. a) 0.44 m
b) 1.1×10^{-2} m

12.5

2. a) 3.6°
b) 2.9°
3. a) 6.0×10^{-2} m
5.0×10^{-2} m

12.6

2. Destructive

13.1

1. a) 300 Hz, 3.3×10^{-3} s
b) 1.15 m
2. a) 5.0×10^{-3} s, 200 Hz
c) 1.7 m
3. 0.04 s, 25 Hz

13.2

2. 11.8 times faster
3. a) 4.08×10^3 m
b) 4.16×10^3 m
c) 4.31×10^3 m
d) 4.01×10^3 m

13.3

1. a) 7.0×10^2 m/s
   b) 1.4×10^2 m/s
   c) 6.3×10^2 m/s
   d) 1.7×10^3 m/s
2. a) 2.5×10^3 km/h
   b) 5.0×10^2 km/h
   c) 2.3×10^3 km/h
   d) 6.1×10^3 km/h

13.4

2. a) decrease by factor of 4
   b) decrease by factor of 28
   c) increase by factor of 9
   d) increase by factor of 11
3. a) 0.l0 W/m^2
   b) 1.0×10^{-10} W/m^2
   c) 3.2×10^{-7} W/m^2
   d) 6.3×10^{-5} W/m^2
4. a) 100 times louder
   b) 100 times softer
   c) 3.2×10^6 times louder
   d) 891 times softer

13.5

3. a) 662 Hz
   b) 341 Hz

14.3

1. a) 15.4 m
   b) 6.0 m

14.4

2. a) 0.3 m
   b) 6 m/s

14.6

1. a) i) 2.4 m ii) 0.8 m iii) 0.4 m
   b) i) 143 Hz ii) 429 Hz iii) 858 Hz
2. a) 4.8 m, 0.96 m, 0.44 m
   b) 71.7 Hz, 358 Hz, 782 Hz
3. a) 356 Hz
   b) 283 Hz
   c) 253 Hz
   d) 200 Hz

14.8

1. 997 Hz, 1003 Hz

15.4

2. a) 1.6×10^{-19} C
   b) 1 C = 6.25×10^{18} electrons

16.2

2. a) 11A
   b) 3.7×10^{10} A
3. a) 7 s
   b) 4.38×10^{21} electrons

16.3

3. a) 1.1×10^3 C
   b) 6.8×10^{21} *e*
   c) 4.4×10^2 A
4. a) 25 C
   b) 1.5×10^{20} *e*
   c) 9.8×10^5 A

16.5

2. a) 0.19 Ω
   b) 4.6 Ω

16.6

1. a) 60 Ω
   b) 6.7 Ω
   c) 66.7 Ω
2. 26 Ω, 19 Ω, 22 Ω
4. a) 1.0×10^6 Ω
   b) 1.0 Ω

16.7

1. a) 0.11 A
   1.1 V, 1.7 V, 2.2 V
   b) 0.5 A, 0.33 A, 0.25 A
   5 V

c) i)

For 10 Ω	0.115A	1.152 V
For 15 Ω	7.68×10^{-2}A	1.152 V
For 20 Ω	0.192 A	3.84 V

ii)

10 Ω	0.27 A	2.7 V
15 Ω	0.15 A	2.3 V
20 Ω	0.115 A	2.3 V

iii)

10 Ω	0.153 A	1.53 V
15 Ω	0.23 A	3.46 V
20 Ω	0.77 A	1.53 V

16.8

1. a) 120 W
   b) 24 W
2. a) 8.33 A
   b) No
3. a) 500 C
   b) 3.125×10^{21} *e*
   c) 6.0×10^4 J
   d) 14.4 Ω

16.9

1. a) 35.4¢
   b) 3¢
2. a) \$3.60/month
   b) 7.50/month
   c) 11.52¢/month
   d) \$1.85/month
   e) \$0.08/day

17.2

2. a) 1.5 times stronger
   b) 1.23 times stronger
   c) 2 times stronger
   d) $\frac{1}{3}$ times stronger
   e) 1.23 times stronger

18.4

1. a) 0.2
   b) 2 V
   c) 12.5 A
   d) 25 W
   e) 25 W
   f) 4 Ω
2. a) 9.2 V
   b) 10.4 A
   c) 0.88 Ω
   d) 96 W
   e) 96 W

19.3

1.

^{10}C	$\#p = 6$	$\#n = 4$	$\#e = 6$
^{11}C	6	5	6
^{13}C	6	7	6
^{14}C	6	8	6

2. a) $^{35}_{18}$Ar
   b) $^{212}_{83}$Bi
   c) $^{141}_{59}$Pr
   d) $^{227}_{90}$Th
   e) $^{239}_{93}$Np
   f) $^{14}_{7}$N
3. a) $^{234}_{90}$Th
   b) $^{222}_{86}$Rn
   c) $^{206}_{82}$Pb
   d) $^{214}_{82}$Pb

19.4

1. a) 50%
   b) 23%
   c) 4.9×10^{-5}%
   d) 99.96%

19.5

1. 3.0×10^9 J
2. 5.3×10^7 J

Numerical Answers to End-of-chapter Problems

Chapter 1

15. a) 1200 s, b) 390 min, c) 14.4 h, d) 1.4×10^8 s, e) 0.126 h, f) 6.7×10^{-7} a
16. a) 2.5×10^8 μs, 250 000 000 μs, b) 2.50×10^5 m·s, 250 000 ms c) 2.50×10^{-1} ks, 0.250 ks, d) 2.50×10^{-4} m·s, 0.000250 Ms
17. a) 6.9 m/s, b) 41.7 m/s, c) 7.2 km/h, d) 180 km/h
18. a) 316 people, b) 1810 ft
19. a) Yes, speed of 52.9 km/h b) 1763 times slower
21. a) 64000 mm, b) 32 m, c) 32.005 m, d) 24 m
22. a) 20.5 m, b) 49 m, c) 3543.6 m, d) 30.9 km
23. a) 125 m [E], b) 75 m [N], c) 95 m [W], d) 95 m [N], e) 0
24. a) 28 m/s [N], b) 22 m/s [S], c) 33 m/s [E], d) 27 m/s [S]
25. 73 km/h, 67 km/h
27. Slope: a) km/h, b) no units, c) kg/m^3, d) kg/s^2
    Area: a) km·h, b) m^2, c) kgm^3, d) kgm^2/s^2
28. A, C, F, H: standing; B, G: forward motion; D, E: backward motion
29. a) I 2.5 m/s; II 0 m/s; III −1.2 m/s
    b) I 4500 m·s; II 6000 m·s; III 6750 m·s
30. I 2.5 m/s; II 0; III −1.2 m/s
31. 72 m/s; 260 km/h
32. 1200 km/h
33. 20 mm/s
34. −20 mm/s
38. slopes: i) 0.6 m/s; ii) 0.5 m/s, iii) −0.3 m/s, iv) −1.2 m/s
42. average velocity
    AB 4.3 m/s; BC 0 m/s;
    BD −3.8 m/s; AD 0 m/s;
    AE −2.1 m/s; BE −5.8 m/s
43. AB: slope: 0.8 m/s
    CD: slope: 0.83 m/s

Chapter 2

14. b) 43 km/h, 90 km/h, 0 km/h, −162 km/h, −497 km/h
    c) 0.21 m/s^2, 0 m/s^2, −0.21 m/s^2, −0.71 m/s^2, 0 m/s^2, −0.46 m/s^2
    d) 1500 m, 4500 m, 1500 m, −3900 m, −5600 m, −21 800 m
    e) −23 800 m
    f) 12.5 m/s, 25 m/s, 12.5 m/s, −37 m/s, −75 m/s, −180 m/s
    g) −33 m/s
    h) 54 m/s
15. a) 10 m/s, 47 m/s, 31 m/s, −9 m/s
    b) 3.3 m/s^2, 0, −3.9 m/s^2, −4.2 m/s^2
    c) 10 s–14 s
    d) 0 s, 26 s
    e) 10 s
    f) 10 s–14 s, 30 s
16. 4.8 m/s^2
17. −3.9 m/s^2
19. b) 0.15 m/s^2; −0.87 m/s^2, 0.20 m/s^2, 0.10 m/s^2
20. a) 45.5 m, −21 m, −80 m, −20 m
    b) −75 m
21. b) 3.8 s
    c) no
    e) yes
    f) B is 28 m ahead of A
33. 10.2 m/s, 10.4 m/s, 9.20 m/s
34. 6300 m = 6.3 km
35. 4.2 m
36. 2.8 h
37. 72 m
38. 100 m
39. 540 s
40. 3.3×10^{-5} s, 29 s
41. 2.6 s
42. 5.8 m/s = 21 km/h
43. 28 m/s, slowing down
44. 4.1 m/s^2
45. 5.5 m/s
46. −162 m/s^2
47. 19 m/s^2
48. −1.7 m/s^2
49. −2500 m/s^2
50. 1.5 s
51. 19 m/s
52. 9.4 m/s
53. −19 m/s
54. 10.6 s
55. 10 s
56. 38 m, 17 m/s
57. 21 m, 4.8 m/s
58. 17 m, 12 s
59. -2.5×10^5 km/h^2
60. −15 m, 3.1 s
61. a) 4.9 m, b) 120 m, c) 390 m, d) 950 m
62. 4.0 m/s^2, 97 m
63. 15 m
65. 1300 m
66. a) 7.5 s, b) 3.8 m/s, c) 14 m, 23 m
67. 3.53 m/s^2
68. a) 15 s, b) 427 m, c) 55 m/s

Chapter 3

14. a) $\vec{v}_{f_{max}}$ = 10 m/s [E]; $\vec{v}_{f_{min}}$ = 2 m/s [W]
15. a) 0
    b) 0.5 km [N37°E]
    c) 0.5 km [W53°S]
    d) 2.4 km/h
    e) 2.4 km/h [E53°N]
18. a) 9.8 m/s, 20 m/s, 29 m/s, 39 m/s
    b) 17 m/s [R35° D],
    24 m/s [R55°D],
    32 m/s [R64°D],
    41 m/s [R70°D]
19. a) 0 m/s, 9.8 m/s, 20 m/s, 29 m/s
    b) 9.8 m/s, 9.8 m/s, 9.8 m/s, 9.8 m/s
    c) 9.8 m/s [E], 14 m/s [R45°D],
    22 m/s [R64°D],
    31 m/s [R71°D]
20. 150 m
21. 140 m
22. a) 0.64 s, b) 210 m
23. 32 m
24. 2.60 m
25. a) land at same time
    b) 2.0 m
26. (22) 330 m/s [R1.1°D],
    (23) 45 m/s [R9.0°D]
    (24) 40 m/s [R10°D]
27. a) 550 m, b) 950 m, c) 100 m/s, d) 130 m/s [R48°D]
28. a) 14 s b) 1100 m
    c) 160 m/s [R60°D]
29. a) 1000 m b) 1100 m c) 230 m
30. 8.5 m
31. yes
32. yes
33. a) 24 m, b) 4.3 s,
    c) 27 m/s [R53°D]
35. 101.5 km/h, 98.5 km/h
36. a) −35 km/h, b) 35 km/h, c) 135 km/h, d) 135 km/h

37. 28 km/h [E20°S]
38. 186 km/h [W36°S]
39. a) [S13°E] b) 33 km/h [S]
    c) 1.6 h
40. 220 s
41. 16 km/h [E22°N]
42. a) 3°
    b) 0.57 s
43. 280 s
46. *x* component, *y* component;
    a) 29 km/h, 45 km/h
    b) −23 km/h, 66 km/h
    c) 41 km/h, 13 km/h
    d) −35 km/h, −35 km/h
    e) 21 km/h, −17 km/h
47. a) 6.1 km/h b) 5.1 km/h c) 0
48. a) 71 km/h [W45°S]
    b) 50000 km/h^2 [W45°S]
49. $\Delta\vec{v}$ = 17 km/h [E10°S],
    $\vec{a}$ = 12000 km/h^2 [E10°S]
50. 26 m/s [E73°N]
51. a) 5.2×10^{-3} m/s
    b) 4.9×10^{-4} m/s^2 [S45°W]
    c) 4.9×10^{-4} m/s^2 [N45°E]
52. a) 4.4×10^{-4} m/s b) 60°
    c) 7.3×10^{-7} m/s^2 [W60°S]
53. 9.6 m/s^2 [E60°N]
54. 190 km [E82°N]
55. 40 km [E12°N]
56. a) 176 m b) 49 m [E45°N]
    c) [S45°W]
57. v = 1.2 km/h, $\vec{v}$ = 0.33 km/h [E45°N]
58. a) 130 km/h [E18°S] b) 7.9 h
59. a) 20 km/h [N21°W] b) 3.2 min
60. heading: [E21°N];
    ground speed: 28 km/h
61. 1.7 m/s [E]
62. −313 km/h [E52.6°N]

Chapter 4

19. a) 200 N
    b) 5.6 N
    c) 8.8 N
    d) 280 N
20. a) 1.2 m/s^2
    b) 2×10^4 m/s^2
    c) 3.0×10^{-7} m/s^2
    d) 0.23 m/s^2
21. 2900 N
22. a) 7500 N
    b) 11 m/s^2
23. 102 kg
24. 756 N
25. $\vec{F}_{jet} = 1.5 \times 10^5$ N
    $\vec{F}_{jet\ fighter} = 1.6 \times 10^6$ N
26. 1.9×10^4 N
27. 92 N
28. $\vec{a} = -1.2$ m/s^2 170 g
29. 10900 N [S]
30. 0.38 m/s
31. 233 N
32. −467 N
35. a) 8.33 m/s^2
    b) 1.13 m/s^2
    c) 1.84 m/s^2
36. a) $\vec{F}_{net} = 4.0$ N, $\vec{a} = 4$ m/s^2
    b) $\vec{F}_{net} = 3.0$N, $m = 1.5$ kg
    c) $\vec{F}_{net} = 0$, $F_1 = -7.0$ N
    d) $\vec{F}_{net} = 0$, $\vec{a} = 0$, $\vec{F}_1 = 2.5$ N
    e) $\vec{F}_{net} = 6.0$ N, $\vec{F}_1 = F_2 = 2.0$ N
    f) $\vec{F}_{net} = 2.5$ N, $\vec{F}_1 = 8.5$ N
    g) $\vec{F}_{net} = -3$ N, $m = 0.6$ kg
    h) $\vec{a} = 0$, $\vec{F}_{net} = 0$, $\vec{F}_1 = 10$ N,
    Mass can have any value
    i) $\vec{F}_{net} = 1.8 \times 10^{-2}$ N $= \vec{F}_2$
    $= 3.6 \times 10^{-2}$
37. 1.5 m/s^2
38. a) 1.1 m/s^2
    b) 7.8 m/s
39. a) 1.4 m/s^2
    b) 2.9 N
40. a) 1.2 m/s^2
    b) 8.8 N
    c) 2.5 N
    d) 8.8 N, 2.5 N
41. a) 0.42 s
    b) 0.59 m
42. 10900 N
43. a) −3.0 m/s^2
    b) down
    c) 150 m
44. a) −15 N, 0
    b) 40 N, 40 N
    c) 2.5 N, −1.0 N
    d) 30 N, −10 N
45. a) 15 N [S]
    b) 57 N [E45°N]
    c) 2.7 N [W68°N]
    d) 32 N [W72°N]
46. 0.31 m/s^2 [forward]
47. 0.1 m/s^2 [forward]
48. 0.14 m/s^2 [E85°N]
49. a) 0.42 m/s^2 [L12°U]
    b) 30 cm
50. a) 0.56 m/s^2 [R25°U]
    b) 1100 N
51. a) 1.4×10^{-3} m/s^2 [R3.5°U]
    b) 1.2×10^{-3} m/s [R4.0°U]
    c) 0.61 km/h, 0.54 km/h
    d) 700 m, 820 m
52. a) [R40°D]
    b) $F_{net_x} = 120$ N
    c) 7.5 s
53. b) $\vec{a}_L = -0.50$ m/s^2
    $\vec{a}_c = 0.45$ m/s^2
54. b) $\vec{a}_L = -1.0$ m/s^2
    $\vec{a}_c = 0.89$ m/s^2
55. $\vec{a}_L = -0.95$ m/s^2
    $\vec{a}_c = 0.85$ m/s^2

Chapter 5

20. a) 1.60×10^{-7} N
    b) 5.2×10^{-6} N
    c) 2.1×10^{-5} N
    d) 2.0×10^{-10} N
21. 3.83×10^8 m
22. 6.2×10^8 kg
23. a) 668 N
    b) 664 N
    c) 107 N
24. $g_{Mars} = 3.61$ m/s^2
    $g_{Jupiter} = 24.6$ m/s^2
    $g_{Mercury} = 3.31$ m/s^2
25. 1.67×10^{-5} N
26. $r = 6.41 \times 10^6$ m
    $h = 3.25 \times 10^4$ m
27. $r = 6.32 \times 10^7$ m
    $h = 5.68 \times 10^7$ m
28. a) 109 N
    b) 20.0 N
    c) 2.43 N
    d) 48.4 N
    e) 0.072 N
29. a) 2000 N
    b) 32 000 N
    c) 1150 N
30. $t_{Earth} = 10.4$ s
    $t_{Mars} = 5.53$ s
    $t_{Jupiter} = 6.71$ s
    $t_{Mercury} = 18.3$ s
31. a) 6.98 N
    b) 4.85×10^{-3} N/kg
32. 392 N
33. a) no change
    b) greater
    c) no change
    d) less
34. weight = 686 N
    $\vec{a} = 0.91$ m/s^2
35. a) 1300 N
    b) 1013 N
36. 0.9 N
37. 7.3 N
38. 437 N

39. a) 0.27 N
    b) 0.20 N
    c) does not move
40. a) 52 N
    b) 0.40 m/s^2
41. 0.89
42. 0.32
43. crate can't move (friction too large)
44. $\vec{F}_A > 392$ N, any $\vec{F}_A$ will start fridge moving
45. $\vec{F}_A > 451$ N
46. a) 19 N
    b) -3.33 m/s^2
    c) 1.16 m
    d) 0.83 s
47. a) 5.04 N
    b) 99 N
48. 2.26×10^4 N
49. a) 0.45 m/s^2
    b) 2.86 N
50. i) 0.27 m/s^2
    ii) $\vec{F}_{T_1} = 8.8$ N
    $\vec{F}_{T_2} = 2.5$ N
51. a) 62 N/m
    b) N·m
52. a) 17 N
    b) 32 N
    c) 59 N
53. a) 0.33 m
    b) 0.18 m
    c) 1.64×10^{-3} m
54. 1.68 lb
55. 1.2 m/s^2
56. 2900 N/m
57. 5200 N
58. 0.9 m
59. 3.1 m/s^2

Chapter 6

16. a) 480 kg·m/s
    b) 40800 kg·m/s
    c) 2.3 kg·m/s
    d) 722800 kg·m/s
    e) 7.25×10^{-3} kg·m/s
17. a) 2.86 kg·m/s
    b) 2.86 kg·m/s
18. a) 7000 kg·m/s
    b) 7000 kg·m/s
19. a) 84000 kg·m/s
    b) 84000 kg·m/s
20. a) 1750 Ns
    b) 0.3 Ns
    c) -200 Ns
21. -12.6 m/s
22. 63.6 m/s
23. a) 1500 kg·m/s
    b) 25 m/s
24. 2624 km/h
25. 3.3 m/s
26. a) 320 N
    b) 32 N
27. a) -370 N
    b) -1470 N
    c) -48900 N
28. a) -21800 N
    b) -19.8 kgm/s
    c) -19.8 kgm/s
29. a) -168 N
    b) -2800 m/s^2
30. a) -500 kgm/s
    b) -500 kgm/s
    c) -455 N
    d) 2.29 m
31. 5.2 m/s
32. 9.4 m/s
33. 7.2 m/s
34. 3.1 m/s
35. 0.6 m/s
36. 0.11 m/s
37. 8.6 m/s
38. a) 1.79×10^{-10} m/s
    b) 29700 m/s
39. -145 m/s
40. a) 44 m/s
    b) 52 kg·m/s
    c) -52 kg·m/s
    d) 1.3×10^{-3} s
    e) -4.0×10^4 N
    f) 1.6×10^5 m/s^2
41. a) 8.33×10^4 kg·m/s
    b) -83300 kg·m/s
    c) 1372 N
    d) 61 s
    e) 250 m

Chapter 7

12. 62.5 J
13. 0 J
14. 0 J
15. 1.2×10^3 N
16. 0.404 m
17. 62 J
18. a) 1.1×10^4 J
    b) 1.1×10^4 J
    c) acceleration in a), constant speed in b)
19. 6.0×10^4 J
20. 25 kg
21. 2.0×10^5 J
22. 2.83×10^3 J
23. 1.50×10^3 W
24. 2.9×10^6 J
25. 8.3×10^2 W
26. 0.750 s
27. 0.158 m/s
28. 6.8×10^4 W
29. a) 3.00 J
    b) 18.8 J
30. 7.40 kg
31. 78.2 J
32. 4.9×10^5 J
33. 54 km/h
34. 3.9×10^3 J
35. a) 15 m/s
    b) 30 m/s
36. a) 7.00 J
    b) 4.85 J
    c) 0.81 J
37. a) 41 J
    b) 92 J
    c) -10 J
38. 75%
39. 1.34×10^4 J, 1.71×10^4 J
40. 7.4 J
41. $E_k = 2.5 \times 10^3$ J, $E_g = 2.0 \times 10^3$ J
42. 31.4 m/s
43. 2.59 m
44. 34.3 m/s
45. 71.6%
46. 0.50 m/s
47. a) 3.66×10^3 J
    b) 3.78×10^3 J
    c) 96.8%

Chapter 8

23. a) 373 K
    b) 248 K
    c) 0 K
    d) 273 K
    e) -216°C
    f) 27°C
24. 3.36×10^5 J
25. 2.7×10^4 J
26. 108°C
27. a) A = 4.2 kJ/°C
    2.5 kJ/°C
    2.0 kJ/°C
    b) A
    c) A
    d) slope = heat capacity
28. a) 54.4°C
    b) 4.8°C
29. 4.60×10^3 J
30. 88.6°C
31. 2.87 kg

32. 12 kg or 12 L
33. a) 1.20×10^4 J
    b) 2.0×10^3 J/kg°C
34. a) 2.5×10^4 J/kg
    b) 2.5×10^4 J
35. 5.3 kg
36. 4.0×10^5 J
37. 6.4×10^5 J
38. 6.2×10^5 J
39. lead
40. 0.477 kg

Chapter 9

21. a) either north or south
    b) west
22. lower, middle, top
23. 1.01×10^{-6} s
24. 229 days
25. yes, in 11 s
26. 2.99×10^8 m/s
27. 2.83×10^8 m/s
28. stationary (26 years), traveller (23.74 years)
29. 7.07×10^6 m/s
30. infinite amount of time
31. 2.2 m tall
32. 1.2×10^{-6} m
33. 7.5×10^2 kg
34. 0.14 m
35. a) 0.503 kg
    b) 1.14 kg
36. 2.6×10^8 m/s
37. 2.12×10^8 m/s
38. $1340.00
39. 9.0×10^{18} J
40. 3.6×10^{-28} kg
41. 1.8×10^{-13} J
42. 5.22×10^{-4} kg
43. 4.59×10^{20} J
44. 1.64×10^{-13} J

In questions, all angles without decimal places are assumed exact.

Chapter 10

16. a) 4 m
    b) 5 cm
    c) 8 s
    d) 0.1 s^{-1}
    e) 0.5 m/s
17. a) 8 m, 10 cm, 16 s, 0.06 s^{-1}, 0.5 m/s
    b) 2 m, 10 cm, 4.0 s, 0.25 s^{-1}, 0.5 m/s
18. 0.32 s, 3.1 s^{-1}
19. 0.83 s, 1.2 s
20. 0.017 s
21. a) 2.5 rev/s
    b) 0.4 s
22. i) 1.3 Hz, 0.77 s
    ii) 0.75 Hz, 1.3 s
    iii) 0.555 Hz, 1.80 s
23. i) 4800
    ii) 2800
    iii) 2100
24. a) 4.62×10^{16} Hz
    b) 5.00×10^{16} Hz
    c) 5.17×10^{16} Hz
    d) 5.77×10^{16} Hz
    e) 6.32×10^{16} Hz
    f) 7.5×10^{16} Hz
25. a) 0.138 h
    b) 3.53×10^{-4} h
    c) 5.36 h
    d) 0.0842 h
26. a) i) 1.79×10^9 s
    ii) 4.56×10^6 s
    iii) 6.96×10^{10} s
    iv) 1.092×10^9 s
    b) i) 1.79×10^7 s
    ii) 4.56×10^4 s
    iii) 6.96×10^8 s
    iv) 1.092×10^7 s
27. 9.4608×10^{15} m
28. 100 years
29. 5.33×10^{-7} s
30. 1.38×10^7
31. 0.8 cm, −0.4
32. 0.8 cm, −0.4
33. 618 cm
34. 7.5 m
35. 65 cm
36. 20.5 cm
40. yes, yes, no, no
41. 23°
42. 50°
44. 4.5 m
45. yes
46. a) inverted, real, same size
    b) inverted, real, larger
    c) inverted, real, smaller
47. virtual, larger, upright
48. at focus
49. 20 cm, 100 cm
50. virtual, smaller, upright
54. a) 60 cm
    b) −0.2
    c) 1.6 cm
    d) real, inverted, smaller
55. a) 30 cm
    b) 30 cm
    c) −1
    d) 1.5 cm
    e) inverted, real, same size
56. a) −41 cm
    b) 3.4
    c) 75 cm
    d) upright larger, virtual
57. a) at focus (20 cm)
    b) ∞
58. 17.0 cm
59. a) diverging
    b) negative
    c) −3.55 cm
    d) 0.355, 3.55 cm
    e) virtual, smaller, upright
61. a) −48 cm
    b) 8.6 cm
    c) virtual, smaller, upright
62. 20.0 cm
63. a) 10 cm
    b) −20 cm
    c) virtual, upright, larger

Chapter 11

28. a) 1.24×10^8 m/s
    b) 1.97×10^8 m/s
    c) 2.26×10^8 m/s
    d) 2.31×10^8 m/s
29. a) 0.413
    b) 0.658
    c) 0.752
    d) 0.769
30. a) 1.90
    b) 1.46
    c) 1.50
    d) 0.79
31. 5.31×10^{-5} s
32. a) 1.25×10^8 m/s
    b) 2.4
    c) diamond
33. a) 0.5
    b) 0.87
    c) 0.71
    d) 0.218
    e) 0.96
    f) 0.0
    g) 1.0
34. a) 20.0°
    b) 40.0°
    c) 44.4°
    d) 19.4°
    e) 90.0°
35. a) 22.1°
    b) 11.9°
    c) 21.6°

d) 15.3°
36. a) 29.2°
b) 15.6°
c) 28.6°
d) 20.0°
37. a) 24.8°
b) 4.11°
c) 7.50°
d) 5.48°
38. a) 1.28
b) 2.40
c) 1.27
39. a) 1.71
b) 3.20
c) 1.69
40. air → glass 13.0°
glass → water 14.9°
glass → air 10°
water → glass 13°
41. 2.26×10^8 m/s
42. 2.3 m
43. 2.0 m
44. 319 cm
45. a) red: 19.2°, violet: 18.9°
b) red: 29.99°, violet: 29.92°
50. a) 24.4°
b) 48.8°
c) 41.8°
d) 33.3°
51. a) 2.00
b) 2.66
52. glass → water 61.0°
glass → air 41.1°
53. diamond → zircon 51.7°
diamond → ice 32.5°
zircon → ice 43.2°
54. a) inverted, same size, real
b) inverted, larger, real
c) no image
d) upright, real, larger
55. a) smaller, virtual, upright
b) smaller, virtual, upright
c) smaller, virtual, upright
d) smaller, virtual, upright
56. a) smaller, inverted
b) larger, inverted
c) larger, virtual
57. a) −380 cm, 60 mm
b) −60 cm, 12 mm
c) −20 cm, 6 mm
d) −5 cm, 3.8 mm
58. a) virtual, smaller, upright
b) virtual, smaller, upright
c) virtual, smaller, upright
e) virtual, smaller, upright
61. 0.4
62. 0.14
64. a) 30 cm, −1, −5 cm
b) 37.5 cm, −1.25, −6.25 cm
c) no image
d) −30 cm, 1, 5 cm
65. a) −10 cm, 0.33 cm, 1.7 cm
b) −9.375 cm, 0.3125, 1.56 cm
c) −7.5 cm, 0.5, 2.5 cm
d) −6.0 cm, 0.6, 3.0 cm
66. i) 6.25 cm, −0.25, −1.25 cm
ii) 100 cm, −4, −20 cm
iii) −50 cm, 2, 10 cm
67. a) −380 cm, 20, 60 mm
b) −60 cm, 4, 12 mm
c) −20 cm, 2, 6 mm
d) −5 cm, 1.25, 3.8 mm
68. a) −9.74 cm, 0.65, 2.0 mm
b) −8.7 cm, 0.58, 1.7 mm
c) −6.67 cm, 0.44, 1.3 mm
d) −3.33 cm, 0.22, 0.66 mm
69. 35 mm: 0.035 m, −0.007, −1.05 cm
100 mm: 0.102 m, 0.020, 3.0 cm
70. 35 mm
71. −10 cm, 2, 12 mm
72. a) −10 cm
b) 5.0 cm
c) convex
75. a) 10 diopters
b) 3.3 diopters
c) −2.5 diopters
76. a) −0.20 m
b) 2
c) converging
77. a) 0.8 m
b) −0.4 m
c) diverging
78. a) 12.75 cm
b) real image
c) −3.33 cm
d) virtual image
e) −20 mm
f) 20
g) inverted
79. 2.5 diopters

Chapter 12

17. 6.65×10^{14} s^{-1}
18. 5.5×10^{14} s^{-1}
19. a) 7.35×10^{14} s^{-1}
b) 6.5×10^{14} s^{-1}
20. a) moving away
b) 2.00×10^6 m/s
c) 596 nm
21. 138 km/h
22. a) 188 km/h
b) 88 km/h
23. 2.03×10^{10} s^{-1}
24. a) 53.1°
b) 56.3°
c) 41.6°
d) 45.7°
25. 1.73
27. a) 97.0%
b) 75%
c) 11.7%
d) 0.76%
28. 39.2°
29. 2.9%
30. a) more than red
b) 1.75
31. 468 nm
32. 4.0×10^{-12}
33. a) $\frac{\lambda}{2}$
b) $\frac{3\lambda}{4}$
c) $\frac{\lambda}{4}$
35. a) 7.9°
b) 4.0°
c) 24.4°
d) 20°
36. 3.2×10^{-6} m
37. 5.36×10^{-6} m
38. 2.14×10^{-4} m
39. 0.3°
40. 15
41. 21.6 m
42. a) 3.25×10^{-7} m
b) $\frac{1}{2}$
43. a) 7.4°
b) 5.5°
44. 8.37×10^{-7} m
45. 6.74×10^{-6} m
46. a) 17.4 cm
b) 14.5 m
47. 5.39°
48. a) 6.2 mm
b) 0.10°
49. a) $\lambda < w$
b) 1
50. a) constructive
b) destructive
c) constructive
d) constructive
51. minimum (dark)
52. a) 1.5×10^{-7} m
b) 3.00×10^{-7} m

53. a) 2.25×10^{-7} m
    b) 1.38×10^{-7} m

Chapter 13

24. a) 125 Hz
    b) 0.008 s
25. a) 0.92 Hz
    b) 1.08 s
26. a) 0.75 m
    b) 0.80 m
    c) 0.77 m
27. a) 350 m/s
    b) 1260 km/h
28. λ = 187 500 m
    750 football fields
29. a) 3.4 m
    b) 0.008 s
    c) 425 m/s
30. a) 0.15 m/s
    b) 200 m/s
    c) 15 m/s
    d) 2500 m/s
    e) 5.1×10^{7} m/s
31. a) $\vec{v}$ = 38 m/s
    b) $\vec{v}$ = 50 m/s
    c) $\vec{v}$ = 0.0063 m/s
    d) $\vec{v} = 3.5 \times 10^{-4}$ m/s
32. λ = 0.782 m
    383 wavelengths
33. a) 2.06 s
    b) 1.38 s
    c) 0.39 s
    d) 4.26 s
34. a) 1.23 m
    b) 1.267 m
    c) 0.1119 m
    d) 0.3428 m
35. a) 332 m/s
    b) 347 m/s
    c) 350 m/s
    d) 323 m/s
36. 3.84×10^{-3} m
37. 2454 m
38. 640 m
39. 13.3°C boxed too!
    v = 340 m/s boxed too!
40. 690 m
41. Δd = 5100 m
    Δt = 14.8 s
42. i) Δt = 1.00 s you
    ii) Δt = 0.10 s
    friend hears it first
43. 0.676 m (air)
    2.90 m (water)
    4.3
44. a) 2, supersonic
    b) 0.91, subsonic
    c) 0.12, subsonic
    d) 6.0, supersonic
45. a) 0.95
    b) 1.04
    c) 4.90
    d) 5.14
46. 2550 m
47. 5.29
48. i) 7.86×10^{3} m/s
    ii) Mach 25
49. a) 1.5×10^{-6} W/m^2
    b) 3.8×10^{-7} W/m^2
    c) 2.4×10^{-5} W/m^2
    d) 5.4×10^{-5} W/m^2
50. 3.5 m away
51. 5.45×10^{-4} W/m^2
52. a) 62.5 m^2
    b) 11.4
    c) 3.37
53. a) 2
    b) 3
    c) −2
    d) −3.46
    e) 6.75
    f) 0
    g) does not exist
54. a) log 100
    b) log 1000000
    c) log 0.01
    d) log 0.000001
    e) log 3162.28
    f) log 2.24
55. a) 1.26
    b) 2.51
    c) 0.79
    d) 0.50
    e) 1.78
    f) 1.12
56. a) 10^{6}
    b) 10^{10}
    c) 10
    d) 3.2×10^{4}
57. a) 8.75×10^{-7} w/m^2
    b) 6 dB
58. a) 1000
    b) 158.5
    c) 77.6
59. 250
60. 20 m back
61. 100
62. 10
63. 316 228
64. a) 1840 Hz
    b) 1580 Hz
    c) 1930 Hz
65. a) 1830 Hz
    b) 1590 Hz
    c) 1910 Hz
66. 9.49 m/s
67. 58 m/s
68. 86 m/s
69. 346 Hz
70. a) 1960 Hz
    b) 1640 Hz
71. a) 1980 Hz
    b) 1650 Hz

Chapter 14

6. a) air column and bottle
    b) skin on drum
    c) air column pipes
    d) strings
    e) door
13. 0.32 m
14. $f_1 = f_2 = 1.0 = 10^{3}$ Hz (unchanged)
15. 4.32×10^{3} Hz
17. #3, mechanical resonance
19. 0.48 m, decrease base fundamental frequency
20. 0.40 m
21. a) 347 m/s
    b) 0.365 m
    c) 18.3 cm
22. 8.55 cm
23. a) 92.0 cm, 120 cm
    b) 371 Hz, 284 Hz
    c) 15°C
24. a) 20 cm
    b) 1.7×10^{3} Hz
25. 578 Hz
26. a) 347 m/s
    b) 1.7 m
    c) 2.0×10^{2} Hz
27. 1.448×10^{3} Hz
28. a) 900 Hz
    b) 1.15×10^{3} Hz
    c) 970 Hz
    d) 1.0×10^{3} Hz
29. a) 1.10×10^{3} Hz
    b) 778 Hz
30. b) 4.0 cm
    c) 8.6×10^{3} Hz
31. 424 Hz
32. 197 Hz
36. 2nd − 1.54×10^{3} Hz,
    4th − 2.56×10^{3} Hz,
    5th − 3.07×10^{3} Hz
37. a) 12 Hz

b) 5 Hz
c) 24 Hz

38. yes, 444 Hz and 436 Hz,
444 Hz—reduce tension,
436 Hz—increase tension
39. 515 Hz and 509 Hz

Chapter 15

10. (+) protons, (−) electrons
11. a) 0
b) −
c) +
d) 0
e) +
12. a) rubber (−)
b) silk (+)
c) acetate (−)
d) glass (+)
13. a) negative(−)
b) electrons
14. a) glass (+), silk (−)
b) silk attracted to glass
15. same as balloon (−)
16. a) insulator
b) conductor
c) insulator
d) insulator
e) insulator
f) insulator
17. shortest path to ground
19. detect charge
20. a) positive, contact
b) repel
c) return to normal
21. 9.38×10^{19} electrons
22. 7.0×10^{12} electrons
23. $+ 6.4 \times 10^{-8}$ C
24. 4.3×10^{-11} C
25. 1.5×10^{7} electrons

Chapter 16

9. 1.3×10^{3} s
10. 9.1×10^{2} C
11. 2.0×10^{3} V
12. 3.8 V
13. 8.01×10^{-14} J
14. 4.1×10^{3} J
15. 1.2×10^{2} V
16. 6.0×10^{4} J
17. 6.9 A
18. 4.6×10^{4} J
19. 2.4×10^{2} V
20. a) 1.5×10^{3} A
b) 4.5×10^{9} J
21. 4.0×10^{-15} J
22. 9.1×10^{5} J
23. 20 Ω
24. 0.33 A
25. 1.1×10^{2} V
26. 200 Ω
27. 2000 Ω
28. 2.2 Ω
29. a) 3.2×10^{1} Ω
b) 1.3 Ω
c) 4.8 V
30. a) 2.3×10^{1} Ω
b) 12 Ω
31. a) 110 Ω
b) 3.2 Ω
c) 5.8 Ω
32. 5
33. 10 Ω
34. 35 Ω
35. a) $V_1 = 24$ V, $I_1 = 3$ A, $R_1 = 8$ Ω
$V_2 = 9$ V, $I_2 = 3$ A, $R_2 = 3$ Ω
$V_3 = 21$ V, $I_3 = 3$ A, $R_3 = 7$ Ω
$V_T = 54$ V, $I_T = 3$ A, $R_T = 18$ Ω
b) $V_1 = 9$ V, $I_1 = 2$ A, $R_1 = 4.5$ Ω
$V_2 = 9$ V, $I_2 = 2$ A, $R_2 = 4.5$ Ω
$V_T = 9$ V, $I_T = 4$ A, $R_T = 2.25$ Ω
c) $V_1 = 24.2$ V, $I_1 = 0.97$ A,
$R_1 = 25$ Ω
$V_2 = 24.2$ V, $I_2 = 1.61$ A,
$R_2 = 15$ Ω
$V_3 = 25.8$ V, $I_3 = 2.58$ A,
$R_3 = 10$ Ω
$V_T = 50$ V, $I_T = 2.58$ A,
$R_T = 19.4$ Ω
d) $V_1 = 75$ V, $I_1 = 3$ A, $R_1 = 25$ Ω
$V_2 = 20$ V, $I_2 = 2$ A, $R_2 = 10$ Ω
$V_3 = 5$ V, $I_3 = 1$ A, $R_3 = 5$ Ω
$V_4 = 15$ V, $I_4 = 1$ A, $R_4 = 15$ Ω
$V_T = 95$ V, $I_T = 3$ A,
$R_T = 31.7$ Ω
e) $V_1 = 29.5$ V, $I_1 = 5.9$ A,
$R_1 = 5$ Ω
$V_2 = 2.5$ V, $I_2 = 2.5$ A,
$R_2 = 1$ Ω
$V_3 = 2.5$ V, $I_3 = 0.17$ A,
$R_3 = 15$ Ω
$V_4 = 2.5$ V, $I_4 = 0.25$ A,
$R_4 = 10$ Ω
$V_5 = 2.5$ V, $I_5 = 2.5$ A,
$R_5 = 1$ Ω
$V_6 = 118$ V, $I_6 = 5.9$ A,
$R_6 = 20$ Ω
$V_T = 150$ V, $I_T = 5.9$ A,
$R_T = 25.5$ Ω
f) $V_1 = 6$ V, $I_1 = 0.40$ A,
$R_1 = 15$ Ω
$V_2 = 1.2$ V, $I_2 = 0.12$ A,
$R_2 = 10$ Ω
$V_3 = 1.2$ V, $I_3 = 0.24$ A,
$R_3 = 5$ Ω
$V_4 = 4.8$ V, $I_4 = 0.40$ A,
$R_4 = 12$ Ω
$V_T = 12$ V, $I_T = 0.40$ A,
$R_T = 30.3$ Ω
36. a) 3.12×10^{3} W
b) 1.4×10^{3} W
c) 7.00 W
37. a) 1.8×10^{3} W
b) 0 A
38. a) 10 A
b) 20 A
c) 4.8×10^{3} W
d) conductor burn out
39. $15.08/year
40. $9.41

Chapter 17

20. a) in to page, over top
b) clockwise
c) out of page from the top
d) counterclockwise
e) out of page from the top
21. a) in to page (X)
b) in left (X), out right (•)
c) right to left
d) out of page (•)
e) in right (X), out left (•)
f) left to right
22. a) north (top), south (bottom)
b) north (top), south (bottom)
c) north (top/right),
south (bottom/left)
d) north (top/left),
south (bottom/right)
23. a) in left, out right
b) in right, out left
24. a) 16 N
b) 20 N
c) 15 N
25. a) 14.4 V
b) 12 V
26. a) field (down), force (right)
b) north (top), force (left)
27. a) field (up), current in (X)
b) north (top), current in (X)
28. a) north (bottom), field (up)
b) north (top), field (down)
29. a) top (in), bottom (out)
b) top (in), bottom (out)
30. north lower left, turns counter-
clockwise

Chapter 18

21. $V = 100$ V, $I = 12$ A
22. a) 55 turns
    b) 27.5 turns
23. a) 0.57
    b) 21 V
    c) step-up
24. a) 3.3×10^3 W
    b) 2.8×10^1 A
    c) 0.12
25. a) step-up
    b) converted to AC
    c) 0.1
    d) 5 A
26. 8.3 V
27. a) 11.5 V
    b) 5.8×10^{-2} A
    c) 41.8 W
28. a) 120 V
    b) 90 A
    c) 1.1×10^4 W
29. a) 2
    b) 5 A
30. a) step-up, turn ratio of 8.7×10^{-2}
    b) 5.2 A
31. a) 1.6×10^2 A
    b) 1.2×10^3 W
    c) 0.67%
32. a) 562 MW
    b) 28.7 m

Chapter 19

12.

Symbol	Z	A	N	${}^{A}_{Z}X$
H	1	3	2	${}^{3}_{1}\mathrm{H}$
Li	3	7	4	${}^{7}_{3}\mathrm{Li}$
C	6	14	8	${}^{14}_{6}\mathrm{C}$
N	7	14	7	${}^{14}_{7}\mathrm{N}$
Na	11	24	13	${}^{24}_{11}\mathrm{Na}$
Co	27	59	32	${}^{59}_{27}\mathrm{Co}$
Sr	38	88	50	${}^{88}_{38}\mathrm{Sr}$
U	92	238	146	${}^{238}_{92}\mathrm{U}$
Pu	94	239	145	${}^{239}_{94}\mathrm{Pu}$

13. a) ${}^{1}_{1}p^{+}$
    b) ${}^{4}_{2}\mathrm{He}^{2+}$
    c) ${}^{1}_{0}n$
    d) ${}^{0}_{-1}e$
14. a) ${}^{14}_{7}\mathrm{N}$
    b) ${}^{1}_{0}n$
    c) ${}^{4}_{2}\mathrm{He}$
    d) ${}^{0}_{-1}e$
    e) ${}^{20}_{10}\mathrm{Ne}$
15. a) ${}^{0}_{-1}e$ (beta)
    b) ${}^{4}_{2}\mathrm{He}$ (alpha)
    c) ${}^{2}_{1}\mathrm{H}$
    d) ${}^{4}_{2}\mathrm{He}$ (alpha)
    e) ${}^{0}_{-1}e$ (beta)
    f) ${}^{0}_{-1}e$ (beta)
17. 45 hours
18. a) 1.8×10^6 Bq
    b) 1.16×10^4 days
19. 1.15×10^4 a
20. 75.0 d
21. a) 5.0×10^5 kJ
    b) 5.6×10^{-9} kg
    c) 1.4×10^{-10}%
22. a) 6.1×10^2 kg/day
    b) 3.7×10^{-18}%/year
23. 1.20×10^{22} fissions/s
24. 1.5%