Appendix D ANSWERS

This section includes numeric and short answers to questions in Section Questions, Chapter and Unit Quizzes, and Chapter and Unit Reviews.

Chapter 1

Section 1.1 Questions, p. 17

4. (a) 4.97×10^2 s
   (b) 2.56 s
5. (a) 0.0 m/s; 5.0 m/s
   (b) 2.5 m/s [E]; 11 m/s [W]; 0.31 m/s [E]
   (c) 0.0 m/s; 2.5 m/s
   (d) 11 m/s [W]
8. (a) 87 m
   (b) 0.73 m/s
   (c) 65 m [43° S of E]
   (d) 0.54 m/s [43° S of E]
10. See Table 3 below.

Section 1.2 Questions, pp. 30–31

3. (a) 1.54 (km/h)/s [E]
   (b) 0.427 m/s^2 [E]
5. (b) 13 m/s^2 [W]
7. 12 m/s [E]
8. 28 m/s
10. (a) 15 m/s [fwd]
    (b) 25 m [fwd]
11. (a) 2.0×10^{15} m/s^2 [E]
    (b) 1.0×10^{-8} s
12. 1.05×10^4 m [fwd]
13. (a) 2.1×10^2 m/s [fwd]
    (b) 2.7×10^{-3} s
14. (a) 45 s (from graph)
    (b) 75 s
    (c) 900 m
15. 0.76 m/s^2 [31° E of N]
16. 3.45 (km/h)/s [52.7° W of S]

Section 1.3 Questions, p. 40

3. (a) 27 m/s; 97 km/h
   (b) 31 m/s; 1.1×10^2 km/h
4. Java: 1.336 m; London: 1.330 m
5. 2.9×10^3 m/s; 1.1×10^4 km/h
6. (a) 1.3 s
   (b) 13 m/s [up]
   (c) 6.8 s
7. 9.6 m/s [down]
8. (a) 1.1 s
10. No; 7.10 m

Section 1.4 Questions, pp. 50–51

3. 29 m/s [horizontally]
4. (a) 0.71 s
   (b) 17 m
   (c) 25 m/s [16° below the horizontal]
   (d) 0.38 m
5. (a) 0.87 s
   (b) 2.3 m
   (c) 11 m/s [75° below the horizontal]
6. 54°, 74°, 44.4°
7. (a) 1.6×10^2 s
   (b) 1.2×10^5 km
   (c) 31 km
8. (a) 1.1×10^2 m
   (b) 24 s
   (c) 6.2×10^2 m
11. (a) 22 m

Section 1.5 Questions, p. 57

2. (a) 4.0×10^1 m/s [53° N of W]
   (b) 74 m/s [44° N of W]
3. (a) 0.56 m/s
   (b) 0.94 m/s [downstream, 53° from the initial shore]
   (c) upstream, 42° from the shore
4. 3.5×10^2 km/h [34° E of S]
5. (a) approximately 32 km/h

Chapter 1 Self Quiz, p. 63

1. F
2. F
3. F
4. T
5. F
6. T
7. T
8. F
9. F
10. T
11. F
12. (a)
13. (d)
14. (b)
15. (d)
16. (c)
17. (e)
18. (e)
19. (c)

Chapter 1 Review, pp. 64–67

1. (a) 27.8 m/s
   (b) 3.5×10^2 km/h
2. (a) $L \times T^{-1}$
   (b) $(L/T^3) \times T$
   (c) $(L/T^2) \times T \times T$
8. (a) and (b) 3.1×10^2 m [7.4° N of E]
9. (a) 7.0 km [28° N of W]
   (b) 11 km [18° N of W]
10. (a) about 2×10^3 m [down] (assuming that people are sitting down to dinner)
    (b) approximately 0 m (assuming people are asleep in beds and beds have random directions)
11. 52.426 m/s
12. (a) 64 m
    (b) about 13 car lengths (assuming 1 car is 5 m)
13. (a) 1.2×10^2 s
    (b) 21 m/s
15. (a) 2.3 m/s
    (b) 1.6 m/s [33° below the horizontal]
16. (a) 17 m [29° E of S]
    (b) 2.7 m/s [29° E of S]
18. (a) 0.53 km
    (b) 2.4 (km/h)/s
19. (a) 21 m/s^2 [fwd]
    (b) 25 m/s
    (c) $2.1\,|\vec{g}\,|$
20. 1.0×10^5 m/s^2 [fwd]
21. 533 m/s [fwd]
22. 6.1 m/s [up]
23. (a) 16 s
    (b) 12 s
24. 3.9 m/s^2 [53° W of S]
25. 54 m/s [E]
26. 0.34 s and 3.1 s
28. (a) 3.50×10^4 m/s; 1.26×10^5 km/h
    (b) 2.23×10^4 m/s
    (c) 1.02×10^{-2} m/s^2
30. (a) 0.50 s
    (b) 0.3 m
    (c) 19 m/s [15° below the horizontal]
31. 29 m/s [horizontally]
33. 2.6×10^2 km/h [60° E of S]
34. (a) 0.50 m/s
    (b) 0.94 m/s [downstream, 58° from the near shore]
    (c) upstream, 51° from the near shore
35. 5.5×10^2 km/h [15° S of W]
36. 8.9 m above
38. (a) 5.2° above the horizontal
    (b) 0.89 m/s^2
40. (a) 2.0 min
41. (a) 0.87 s
46. 62 m/s
47. (a) 2.9×10^2 m
    (b) 16 s
48. (a) [7.5° W of S]
    (b) 14 s
50. 2.0 km/h

Table 3 Data for Question 10 (for Section 1.1)

Speed	Reaction Distance		
	no alcohol	4 bottles	5 bottles
17 m/s (60 km/h)	14 m	34 m	51
25 m/s (90 km/h)	20 m	50 m	75
33 m/s (120 km/h)	26 m	66 m	99

Chapter 2

Section 2.1 Questions, p. 76

4. 1.3 N [71° below the horizontal]
5. (a) and (b) 6.4 N [39° S of W]
   (c) and (d) 4.9 N [60° S of E, to two significant digits]
6. 5.0×10^1 N [30° N of W, to two significant digits]

Section 2.2 Questions, p. 87

1. 0 N
2. 19 N [up]
3. 6.6×10^2 N [up]
4. 3.51×10^{15} m/s^2
5. (a) 4.3×10^3 m/s^2 [up]
   (b) 2.8×10^3 N [up]
   (c) 4.4:1
6. 28.0 g
7. (b) 9% decrease
9. 1.96 N
11. (b) 58 kg
    (c) 1.1 m

Section 2.3 Questions, pp. 95–96

2. 0 N
3. (a) 9.80 N
   (b) 29.4 N
   (c) 78.4 N
4. (a) 2.9×10^7 N
5. (a) 1.2 m/s^2
   (b) 3.9×10^2 N
   (c) 0.15 m
6. (a) 2.5 N
   (b) 1.8 N; 6.7 N
   (c) 3.1 N [54° above the horizontal]
7. (a) 0.744 m/s^2
   (b) 12.0 N
   (c) 21.8 N
8. (a) 25 kg
   (b) 86 N
9. 8.8°
10. (a) 0.273 m/s^2
    (b) 30.7 N
11. (a) 1.0 m/s^2
    (b) 56 N
    (c) 56 N
    (d) 0.84 m

Section 2.4 Questions, pp. 106–107

2. 3.7×10^3 N; 0.76 m/s^2
3. (a) $\mu_K = \tan \phi$
   (b) $a = g(\sin \phi - \mu_K \cos \phi)$
4. (b) 8.6 m/s^2

Section 2.5 Questions, p. 111

2. (e) 1.9 m/s^2
   (f) 2.2×10^{-2} N

Chapter 2 Self Quiz, pp. 115–116

1. T
2. F
3. F
4. F
5. F
6. T
7. F
8. F
9. T
10. T
11. F
12. (a)
13. (d)
14. (b)
15. (d)
16. (b)
17. (a)
18. (b)
19. (b)
20. (e)
21. (e)

Chapter 2 Review, pp. 117–119

6. 5.8 m/s^2
7. (a) 0.213 m/s^2
   (b) 2.41×10^{-2} N
8. (a) 1.4 m/s^2
   (b) left string: 2.9×10^2 N; right string: 3.4×10^2 N
9. 729 N [27.0° above the horizontal]
10. (a) 18.3 N
    (b) 70.1 N
14. (a) 96 N
    (b) 1.3 s
15. 4.4 kg
16. 13 m
17. (c) 4.6 m/s^2
19. 21.2 cm/s
20. 27.0 kg
21. $\mu_S = \dfrac{mg}{F_{app}}$
23. (a) 2.9×10^3 N
24. (a) 4.2 m/s
    (b) 1.9×10^3 N
25. (a) 2.7×10^2 N
    (b) 43 N
26. 3.02×10^{-2} m

Chapter 3

Section 3.1 Questions, p. 127

3. (a) 9.19 m/s^2
   (b) 5.2 m/s^2
4. (a) 3.4×10^{-2} m/s^2
5. 0.50 Hz
6. 75 m
7. 3.8×10^8 m
9. (a) 3.4×10^5 g

Section 3.2 Questions, p. 138

2. 22.4 m/s
3. 3.2×10^2 N
4. (a) 9.3×10^{22} m/s^2
   (b) 8.4×10^{-8} N
5. (a) 1.96 N
   (b) 2.22 N
6. (a) 3.8 m/s
7. 1.1 N; 0.54 N
9. (b) 21 m/s
   (d) 2.0 g

Section 3.3 Questions, p. 144

2. 3.1×10^2 N
3. $(\sqrt{2} - 1)r_E$
4. 4.1×10^{-47} N
5. (a) 6.8×10^{-8} N [W]
   (b) 7.9×10^{-7} N [42° S of W]
6. (a) 3.5×10^5 m from Earth's centre
8. (c) 4.23×10^7 m

Section 3.4 Questions, p. 151

3. 9.02:1
4. (a) 2.42×10^4 m/s
   (b) 1.99×10^{30} kg
5. (a) 4.69×10^4 km
   (b) 4.05×10^4 km
6. (a) 1.2×10^2 s
   (b) 8.3×10^{-3} Hz

Chapter 3 Self Quiz, pp. 157–188

1. T
2. F
3. T
4. F
5. F
6. T
7. T
8. T
9. F
10. T
11. T
12. (c)
13. (d)
14. (e)
15. (a)
16. (e)
17. (c)
18. (c)
19. (b)
20. (b)
21. (c)
22. (e)
23. (d)

Chapter 3 Review, pp. 159–161

4. 1.4×10^2 m
5. 0.11 cm/s^2; 2.4×10^{-4} cm/s^2; 1.3×10^{-7} cm/s^2
6. 5.4 s
8. (b) 7.5 m/s
   (c) 1.4×10^2 N
9. (a) 5.44×10^3 m/s
   (b) 1.6×10^2 a
10. 2.70×10^2 N
11. (a) 0.25
13. (b) 1.7 N; 6.2 N
    (c) 2.7 m/s
15. 15 times
16. 5.0 r_E
17. 4.21×10^{-10} N
18. 1.3×10^{-2} m/s^2
19. 4.82×10^{20} N at an angle of 24.4° from the line to the Sun
20. (a) 9.92×10^5 N
21. 1.9×10^2 units
22. (c) 1.65 m/s
    (d) 0.567 Hz
25. 9.80 m/s^2
26. 85 m
27. 8.0 m
28. D

Unit 1 Self Quiz pp. 164–166

1. T
2. F
3. T
4. T
5. F
6. T
7. T
8. F
9. F
10. T
11. F
12. F
13. (c)
14. (e)
15. (b)
16. (e)
17. (c)
18. (a)
19. (c)
20. (b)
21. (c)
22. (e)
23. (d)
24. (d)
25. (a) 3
    (b) 3
    (c) 2
    (d) 2
26. (a) 30.3 m/s
    (b) 1.19×10^6 m/s
    (c) 3.4×10^{-3} m/s^2
    (d) 5.7×10^4 m/s^2
    (e) 1.28×10^{-3} m/s^2
27. direction and relative magnitude of the wind
28. brake pedal, gas pedal, and steering wheel
29. westward and down; down
30. unchanged
31. 26 m/s [71° E of N]
32. $\vec{v}_{CE}$
33. zero
34. zero
35. (a) LT^{-2}
    (b) LT^{-1}
    (c) MLT^{-2}
    (d) $L^3M^{-1}T^{-2}$
    (e) LT^{-2}
    (f) dimensionless
    (g) T^{-1}
    (h) M^{-1}
36. Newton's first law of motion
37. decreases
38. noninertial; fictitious forces; centrifugal force
39. $m(a - g)$; $m(a + g)$
40. mass; weight; 6.0
41. (b)
42. (g)
43. (e)
44. (a)
45. (a)
46. (c); (d)

Unit 1 Review, pp. 167–171

6. (a) 0.71 m/s; 0.79 m/s
   (b) both 0.50 m/s [45° N of E]
7. 6.1 times farther on the Moon
9. (a) 0.43 km
   (b) 3.0 (km/h)/s
   (c) 1.0×10^3 N
10. (a) 0.60 m/s
    (b) 0.32 m [N]
    (c) 0.13 m/s [N]
11. (a) 1.5 cm/s
    (b) 1.5 cm/s [horizontally left; 1.5 cm/s [30° right from up]
    (c) 1.2 cm/s [down]
12. 27 m/s [32° S of E]
15. 2.5×10^2 N
16. 1.4 r_E
17. 9.7×10^2 N
19. 1.1×10^2 m
20. (a) 2.42×10^4 m/s
    (b) 1.88 Earth years
21. (a) 16 m/s [down]
    (b) 16 m/s [left]
    (c) 16 m/s [30° up from left]
22. (a) 7.04 m/s^2
    (b) 1.73×10^{-3} m/s^2
23. (a) 3.2×10^3 N
    (b) 3.2×10^3 N
24. (c) 0.87 m/s^2 [E]
25. 0.47
26. 3.9 m/s^2
27. (a) 7.6×10^2 N
    (b) 4.5×10^2 N
    (c) 6.1×10^2 N
33. 3.6 kg
35. (a) 0.30 s
    (b) 0.042 s
37. 95.0 m
38. (a) 0.83 s
    (b) 4.1 m/s
39. 1.3 m to 5.1 m
    415.6 m
41. 5.6 m
42. 0.13 s
46. (a) 3.0×10^4 km/h
    (b) 4.8×10^3 km
48. (a) 4.5 m/s
50. short by 1.1 m

Chapter 4

Section 4.1 Questions, p. 183

5. (a) 1.7×10^3 J
   (b) -1.7×10^3 J
6. 27.9°
7. (a) 6.3×10^2 N; 0.088
   (b) -2.1×10^3 J
   (d) 1.4×10^3 J

Section 4.2 Questions, p. 188

2. 2.43×10^5 J
3. (a) 3.21×10^5 J
   (b) 32%
   (c) 7.8×10^4 J
4. 11 m/s
5. 0.60 kg
6. (a) 3.09 J
   (b) 4.18 m/s
7. 18 m/s
8. 4.7 m/s

Section 4.3 Questions, p. 194

2. (a) 2.1×10^3 J
   (b) 3.4×10^2 J
3. (a) 4.29 J; 0 J
   (b) 0 J; −4.29 J
4. 15 m
5. (a) −97 J
   (b) 97 J
   (c) 97 J
7. (a) 7.43×10^{15} J
   (b) 6.52 times greater

Section 4.4 Questions, pp. 201–202

2. (a) 0.056 J
   (b) 0 J
   (c) −0.056 J
   (d) 0.056 J; 1.5 m/s
3. 11 m/s
4. (a) 6.10×10^6 J
   (b) 13.6 m/s
5. (a) 4.9 m/s
   (b) back to the original vertical height
6. 17.5°

7. 2.4 m
8. (a) and (b) 0.34
9. (a) 3.5×10^5 J
   (c) 1.2×10^3 kg
   (d) 0.61
10. (a) -2.0×10^2 J
    (b) 1.8×10^2 J
    (c) 2.0×10^2 J

Section 4.5 Questions, pp. 218–219

5. 0.042 m
6. 1.8 N
7. 229 N
8. 2.0×10^{-2} m
9. (a) 0.962 [down]; 3.33 m/s^2 [down]
   (b) 0.151 m
10. 6.37 m/s
11. (a) 91 N/m
    (b) 0.40 J
12. 2.0×10^1 N/m
13. 0.38 m
14. 0.14 m
15. (b) 0.10 m
    (c) 1.0×10^3 N/m
    (d) 9.1 m/s
17. 6.4×10^4 N/m
18. 7.8×10^{-2} m

Chapter 4 Self Quiz, p. 225

1. T
2. F
3. F
4. F
5. T
6. T
7. T
8. F
9. F
10. (c)
11. (c)
12. (e)
13. (d)
14. (e)
15. (a)
16. (d)

Chapter 4 Review, pp. 226–229

9. (a) −49.1 J
   (b) 49.1 J
10. 32°
11. (a) 1.29×10^3 J
    (b) 1.29×10^3 J
    (c) 8.14×10^3 J
12. 5.6 m
13. 8.90 m/s
14. (a) 2.5×10^{12} J
    (b) 3×10^3 people
15. (a) -2.9×10^2 J
    (b) 2.9×10^2 J
    (c) 2.9×10^2 J
16. (a) 9.2 m/s
17. (a) 29 m/s
    (b) 29 m/s
18. (a) 2.3×10^2 N; 1.3×10^2 N
    (b) 1.4 m/s (c) 2.0×10^2 J
19. 1.0×10^4 m/s
20. 8.40 m/s
21. 42 J
22. (a) 239 N/m
    (b) 35.9 N
    (c) 2.69 J; 10.8 J
23. 0.32 m
24. 0.21 kg
25. (a) 0.053 J
    (b) 0.50 m/s
    (c) 0.33 m/s
    (d) 0.053 J
32. (a) 19.8 m/s
    (b) 20.4 m/s
34. (a) 1.12 mg
    (b) 1.12 $mg\Delta y$
35. 0.079 m
36. 0.019 J
37. 2.0 m
38. 8.4 m/s
39. 12 units

Chapter 5

Section 5.1 Questions, p. 238

3. (a) 77 N·s [E]
   (b) 1.1 N·s [forward]
   (c) 3.5×10^2 N·s [down]
   (d) about 0.12 N·s [S]
4. 2.4 m/s [W]
5. 1.6×10^4 N [W]
6. (a) 0.66 kg·m/s [left]
   (b) 0.66 N·s [left]
7. (a) 1.1 kg·m/s [backward]
   (b) 1.1 N·s [backward]
   (c) 0.45 N [backward]
8. 1.8 m/s [backward]
9. 3.0 m/s [N]
10. (a) 11 kg·m/s [up]
    (b) 1.7×10^3 N [up]

Section 5.2 Questions, pp. 244–245

5. 1.9 m/s in the original direction of cart's velocity
6. 5.8 m/s [N]
7. 4.95 m/s [E]
8. (a) 2.34×10^4 kg·m/s [W]; 2.34×10^4 kg·m/s [E]
   (c) zero
9. 82 kg
10. 0 m/s

Section 5.3 Questions, p. 253

4. 3.1 m/s forward and 0.4 m/s backward
5. $\frac{m}{2}$
6. 11 m/s
7. (b) $\frac{mv}{(m + M)}$
   (d) $h = \frac{m^2v^2}{2g\,(m + M)^2}$
   (e) $v = \left(\frac{(m + M)}{m}\right)\sqrt{2gh}$
   (f) 6.6×10^2 m/s

Section 5.4 Questions, pp. 258–259

2. 66° from the initial direction of the neutron's velocity
3. 55 kg
4. 1.7 m/s [47° S of E]
5. (a) 0.22 kg
   (b) 1.3×10^{-4} J

Chapter 5 Self Quiz, pp. 267–268

1. F
2. T
3. F
4. F
5. T
6. T
7. F
8. F
9. T
10. F
11. (e)
12. (d)
13. (d)
14. (d)
15. (e)
16. (d)
17. (b)
18. (c)
19. (a)
20. (d)
21. (a)
22. (d)

Chapter 5 Review, pp. 269–271

7. 8.1×10^2 kg·m/s; 7.9×10^2 kg·m/s
8. 25 m/s
9. 3.2×10^5 N [E]
10. (a) 1.7 N·s [horizontally]
    (b) 28 m/s [horizontally]
11. 1.00 m/s
12. 0.619 km/s
13. 1.90×10^2 m/s [toward Jupiter]
15. 0.08 m/s [N] for the 253-g car; 1.88 m/s [N] for the 232-g car
16. (b) 3.0 m/s; 4.0 m/s
17. 0.561
18. 3.00 m/s [W]
19. (a) 2.3 m/s
    (b) 2.5 m/s
20. (a) 0.80 m/s
    (b) 7.8 N
21. 3.4×10^3 km/h
22. 2.0 m/s [22° S of W]
    (See Table 1 below.)
31. (a) $v_1' = \frac{v_1(m_1 - m_2)}{m_1 + m_2}$; $v_2' = \frac{2mv_1}{(m_1 + m_2)}$
    (b) $v_1' = 0$; $v_2' = v_1$
    (c) $v_1' = v_1$; $v_2' = 2v_1$
    (d) $v_1' = -v_1$; $v_2' = \frac{2m_1v_1}{m_2}$
32. 3.4×10^2 m

Chapter 6

Section 6.1 Questions, p. 277

2. (a) 3.99×10^3 N [toward Earth's centre]
   (b) 1.77 m/s^2 [toward Earth's centre]
3. 7.3×10^{-2} N/kg [toward Earth's centre]
4. (a) 3.0×10^6 m
   (b) 2.8×10^3 N
5. 11.2 N/kg
6. (a) 0.61 m/s^2 [toward Earth's centre]
   (b) 2.9×10^2 N [toward Earth's centre]
7. (a) 2.6×10^3 km
   (b) 0.24 N
8. 0.75 r_E

Section 6.2 Questions, p. 284

4. 1.8×10^8 s
5. 1.6 times
6. 4.0×10^1 h
7. 9.2×10^6 m

Section 6.3 Questions, p. 294

3. (a) -1.7×10^{10} J
   (b) 5.4×10^3 m/s
4. 1.4×10^9 J
5. (a) -1.18×10^{11} J
   (b) 5.88×10^{10} J
   (c) -5.88×10^{10} J
   (d) 7.74×10^3 m/s
6. (a) -3.03×10^{10} J
   (b) 1.52×10^{10} J
   (c) -1.52×10^{10} J
   (d) 94%
7. (a) 6.18×10^5 m/s
   (b) 4.37×10^4 m/s
8. 1.68×10^3 m/s
9. 5.22 M_S
11. (a) 8.86 mm

Chapter 6 Self Quiz, pp. 298–299

1. T
2. T
3. T
4. T
5. F
6. F
7. F
8. F
9. T
10. F
11. (a)
12. (d)
13. (c)
14. (d)
15. (a)
16. (c)
17. (a)
18. (d)
19. (e)
20. (c)
21. (c)
22. (d)
23. (c)
24. (c)
25. (a)
26. (e)

Chapter 6 Review, pp. 300–301

3. 5.1×10^4 km
4. 0.318 N/kg
5. 4.23×10^{-3} N/kg [1.26° from the spacecraft-to-Earth line]
6. 3.3×10^{23} kg
7. (a) 1.22 r_E
   (b) 0.22 r_E
8. (a) 3.1×10^5 km
   (b) 2.1 d
9. 1.08×10^{11} m
10. (a) 1.21×10^4 km
    (b) 9.92×10^7 J
11. (a) 2.64×10^3 m/s
    (b) 8.17×10^9 J
12. (a) -3.99×10^8 J
    (b) $+3.99 \times 10^8$ J
    (c) 2.82×10^2 m/s
13. -5.33×10^{33} J

Table 1 Data for Question 22 (Chapter 5 Review)

Component	1	2	3
Mass	2.0 kg	3.0 kg	4.0 kg
Final Velocity	1.5 m/s [N]	2.5 m/s [E]	2.0 m/s [22° S of W]

14. (a) 4.23 km/s
    (b) 2.37 km/s
15. (a) 2.3×10^8 m/s
    (b) 77% of the speed of light
16. (a) 1.1×10^{26} kg
17. (a) 1.7×10^5 m/s
19. 3.2×10^{14} m
20. (a) and (b) 1.48×10^{14} m^3/s^2
    (c) 1.49×10^{14} m^3/s^2, yes
    (d) 0.557 d, 1.48×10^{14} m^3/s^2; 7.52×10^4 km, 1.48×10^{14} m^3/s^2; 8.67 d, 1.48×10^{14} m^3/s^2; 5.84×10^5 km, 1.48×10^{14} m^3/s^2; See also completed Table 1 below.
22. (a) 1.6×10^3 kg
    (b) 1.0×10^{11} J
    (c) 1.2×10^4 m/s
    (d) 5.0×10^3 m/s
24. 40 min
25. 7.9×10^7 s
26. $E = kT^{-\frac{4}{3}}$

Unit 2 Self Quiz, pp. 304–306

1. F
2. T
3. F
4. F
5. T
6. F
7. F
8. F
9. F
10. F
11. F
12. F
13. T
14. F
15. (c)
16. (c)
17. (a)
18. (d)
19. (e)
20. (c)
21. (e)
22. (d)
23. (c)
24. (a)
25. (c)
26. (a)
27. (d)
28. (d)
29. (a) Galileo Galilei
    (b) Johannes Kepler
    (c) James Prescott Joule
    (d) Tycho Brahe
    (e) Robert Hooke
    (f) Karl Schwartzschild
30. (a) work
    (b) force constant of a spring
    (c) impulse
    (d) force
    (e) thermal energy
    (f) mass of Earth
31. completely inelastic collision; equals; completely inelastic collision
32. zero
33. singularity; Schwartzschild radius
34. (a) A
    (b) E
35. (e), (g), (h), (j), (k), (d), (b), (a), (m)

Unit 2 Review, pp. 307–311

9. 11 m
10. (a) 1.0×10^1 J
    (b) 2.0×10^1 J
    (c) 2.0 m/s [W]
11. (a) 10.0 kg
    (b) 2.50×10^3 N [E]
12. 71 kg·m/s
13. 0.60 m
14. (a) 1.00×10^{-2} J
    (b) 8.00×10^{-2} J
    (c) 0.671 m/s
17. 31 N
18. 3.8 kg
19. (a) 2.7 J
    (b) 0.60 m/s [W]
    (c) -1.6 J
    (d) 2.2×10^2 N/m
20. 0.20 m
21. (a) 0.42 m/s [left]
    (b) 0.87 m/s [left]
    (c) 0.38 m/s [left]
22. 2.8 s
23. 1.6 kg
24. $\frac{2m}{3}$
25. 11 m/s [37° S of E]
26. (a) 9.1 m/s [26° N of W]
    (b) 31%
27. 4.9 m/s [12° W of N]
31. 8.06 m/s^2
32. 0.69 g
33. 5.95×10^{-3} N/kg [toward the centre of the Sun]
34. (a) 6.16 a
    (b) 1.62×10^4 m/s
35. (a) 1.74×10^{14} m^3/s^2
    (b) 1.09×10^8 m
    (c) 8.42×10^4 km
36. 1.90×10^{27} kg
37. (a) 4.23×10^3 m/s
    (b) 2.12×10^3 m/s
    (c) 3.67×10^3 m/s
    (d) 2.39×10^{-19} J
38. (a) 2.4×10^2 m
41. (a) 2.8×10^2 N/m
43. (a) 2.3×10^{-2} J; 2.1×10^{-2} J
    (b) -8.5×10^{-3} N
46. (a) 2.9×10^{41} kg
    (b) 1.5×10^{11} stars
47. 0.26 m/s [right] for both balls
48. (a) 0.80 m/s [N]
    (b) 0.64 J
    (c) 1.6 N [S]
    (d) -4.8×10^2 J
49. 3.4×10^2 m
50. (a) 744 N/m; 15.3 kg
    (c) 2.3 kg
52. 2.4×10^2 N

Table 1 Data of Several Moons of the Planet Uranus (for question 20 Chapter 6 Review)

Moon	Discovery	$r_{average}$ (km)	T (Earth days)	C_U (m^3/s^2)
Ophelia	*Voyager 2* (1986)	5.38×10^4	0.375	1.48×10^{14}
Desdemona	*Voyager 2* (1986)	6.27×10^4	0.475	1.48×10^{14}
Juliet	*Voyager 2* (1986)	6.44×10^4	0.492	1.48×10^{14}
Portia	*Voyager 2* (1986)	6.61×10^4	0.512	1.48×10^{14}
Rosalind	*Voyager 2* (1986)	6.99×10^4	0.556	1.48×10^{14}
Belinda	*Voyager 2* (1986)	7.52×10^4	0.621	1.48×10^{14}
Titania	Herschel (1787)	4.36×10^5	8.66	1.48×10^{14}
Oberon	Herschel (1787)	5.85×10^5	13.46	1.48×10^{14}

Chapter 7

Section 7.2 Questions, pp. 335–336

3. 4.5×10^{-2} N
4. (a) 2.67×10^{-14} N
    (b) 3.6×10^4 N
    (d) 3.6×10^4 N, 3.6×10^3 m/s^2
    (e) 3.6×10^4 N, 3.6×10^3 m/s^2
5. 1.3×10^{-4} C
6. 3.9×10^{-6} C
7. 0.20 N [right], 1.94 N [right], 2.14 N [left]
8. 2.2 N, 1.4 N
9. on the line joining them, 0.67 m from the 1.6×10^{-5} C
10. 55 N/m
13. (a) 5.7×10^{13} C

Section 7.4 Questions, pp. 358–359

1. 4.3×10^{-9} C
2. -0.40
7. 4.0×10^{-5} m
8. (a) -3.6×10^{-2} J
    (b) 1.0×10^4 V, 3.3×10^4 V, 2.8×10^3 V
9. (a) 1.1×10^{-6} C
    (b) 7.1×10^5 N/C

Section 7.5 Questions, p. 364

1. (a) 1.1×10^{14}
    (b) 0, 1.1×10^5 V
    (c) 1.2 N
2. (b) 2.9×10^8
3. (a) 1.9×10^{-18} C
    (b) 12
4. 1.7×10^{-15} C
5. (a) 8.4°
    (b) 0.50 N
8. (a) 4.5×10^5 C
    (c) 1.6×10^{-18} kg

Section 7.6 Questions, p. 371

1. (a) 2.1×10^7 m/s
    (d) 4.8×10^5 m/s
2. (a) 1.0×10^{-18} J
    (b) 1.9×10^6 m/s
    (c) 1.6 cm
3. (a) 4.5×10^{-6} m
4. 7.7×10^{-12} J
5. (a) 1.8×10^{-3} m
    (b) 2.7×10^5 m/s
    (c) 5.1°

Chapter 7 Self Quiz, p. 377

1. F
2. F
3. T
4. F
5. F
6. T
7. (b)
8. (e)
9. (e)
10. (e)
11. (b)
12. (b)
13. (b)

Chapter 7 Review, pp. 378–381

4. 1.0×10^{-3} N
5. 2.4×10^{-9} m
6. (a) 8.2×10^{-8} N
    (b) 3.6×10^{-47} N
    (d) 2.2×10^6 m/s, 1.5×10^{-16} s
7. (a) 21 N away from negative charge
    (b) 59 N toward positive charge
    (c) 91 N toward positive charge
12. (a) 6.0 N/C [right]
    (b) 4.3×10^{-3} N [left]
13. 3.2×10^7 N/C [right]
14. 5.8×10^5 N/C [right]
15. (a) 4.2×10^3 N/C
    (b) 2.9×10^{-3} N
    (c) 2.9×10^{-5} N
    (d) 6.9×10^{-9} C
18. 2.1×10^5 N [55° up from the left], 0, 1.7×10^8 V
19. 8.1×10^6 V
20. 43 J
21. 4.0×10^{-15} J
22. 2.3×10^{-13} J
23. 2.3×10^4 N/C
24. 2.0×10^2 V
26. 5.1 m
27. 4.7×10^{-19} C, ± 3 electrons
28. 49 V
29. -3.6×10^3 V, 9.0×10^3 N/C [toward sphere]
30. 1.3×10^7 m/s
31. 5.9×10^3 V
32. 68 V
33. (a) 1.0×10^7 m/s
    (b) 1.6 cm, to the left
    (c) 0 m/s
34. 1.6×10^{-14} m
35. (a) 0.41 cm
    (b) 8.0×10^7 m/s [4.7° up from the right]
45. (a) 1.0 mm
    (b) 1.5×10^{-3} m

Chapter 8

Section 8.2 Questions, pp. 402–403

2. 1.5×10^{-12} N [up]
3. 8.4×10^{-4} m

Section 8.3 Questions, p. 407

1. (a) 90°
   (b) 0.67 A
   (c) 0 N
2. 2.5×10^{-4} N [up]
3. 1.0 N

Section 8.4 Questions, p. 414

1. 3.2×10^{-6} T
2. 1.6×10^{-3} T
3. 1.5×10^{-3} T
4. 5.8×10^{-4} N
9. (a) 230 A

Chapter 8 Self Quiz, p. 427

1. F	6. T	11. (a)
2. T	7. F	12. (d)
3. T	8. (b)	13. (a)
4. T	9. (b)	
5. F	10. (b)	

Chapter 8 Review, pp. 428–429

6. 0.22 T
7. 1.6 A
8. 6.1×10^{-13} N [down]
9. 2.7×10^{-14} N
10. 9.6×10^{-6} T [S]
11. 2.4×10^{-17} N horizontally toward the wire
12. 1.5×10^{-2} T
13. 0.70 A
14. 0.90 N
15. 7.4×10^{3} A
16. 1.0×10^{10} C/kg
17. 5.2×10^{6} m/s
18. 3.4×10^{-27} kg
19. (a) 2.9×10^{5} m/s
    (b) 7.1 m

Unit 3 Self-Quiz, pp. 432–433

1. T	10. T	19. (a)
2. F	11. F	20. (b)
3. F	12. F	21. (a)
4. T	13. T	22. (d)
5. T	14. F	23. (e)
6. T	15. (b)	24. (c)
7. F	16. (b)	25. (a)
8. T	17. (c)	26. (c)
9. F	18. (d)	

27. (a) field
    (b) inverse square
    (c) magnetic
28. (a) perpendicular
    (b) coaxial
    (c) electric potential energy
    (d) energy, momentum
29. parabolic, circular
30. decrease in magnitude, increases, increases or decreases

Unit 3 Review, pp. 434–437

2. (a) 1.1×10^{3} N [toward the negative charge]
   (b) 3.7×10^{2} N [toward the negative charge]
   (c) 1.6×10^{7} N/C [away from the positive charge]
   (d) 6.6×10^{6} N/C
   (e) 0.49 m
4. 5.8×10^{-7} N [toward the nucleus]
7. 6.7×10^{3} N/C
9. 5.3×10^{7} m/s
11. (a) 2.8×10^{-12} N
12. 3.1 A
13. (a) 3.2×10^{-9} T [down]
    (b) 0 T
14. 3.1 A
15. 1.18 A, 2.36 A
16. (a) 6.0×10^{4} m/s
    (b) 4.1×10^{-2} m
17. 2.0×10^{-4} T [down], 2.5×10^{-5} T [up]
19. (a) 58 A [in opposite directions]

Chapter 9

Section 9.1 Questions, p. 452

1. (a) 24°
   (b) 3.8 cm
2. (a) 24 cm/s, 18 cm/s
   (b) 1.3
3. (a) 44°
   (b) 1.1
   (c) 5.4 cm
4. 22 cm/s, 13 cm/s
5. 34°
6. 19.9°
8. 67°
9. 24°

Section 9.2 Questions, p. 454

3. 6.3×10^{-4} m

Section 9.3 Questions, p. 460

3. 2
5. 2.0 cm, 12 cm/s
7. 1.25 m
8. 1.0 cm, 1.0 cm, 1.0 cm
9. (a) 169 Hz
   (b) 8.00 m, 10.00 m, 12.00 m
   (c) 4th
11. (a) due north, N49°E, N49°W
    (b) N49°E, N49°W

Section 9.4 Questions, p. 468

5. 4.50×10^{8} m/s

Section 9.5 Questions, p. 475

5. 16
6. (a) 4.2×10^{2} nm
   (b) 8.0×10^{-3} m
7. (a) 5.4×10^{-7} m
   (b) 4.4×10^{-4} m
8. 4.4×10^{-7} m
9. 1.1°, 2.2°, 3.3°

Section 9.6 Questions, p. 479

3. 5.4×10^{-7} m
4. 7.50×10^{14} Hz to 4.00×10^{14} Hz
5. 1.0°
6. 1.2×10^{-5} m

Chapter 9 Self Quiz, pp. 488–489

1. F	9. F	17. (d)
2. T	10. F	18. (c)
3. F	11. (b)	19. (c)
4. F	12. (d)	20. (c)
5. F	13. (a)	21. (a)
6. F	14. (d)	22. (d)
7. T	15. (b)	23. (e)
8. F	16. (e)	

Chapter 9 Review, pp. 490–491

3. 0.88
8. 1.92
9. 13.4°
10. 5.9×10^{-7} m
11. 6.6×10^{-7} m
12. 3.8 mm
13. 15.4 cm
15. (a) 1.3×10^{-4} m
    (b) 0.43°
16. 6.6×10^{-7} m
17. 12 nm
18. 631 nm
19. 621 nm
20. 28 mm
21. 2.4 mm
26. 17°
27. (b) 26 cm
28. 9.7 km
29. 2.8×10^{-5} m
30. 7 cm
31. 25 m/s
32. 8.3 MHz

Chapter 10

Section 10.2 Questions, p. 507

2. 5.41×10^{-7} m
3. 5.57×10^{-5} m
4. 6.34×10^{-7} m
5. (a) 9.2°
   (b) 18.4 cm
6. 12.2°
7. 63.3 cm
8. 3.5×10^{-5} m
9. (a) 9.0°
   (b) 12

Section 10.3 Questions, p. 511

2. 6.5°
3. 518 nm, 593 nm, 737 nm
4. 10.0°
5. 9.00×10^{3} lines/cm
7. 1.10

Section 10.4 Questions, p. 519

3. 112 nm, 225 nm
4. (a) 104 nm
   (b) 207 nm
5. 6.0×10^{-7} m
6. 3.0×10^{-3} cm
7. 94.8 nm

Section 10.5 Questions, p. 524

3. 3.90×10^{-6} m
4. 199 nm
5. 103 nm
6. 380 nm
7. 1.30×10^{2} nm

Section 10.7 Questions, p. 529

2. 8.36×10^{-5} m
3. 5.21×10^{-7} m
4. 171 nm
5. 719 nm

Section 10.8 Questions, p. 539

1. (a) 1.67×10^{10} Hz
   (b) 9.38×10^{-3} m
   (c) 5.00×10^{6} m
   (d) 4.62×10^{14} Hz
2. 0.12 s
3. 42°

Chapter 10 Self Quiz, p. 545

1. F	5. T	11. (c)
2. (a) F	6. F	12. (c)
(b) T	7. T	13. (d)
(c) T	8. T	14. (d)
3. F	9. F	15. (e)
4. T	10. (d)	16. (e)

Chapter 10 Review, pp. 546–547

2. 6.2×10^{-7} m
3. 1.3×10^{-6} m
4. 6.00×10^{-7} m
5. 8.3×10^{-5} m
6. (a) 1.28×10^{-6} m
   (b) 589 nm
7. 46.1°
8. 69.4 cm
9. 3.9×10^{-6} m
10. 596 nm
11. 1.70×10^{5} lines/cm
14. 1.14×10^{-7} m, 8.02×10^{-8} m
15. 222 nm
16. 1.10×10^{2} nm, 329 nm
17. 218 nm
18. 7.10×10^{2} nm
19. 6.9×10^{-5} cm
20. 97.8 nm
22. (a) 3.5×10^{-5}°
    (b) 56°
24. 1.13×10^{5} Hz
29. (a) 28.5°
    (b) 45.7°
30. 4.86×10^{-7} m, 3
31. 73

Unit 4 Self Quiz, pp. 550–551

1. T	9. (e)
2. T	10. (c)
3. F	11. (e)
4. T	12. (d)
5. T	13. (d)
6. F	14. (b)
7. T	15. (b)
8. F	16. (e)

17. period
18. source
19. $\frac{\lambda}{w}$

20. nodal
21. out of phase, wavelength
22. medium
23. transverse
24. greater
25. $\sin\theta_n = \frac{n\lambda}{w}$
26. greater
27. larger
28. **Matching** (See Table 1 below.)

Unit 4 Review, pp. 552–555

2. 259 nm
4. (a) 2.4 cm
   (b) 24 cm/s
5. (a) 3.0 cm
   (b) 2.5 Hz
7. (a) 6.7×10^{-7} m
8. 16.6:1
9. 5.70×10^{-7} m
10. 1.15×10^{-5} m
11. 6.65 mm
12. 5.2×10^{14} Hz
13. 1.9 cm
14. 8.20×10^{-4} m
15. 0.66 mm
16. 3.00×10^{-4} m
20. 6.5×10^{-7} m
21. (a) 0.21°
    (b) 22°
22. 4.20×10^{-3} m
23. (a) 33°
24. 6.3×10^{-6} m
25. 32 mm
26. 5.3 mm
27. 0.5
30. 35 cm
31. 5.74×10^{-7} m
32. (b) 3.33×10^{-7} m
33. 5.30×10^{-7} m, 7.77×10^{-7} m
34. 90.6 nm
35. 102 nm
36. 183 nm, 366 nm
37. 1.93×10^{-7} m
38. 596 nm
39. (d) 442 nm
40. 1.18×10^{-5} m
41. 283
42. 3.3×10^{-5} m
43. 5.89×10^{-4} m
46. 11.7 cm
50. 13 m
51. (a) 1.0×10^{4} m, 6.7×10^{3} m
    (b) 1.1×10^{-2} m,
    1.1×10^{-2} m
52. 3.0 cm
53. 6.67×10^{3}
54. 1.2×10^{-7} m
55. 9.1×10^{-4} m

Chapter 11

Section 11.2 Questions, p. 579

6. (a) 1.6×10^{-5} s
   (b) 6.5×10^{2} m
   (c) 92 m
7. 42 a
8. 115 m
9. (a) 66.7 m
   (b) 1.2×10^{6} m
   (c) 4.8 s
10. (b) 0.436 m^3
    (c) 1.67×10^{12} kg·m/s
11. 8.71×10^{-9} kg·m/s
12. (a) 0.89c
    (b) 0.40c
    (c) 0.10 c to 0.15 c

Section 11.3 Questions, p. 584

2. 9.0×10^{16} J
3. 2.91×10^{16} kg
4. 1.8 kg
5. 1.95×10^{-10} J
6. (a) 2.84×10^{-30} kg
   (b) 1.60 MeV
7. $\$3.8 \times 10^{9}$
8. 8.36×10^{6} km
9. 24 MeV

Chapter 11 Self Quiz, pp. 588–589

1. F
2. T
3. T
4. (a) T
   (b) F
   (c) T
5. F
6. F
7. (a) T
   (b) T
8. T
9. T
10. F
11. F
12. (d)
13. (c)
14. (d)
15. (a)
16. (b)
17. (e)
18. (a)
19. (a)
20. (b)
21. (d)
22. (b)
23. (a)

Table 1 (for Unit 4 Self Quiz question 28)

Scientist	Discovery or Innovation
Gabor	holography
Grimaldi	diffraction of light at two successive slits
Hertz	creation and detection of radio waves
Huygens	wavelet model for propagation of wave fronts
Land	commercially viable polarizing filters
Maxwell	mathematical theory of electromagnetic waves
Marconi	transmission of radio signals
Michelson	interferometer
Newton	particle theory of light
Poisson	diffraction of light around a small disk
Young	two-slit interference

Chapter 11 Review, pp. 590–591

8. 123 m
9. 2.28×10^{3} km
10. 523 m
11. 1.4
12. 1.58×10^{-30} kg·m/s
13. 8.7×10^{-30} kg
14. 1.05 kg
15. 0.615 MeV
16. 1.0 MeV
17. (a) 6.49×10^{5} J
    (b) 1.4:1
18. 1.39×10^{20} stars
19. (a) 1.13×10^{27} kg
    (b) 5.75×10^{-5}:1
20. (a) 1.1×10^{16} kg
    (b) 1.1×10^{13} m^3
21. (a) 2.06×10^{4} months
    (b) 4.30×10^{3} homes
24. 1.34×10^{-21} kg·m/s
25. 0.87c
26. 0.943c
27. 1.80×10^{8} m/s

Chapter 12

Section 12.1 Questions, pp. 608–609

8. 1.63×10^{-18} J, 10.2 eV
12. 1.1×10^{15} Hz
13. 2.00×10^{2} nm
14. 1.38 eV
15. (a) 1.5×10^{15} Hz
    (b) 9.9×10^{-19} J, 6.2 eV
    (c) 3.3×10^{-27} kg·m/s
16. (a) 2.65×10^{-25} kg·m/s
    (b) 2.91×10^{5} m/s
    (c) $E_{\text{K electron}} = 3.86 \times 10^{-20}$ J,
    $E_{\text{photon}} = 7.96 \times 10^{-17}$ J
17. 2.36×10^{-9} eV,
    4.23×10^{-7} eV
20. 1.85×10^{16} photons
21. (a) 2.0×10^{-23} J
    (b) 4.2×10^{27}

Section 12.2 Questions, p. 620

4. (a) 2.6×10^{-11} m
   (b) 6.1×10^{-10} m
   (c) 9.1×10^{-16} m
5. 5.49×10^{-12} m
6. 3.3×10^{-24} kg·m/s,
   1.1×10^{-32} kg
7. 6.6×10^{-26} kg
8. 5.5×10^{-10} m
9. (a) 5.29×10^{-15} m
   (b) 4.70×10^{-12} J
   (c) 2.94×10^{7} eV
10. 1.5×10^{4} eV

Section 12.3 Questions, p. 625

3. 4.4×10^{-40}:1
4. 5.1×10^{-14} m
5. 6.1×

Section 12.4 Questions, p. 638

6. 543 nm
7. (a) 1.25×10^{-4} J
   (b) 3.98×10^{14} photons

Section 12.5 Questions, p. 649

2. (a) 12.1 eV
   (b) 12.1 eV, 10.2 eV, 1.9 eV
3. 3.4 eV
4. 412 nm, 7.3×10^{14} Hz
5. 4
6. (a) 3.32×10^{-10} m
7. 5.2×10^{-9} N

Section 12.6 Questions, p. 653

3. (a) 3.07×10^{-34} m
   (b) $\pm 1.76 \times 10^{-32}$ kg·m/s

Chapter 12 Self Quiz, pp. 659–660

1. F
2. T
3. F
4. T
5. F
6. F
7. T
8. F
9. T
10. T
11. F
12. (d)
13. (b)
14. (c)
15. (b)
16. (a)
17. (e)
18. (d)
19. (d)
20. (e)
21. (d)
22. (d)
23. (a)
24. (b)

Chapter 12 Review, pp. 661–663

4. 5.04×10^{-7} m
5. 1.0×10^{-19} J, −0.64 eV
6. 1.67 eV
7. 1.62×10^{-27} kg·m/s
8. 2.68 eV
9. 1.00×10^{-11} m
10. 582 nm
11. (a) 2.88×10^{-10} m
    (b) 2.88×10^{-10} m
21. 64×
24. 2.1×10^{-10} m
25. (a) 2.8×10^{17} photons
    (b) 9.3×10^{8} photons/cm^3
29. (a) 2.7 eV
    (d) 6.6×10^{-34} J·s
30. 547 nm
34. 4.8×10^{-23} kg·m/s
35. 2.33×10^{2}:1
36. 9.1×10^{-9} m
37. 2.7×10^{-6}:1

Section 13.1 Questions, p. 676

1. See Table 1 below.
2. (a) ^4_2He, α decay
   (b) $^0_{-1}\text{e}$, β decay
   (c) ^4_2He, α decay
   (d) $^0_{-1}\text{e}$, β decay
   (e) $^0_{-1}\text{e}$, β decay
   (f) $^0_{-1}\text{e}$, β decay
   (g) ^4_2He, α decay
   (h) ^4_2He, α decay
3. (a) $x = 82, y = {}^0_{-1}\text{e}$
   (b) $x = 214, y = 84$
   (c) $x = 226, y = 88$
   (d) $x = {}^4_2\text{He}$
   (e) $x = {}^3_1\text{He}$
   (f) $x = 141$
6. $E = 1.02 \times 10^8$ eV
   $E_n = 7.30 \times 10^6$ eV
7. (a) ${}^{14}_6\text{C} \rightarrow {}^{14}_7\text{C} + {}^0_{-1}\text{e} + \bar{\nu}$
   (b) 1.56×10^5 eV

Section 13.2 Questions, p. 686

1. (a) 3.8×10^8 Bq
   (b) 1.5×10^{10} a
2. $t_{1/2} = 3.8$ h
3. 6.47×10^8 a
4. 1.24×10^4 a

Section 13.3 Questions, p. 698

3. (a) 2.0×10^7 m
   (b) 0.067 s

Section 13.4 Questions, p. 704

5. (a) β decay
   (b) W boson and Z boson
8. (a) electromagnetic, weak, gravity
   (b) electromagnetic, weak, gravity
   (c) weak, strong, gravity
   (d) electromagnetic, weak, strong, gravity
   (e) weak
9. 2.5×10^{-18} m to 2.2×10^{-18} m

Section 13.5 Questions, p. 712

1. (a) anti-kaon (K^-)
   (b) pi minus (π^-)
   (c) sigma zero (Σ^0)
   (d) sigma plus (Σ^+)
7. (a) $u\bar{s}$
   (b) uds

Section 13.7 Questions, p. 732

10. 2.0×10^{28} eV;
    2.0×10^{17} eV

Chapter 13 Self Quiz, p. 375

1. T	7. F	12. (d)
2. F	8. F	13. (a)
3. T	9. F	14. (a)
4. F	10. (b)	15. (e)
5. T	11. (c)	16. (c)
6. T		

Chapter 13 Review pp. 736–737

2. (a) $x = 212, y = 82$
   (b) $x = 234, y = 90$
   (c) $x = 82$
   (d) $x = 49, y = 16$
   (e) $x = +1, y = 0, z = e$
   (f) $x = 6, y = 13, z = C$
5. (a) ${}^{239}_{94}\text{Pu} \rightarrow {}^{235}_{92}\text{U} + {}^4_2\text{He}$
   (b) 5.24 MeV
6. (a) 4.61 mg
   (b) 23 h
7. 1382 a
20. (a) 7.3×10^8 C/kg
    (b) 2.2×10^{-28} kg
26. (b) 35 h
31. (a) 1876.6 MeV/c^2
    (b) 2.165823 u
    (c) 0.151271 u,
    1.62×10^{-4} MeV, or
    1.2×10^{18} J

Unit 5 Self Quiz, pp. 740–741

1. T	10. T	19. (a)
2. F	11. F	20. (a)
3. T	12. F	21. (a)
4. T	13. T	22. (e)
5. F	14. F	23. (a)
6. T	15. T	24. (b)
7. F	16. T	25. (e)
8. T	17. (a)	
9. F	18. (c)	

26. inertial, noninertial
27. ether does not exist
28. length
29. rest mass
30. quanta
31. different
32. lower
33. probability
34. 0, 1.0
35. heated solid, electrically excited gases
36. not deflected
37. decreases, increases, decreases
38. 400 a
39. spin
40. **Matching** (See table below.)

Unit 5 Review, pp. 742–745

5. 1.74×10^{-6} s
6. (a) 12:49 P.M., 1:06 P.M.
   (b) 7.9×10^8 km
   (c) 2.6×10^{16} J
7. 99.1 m
8. 3.8×10^{-19} kg·m/s
9. 4.73×10^{-22} kg·m/s
10. (a) 3.8×10^{-6} s
    (b) 7.1×10^{-22} kg·m/s
12. 3.1×10^{-9} kg
13. 2.1×10^{-8} kg
14. 1.42×10^{-15} J
16. 3.33:1
17. 622 nm
21. (a) 1.21×10^{15} Hz
    (b) -3.28 V
22. 0.27 eV
23. 2.30 eV
24. 6.2×10^5 m/s
27. 1.26×10^{-27} kg·m/s
28. 9.9×10^{-27} kg·m/s
29. 9.86×10^{-24} kg·m/s
30. (a) 0.4 eV
    (b) 1.4×10^8 m/s
    (c) 1.1×10^{-22} kg·m/s
31. 7.3×10^{-10} m
32. (a) 3.0 eV
    (b) 3.1 eV, 1.3 eV, 8.0 eV
34. (a) 12.1 eV
    (b) 2.55 eV
37. (a) $x = 9, y = 15$, Z = N
    (b) $x = 90, y = 222$, Z = Rn
    (c) $x = 2, y = 4$, Z = He
    (d) $x = 83, y = 214$, Z = Tl
    (e) $x = 93, y = 239$, Z = Np
38. 8.762 MeV/nucleon
39. $x = 82, y = 210$, Z = Pb,
    $q = 2, r = 4$, S = He
41. 30 a
42. (a) 1.25×10^{12} Bq
    (b) 2.22×10^{12} Bq
43. 2.10×10^3 a
44. 3.62×10^3 a
45. 69 Bq
64. 6.67×10^{20} photons
65. 4.5×10^{43} photons
69. (b) 9.5×10^2 MeV/c^2
    (c) n^0 particle

Matching (for Unit 5 Self Quiz question 40)

α-scattering experiment	Rutherford
radioactivity	Becquerel
diffraction of particle	Davisson
energy levels in the hydrogen atom	Bohr
energy levels in an excited gas	Frank
matter waves	de Broglie
particle classification	Gell-Mann
momentum of a photon	Compton
photoelectric effect	Einstein
planetary model of the atom	Rutherford
quanta	Planck
uncertainty	Heisenberg

Table 1 (for Section 13.1 question 1)

Type of Emission	Mass	Charge	Speed	Penetrating Power	Ionization Ability
α	6.68×10^{-27} kg	2+	up to 6.67×10^7 m/s	5 cm of air	yes
β	9.31×10^{-31} kg	β^- negative β^+ positive	6.67×10^7 m/s to 3×10^8 m/s	3–6 mm of aluminium	yes
γ	none	none	3×10^8 m/s	30 cm of lead	yes