

These pages include numerical and short answers to chapter section questions and Chapter Self-Quiz, Chapter Review, Unit Self-Quiz, and Unit Review questions.

Unit 1

Are You Ready?, pp. 4–5

- (a) m
(b) s
(c) m/s
- (a) 18 m
(b) 24 m
(c) 17 m
- (a) 56°
(b) 74°
(c) 56°
- (a) 0.45963 km
(b) 23 m/s
(c) 100.0 km/h
(d) 3.1557×10^7 s
- (a) $a = 21$, $b = 7.3$
(b) $c = 23$, $d = 19$
(c) $e = 70$, $f = 57$

1.1 Questions, p. 13

- 51 m [W]
- 191 km [E]
- (a) 13 m [W]
(b) 7.0 m [W]
(c) 21 m [N]
(d) 0.0 km

1.2 Questions, p. 20

- 3 m/s [W]
- 38 m [S]
- 0.58 s
- 497 m/s [S]

1.3 Questions, p. 30

- (a) 4.0 m/s^2 [E]
(b) 3.5 m/s^2 [E]
(c) 0.30 m/s^2 [E]
- 1.3 m/s^2 [W]
- 0.40 s
- (a) 16.6 m/s [N]
- 140 m/s²

1.5 Questions, p. 39

- 2.3×10^2 m [N]
- (a) 1.7 m/s^2 [W]
(b) 1.2×10^2 m [E]
- 13 m/s [E]
- A wins by 27 s.
- 0.31 m/s^2
- (a) 56 m/s^2 [up]
(b) 2.2×10^2 m/s [up]

1.6 Questions, p. 43

- (a) 9.8 m/s^2 [down]
(b) 9.8 m/s^2 [down]
(c) 9.8 m/s^2 [down]
- (a) 0.55 s
(b) 3.8 m/s [down]
- (a) 3.3×10^2 m
(b) 8.2 s
(c) 16 s
- 24 m/s [down]

Chapter 1 Self-Quiz, p. 51

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

Chapter 1 Review, pp. 52–57

- (b)
- (c)
- (d)
- (d)
- (a)
- (c)
- (a)
- (d)
- (c)
- F
- F
- T
- F
- F
- T
- (a) v
(b) i
(c) vi
(d) ii
(e) iii
(f) iv
- 2000 m [W]
- 1750 m [E]
- 4500 m [E]
- 750 m [W]
- 130 km [E]
- 63 m/s
- 45 m
- 39 m/s [S]
- 14 m/s [E]
- 270 s
- 997 m
- 4.0 m/s^2 [E]
- 13 m/s [W]
- 2.74 ms
- 86 km/h [S]
- 5.9 m/s
- 12 m [E]
- 17 m [W]
- (a) $\vec{v}_f^2 = \vec{v}_i^2 + 2a\Delta d$
(b) 4.3 m/s [down]
- (a) 1.4 s
(b) 14 m/s [down]
- (b) 580 m [E]
- (b) 18 m [S]
- 2.0 m/s [E]
- 24 m/s [N]
- 19 m/s [W]

- 12 h
- 12 min
- 8.3 m/s^2
- 1.3 s
- 10.6 m/s^2 [up]
- 0.94 m/s^2
- (a) From 0 s to 3.0 s,
 $\vec{a} = 0.33 \text{ m/s}^2$ [E].
From 3.5 s to 5.0 s,
 $\vec{a} = 0 \text{ m/s}^2$.
(b) 4.5 m [E]
- (a) 14 m/s [S]
(b) 20 m/s [S]
- (a) about -2.5 m [E]
- (a) 4.0 s
(b) 90 m
- 0.79 m/s^2
- (a) 160 m [forward]
(b) 100 km/h [forward]
- 43 m
- (a) 25 m
(b) 4.5 s
- (a) 2.0 m/s^2 [S]; -3.0 m/s^2 [S]
 $d = 21$ m
(e) $\vec{d} = 9.0$ m [S]
- (a) 1.0 s and 5.0 s

2.1 Questions, p. 65

- 350 m [S 31° E]
- 26 km [N 67° E]
- 27 m [E 27° S]
- (a) 9.5 m/s [E 69° S]
(b) 11 m/s
- (a) 87 km [N]
(b) 5.2×10^2 km/h [N]

2.2 Questions, p. 75

- (a) 13 km [W], 15 km [N]
(b) 2.6 km [W], 15 km [S]
(c) 36 km [E], 17 km [N]
- 15 km [E 70° N]
- 16 m [N 51° E]
- 52.23 m [S 11° W]
- 1.0×10 m [S 3° E]
- (a) 11 km [W 36° N]
(b) 37 m [E 30° N]
- 15 m [N 32° W]
- (a) 5.9 h
(b) 12 km
- 3.3 s, 4.2 m/s [N 17° E]

2.3 Questions, p. 81

- 20 m, 2.00 s
- (a) 90°
(b) 45°
- (a) 2.3 s
(b) 3.9 s
- The golfer was 41 m from the hole. The maximum height of the ball was 10 m.
- 7.2 m

Chapter 2 Self-Quiz, p. 89

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

Chapter 2 Review, pp. 90–95

- (b)
- (d)
- (b)
- (a)
- (b)
- (c)
- (c)
- (a)
- (a)
- F
- T
- F
- F
- F
- T
- F
- T
- F
- (a) ii
(b) i
(c) iv
(d) v
(e) iii
- (a) 17 m [E 63° N]
(b) 79 cm [W 56° S]
(c) 44 km [N 27° W]
- (a) 1 cm : 50 m
(b) 1 cm : 150 km
(c) 1 cm : 500 m
- (a) 566 m [N 72° W]
(b) 37 cm [S 22° E]
(c) 7150 km [W 52° S]
- (a) $\Delta \vec{d}_x = 16$ m [W]
 $\Delta \vec{d}_y = 49$ m [S]
(b) $\Delta \vec{d}_x = 37$ km [E]
 $\Delta \vec{d}_y = 9.2$ km [N]
(c) $\Delta \vec{d}_x = 91$ m [W]
 $\Delta \vec{d}_y = 13$ m [S]
- (a) 5.8 m [W 30° S]
(b) 19 m [E 16° N]
(c) 71 km [W 26° N]
- 5.4 m
- 6.3 m
- 8.1 m
- 31 m [W 84° S]
- (a) 18 s
(b) 6.5 m/s [W 18° N]
(c) 110 m

39. $v_x = 9.6 \text{ m/s}$
 $v_y = 11 \text{ m/s}$
40. (a) 0.52 s
 (b) 2.2 m
41. (a) 26.2 m/s
 (b) 70.0 m
46. (b) 4.5 min
47. 1460 m [N 59° W]
48. 3260 m [W 57.5° S]
49. (a) 6.0 min
 (b) 18 km/h [W 45° S]
50. 7.14 min
51. $8.0 \times 10^2 \text{ m}$ [N];
 boat is travelling [N 43° E]
52. 25 m
53. $2.0 \times 10^1 \text{ m/s}$ [N 34° W]
54. 3.7 m/s
55. (a) [N]
 (c) [N 17° W]
 (d) 14 s
56. (a) 0.74 m
 (b) 5.1 m/s
 [73° above horizontal]
57. (a) 1.9 s
 (b) 26 m
 (c) 4.6 m
58. (a) 13 m/s
 (b) 53°

Unit 1 Self-Quiz, pp. 98–99

- | | | |
|---------|---------|-------|
| 1. (c) | 14. (d) | 27. F |
| 2. (b) | 15. (c) | 28. F |
| 3. (c) | 16. (b) | 29. F |
| 4. (b) | 17. (c) | 30. F |
| 5. (b) | 18. (c) | 31. T |
| 6. (d) | 19. F | 32. F |
| 7. (c) | 20. F | 33. F |
| 8. (b) | 21. T | 34. F |
| 9. (b) | 22. F | 35. F |
| 10. (a) | 23. F | 36. T |
| 11. (b) | 24. F | 37. F |
| 12. (a) | 25. T | 38. T |
| 13. (c) | 26. T | 39. T |

Unit 1 Review, pp. 100–107

- (c)
- (c)
- (b)
- (d)
- (b)
- (c)
- (d)
- (b)
- (d)
- (b)
- (b)
- T
- T
- F
- T
- F
- F
- F
- F
- T
- T
- F
- T

- (a) vii
 (b) iv
 (c) v
 (d) ii
 (e) iii
 (f) i
 (g) vi
- 1500 m [W]
- 5870 m [W]
- 1750 m [E]
- 185 m [E]
- 65 m/s
- 29 m/s [E]
- 9.1 m/s [E]
- 1000 m
- 1.8 m/s²
- 15.6 m/s
- $1.13 \times 10^{-2} \text{ s}$
- 12 m [E]
- 1.7 s
 (b) 17 m/s
- (a) 86 m [N 82° E]
 (b) 97 cm [S 67° E]
 (c) 3190 km [W 22° S]
- 1400 m
- 2.6 m [N 18° E]
- (a) $d_x = 20 \text{ m}$ [W]
 $d_y = 80 \text{ m}$ [S]
 (b) $d_x = 33 \text{ m}$ [E]
 $d_y = 7.6 \text{ m}$ [N]
 (c) $d_x = 41 \text{ m}$ [W]
 $d_y = 88 \text{ m}$ [S]
- (a) $d_T = 4.4 \text{ m}$ [W 25° S]
 (b) $d_T = 7.8 \text{ m}$ [E 76° N]
 (c) $d_T = 74 \text{ m}$ [W 12° N]
- $d_T = 32 \text{ m}$ [W 41° S]
- (a) $3.2 \times 10^2 \text{ s}$
 (b) 0.9 m/s [S 13° E]
 (c) $2.9 \times 10^2 \text{ m}$
- $v_x = 10 \text{ m/s}$
 $v_y = 19 \text{ m/s}$
- (a) 0.49 s
 (b) 2.6 m
- 5.0 m/s^2 [down]
- (a) 3.87 s
 (b) 78.0 m
- (a) 166 m
 (b) 29.3 m/s or 105 km/h
- 917 m [N], $d_T = 1550 \text{ m}$ [N 53.8° E]
- 23 m
- (a) 3.7 s
 distance travelled = 76 m
 maximum height = 17 m
 (b) 18 m/s, 60°

Unit 2

Are You Ready?, pp. 110–111

- (a) 1.6 m/s^2 [E]
 (b) 7.9 m/s [down]
 (c) 1.1 m/s^2 [N]
 (d) 1.6 m/s^2 [E], 13.6 m/s [W]

3.1 Questions, p. 122

- (a) 20 N [down]
 (b) 610 N [down]
- (a) 21 N [up]
 (b) 6.0 N [left]
 (c) 0 N

3.2 Questions, p. 129

- (a) $F_1 = 17 \text{ N}$ [right]
 $F_2 = 32 \text{ N}$ [up]
 (b) $F_1 = 26 \text{ N}$ [right]
 $F_2 = 54 \text{ N}$ [down]

3.3 Questions, p. 136

- (a) 120 N [forward]
 (b) 28 N [up]
- (a) 4800 m/s^2 [E]
 (b) 150 m/s^2 [forward]
- (a) 1200 kg
 (b) 5.5 kg
- 130 N [downhill]
- 1.5 kg
- (a) 150 N [up]
 (b) 2.6 m/s^2 [up]
- 3.0 m/s^2
- (b) 5900 N [E]
- (a) 2.4 m/s^2 [left]
- 3.4 s

3.4 Questions, p. 141

- (b) 0.24 N [E] for toy car
 0.24 N [W] for the ball
- (a) 0.82 m/s^2 [W] for skater 1
 1.1 m/s^2 [E] for skater 2
- (a) 0.20 m/s^2 [left] for male astronaut
 0.25 m/s^2 [right] for female astronaut

3.5 Questions, p. 147

- (a) 65 N
 (b) 65 N
 (c) 65 N
- (a) 260 N
 (b) 1700 N [forward]
- 7.7 s
- (a) 650 N [forward]
 (b) 650 N [forward]
 (c) 1900 N [forward]
 (d) 330 N [backwards]
- 2.4 s
- (a) 1.5 m/s^2 [forward]
 (b) force sensor 1: 3.3 N
 force sensor 2: 3.3 N
 force sensor 3: 7.1 N
 force sensor 4: 7.1 N
 force sensor 5: 9.8 N
 force sensor 6: 9.8 N
 (c) 20 N [forward]
- 0.56 m/s^2 [forward]
- (a) 11 m/s
 (b) 10 m/s
 (c) 82 m

Chapter 3 Self Quiz, p. 153

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

Chapter 3 Review, pp. 154–159

- (c)
- (a)
- (d)
- (d)
- (d)
- (b) 2.4 kg
- (a) 48 N
 (b) 12 N
- (a) 125 N
 (b) 100 N
- (a) 1.6 m/s^2
 (b) 120 N
 (c) 120 N
- (b) 1.8 m/s^2 for the girl
 0.83 m/s^2 for the raft
- (b) 1.2 m/s^2 [right] for the boy
 1.3 m/s^2 [left] for the girl

62. (b) 90 N (c) 110 kg
 63. (a) 1.4 m/s^2 (c) 9 kg
 64. (a) 0.2 m/s^2 [left] for male;
 0.25 m/s^2 [right] for female
 65. (a) $1.4 \times 10^5 \text{ N}$
 (b) $6.4 \times 10^4 \text{ N}$
 66. (a) 290 N on string A;
 120 N on string B
 (b) 340 N on string A;
 120 N on string B
 (c) 340 N on string A;
 160 N on string B
 67. 4.4 N for string A, 6.9 N for
 string B, 11 N for string C
 68. 5 N for string A, 11 N for
 string B, 15 N for string C,
 1.2 m/s^2 [right]
 69. 9 N for string A, 20 N for
 string B, 24 N for string C
 70. (a) 54 N
 (b) $1.10 \times 10^2 \text{ N}$
 (c) 9.37 m

4.1 Questions, p. 167

5. (a) 74 kg
 (b) 89 N
 6. (a) 1.03 N
 7. (b) 310 N
 (c) 1.627 N/kg [down]
 10. (a) 240 N
 (b) 290 N
 (c) 160 N

4.2 Questions, p. 172

3. (a) $\mu_s = 0.40$, $\mu_k = 0.30$
 5. (a) 0.35
 (b) 330 N
 (c) 570 N
 7. (a) 59 000 N
 (b) 47 000 N

4.3 Questions, p. 178

1. (a) 450 N
 (b) 1300 N
 2. (a) 1.4
 3. (a) 0.40
 (b) 12 N
 (c) $F_{\text{Smax}} = 37 \text{ N}$, $F_T = 18 \text{ N}$
 4. (a) 0.30
 5. (a) 18 N
 (b) 86 washers
 (d) 0.75 m/s^2 [right]
 6. (a) 0.84
 (b) 0.76
 7. (a) 0.21
 (b) 0.89 s
 8. (a) i) 2.9 m/s^2 [forward]
 ii) 5.8 m
 iii) 0.39
 9. 46 N
 10. 0.11

Chapter 4 Self Quiz, p. 197

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

Chapter 4 Review, pp. 198–203

1. (c)
 2. (b)
 3. (a)
 4. (d)
 5. (a)
 6. (b)
 7. (d)
 8. (c)
 9. (c)
 10. (d)
 11. (c)
 12. (a) iii
 (b) i
 (c) iv
 (d) ii
 20. (d) 250 N
 24. (b) 9.78 N/kg
 28. 490 N
 29. (a) 58 kg
 (b) 74 kg
 (c) 36 kg
 31. (c) 74 N
 33. (a) 0.22
 34. (a) 12 N
 (b) 6.3 N
 36. 17 N
 37. (a) 190 N
 (b) 130 N
 38. 0.68
 45. 0.30
 49. (a) 38 kg
 (b) 0.41
 50. (a) 1.25 m/s^2 for sled team 1
 1.18 m/s^2 for sled team 2
 51. (a) 0.5 m/s^2
 (b) 8.3 m/s^2

Unit 2 Self Quiz, pp. 206–207

1. (a) 13. (b) 25. F
 2. (a) 14. (c) 26. T
 3. (a) 15. (c) 27. F
 4. (b) 16. (c) 28. T
 5. (a) 17. F 29. F
 6. (c) 18. F 30. F
 7. (b) 19. F 31. F
 8. (c) 20. T 32. T
 9. (c) 21. F 33. T
 10. (d) 22. F 34. F
 11. (c) 23. T 35. T
 12. (c) 24. T 36. F

Unit 2 Review, pp. 208–215

1. (b)
 2. (a)
 3. (a)
 4. (b)
 5. (a)
 6. (a)
 7. (b)
 8. (d)
 9. (c)
 10. (a)
 11. (c)
 12. (a)
 13. (a)
 14. F
 15. F
 16. F
 17. T
 18. F
 19. F
 20. T
 21. F
 22. F
 23. T
 24. T
 25. (a) iv
 (b) ii
 (c) vi
 (d) v
 (e) i
 (f) iii
 31. 40 800 N
 34. 78 N
 36. (a) 160 N [forward]
 (b) 4.2 N [down]
 37. (a) 2.0 m/s^2 [N]
 (b) 3.44 m/s^2 [up]
 38. 0.23 N [opposite direction
 of motion]
 39. $5.5 \times 10^4 \text{ m/s}^2$
 40. (a) 3.3 m/s^2
 (b) 3.1 m/s^2
 (c) 1.3 N
 42. (a) 0.48 m/s^2
 43. (a) 4.9 N
 (b) 5.3 N
 (c) 4.4 N
 44. (d) 2.2 N
 45. (b) 9.79 N/kg
 48. 22 N
 49. (c) 2100 N
 50. (a) 0.61
 51. (a) 5.2 N
 (b) 1.6 N
 52. (a) 0.40
 (b) 0.29
 53. 7.7 m/s^2
 54. 18 N
 55. 3.1 m
 60. 17 N
 61. 84 N
 62. (a) 0.50 m/s^2
 63. 0.03 m/s^2 [left]
 64. (a) 4.2 N
 (b) 420 N
 65. (a) 3.7 m/s^2
 (b) 670 N
 (c) 3200 N
 66. (b) 2.2 m/s^2 [right] for the
 jumpers
 1.3 m/s^2 [left] for the boat
 68. (a) 2.0 m/s^2 ; 8.0 N
 (b) 1.0 m/s^2 ; 8.0 N
 69. (a) 2.6 m/s^2
 (b) 11 N for rope A
 25 N for rope B
 70. (a) 250 N for box 1
 690 N for box 2
 (b) 190 N for box 1
 630 N for box 2
 (c) 250 N for box 1
 630 N for box 2
 71. 4.4 m/s^2
 72. (a) 50 kg
 (b) 0.49

73. 0.56 m/s^2 for team 1
 0.60 m/s^2 for team 2
 74. (a) 7.8 m/s^2
 (b) 0.74 m/s^2

Unit 3

Are You Ready?, pp. 218–219

1. (a) 12 m
 (b) 0 N

5.1 Questions, p. 229

1. 325 J
 2. (a) 18 kJ
 (b) -9.7 kJ
 (c) 0 J
 (d) 0 J
 3. (a) 830 J
 (b) 420 J
 4. (b) 21 N
 (c) -250 J
 5. (b) 12 kJ
 (c) -12 kJ
 6. 2 J
 7. (a) 9.9 m
 (b) The work done by gravity
 is -190 J . The work done
 by the rope is 240 J.
 (c) 44 J
 (d) 4.4 N; 44 J
 9. (a) The work done in section
 A is 10 J; section B is 2.5 J;
 section C is -2.5 J .
 (b) 10 J

5.2 Questions, p. 235

1. 11 m/s
 2. (a) 39 J
 (b) 32 N
 3. (a) 6.6 kJ
 (b) 11 m
 (c) 4.1 m
 (d) 0 J
 4. 240 J

5.3 Questions, p. 241

2. (a) 13 J
 (b) 21 m
 (c) 24 m/s
 3. 21 m

5.4 Questions, p. 249

1. 3800 J
 2. (a) 42 %
 3. 24 m/s

5.5 Questions, p. 254

1. (a) 5400 J
 (b) 170 W
 2. (a) 3.6 s; 890 W
 4. (a) 27 kWh
 (b) \$540

Chapter 5 Self-Quiz, p. 261

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

96. (a) 1000 years
(b) 0.8 g
97. 0.016 %
99. 17 days

Unit 4

Are You Ready?, pp. 374–375

7. 2.5 g/cm^3 or 2500 kg/m^3
20. (a) $c = \frac{da - a}{b - 1}$
(b) $c = \frac{a^2 - b^2}{-4a}$

8.4 Questions, p. 391

1. 0.53 m
2. 35 m/s
3. 0.408 m
4. $t_{\text{p-wave}} = 5.0 \text{ min}$
 $t_{\text{s-wave}} = 8.9 \text{ min}$
7. 4

8.5 Questions, p. 397

3. 1000 km/h
9. 1000 : 1

Chapter 8 Self-Quiz, p. 407

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

Chapter 8 Review, pp. 408–413

1. (b)
2. (c)
3. (d)
4. (a)
5. (c)
6. (b)
7. (c)
8. (a)
9. (b)
10. (d)
11. (d)
12. (c)
13. (a)
14. (a) iv
(b) ii
(c) v
(d) iii
(e) i
24. 3.57 Hz
25. 0.012 s
26. 2.07 m/s
28. (a) 25 %
(b) 75 %
(c) 50 %
(d) 0
29. 2.8 m/s
30. 78.0 cm
31. 0.113 kg/m
32. 0.27 kg
33. 31 m/s
34. 0.0625 kg/m

37. 340 m/s
38. 29.0 °C
40. 0.80
41. 518 km/h
48. 660 Hz
49. 0.031 kg
50. 16.6 N
51. 1.35 N
52. 1922 °C
53. 5.9 °C
54. 3200 km/h
60. (a) 41.8 m to 43.4 m

9.2 Questions, p. 426

5. 94 Hz
6. 290 Hz
7. 1.3 m

9.5 Questions, p. 435

3. 320 Hz
4. 22 m/s
5. approaching = 480 Hz
passing = 409 Hz
6. 58 m/s

Chapter 9 Self-Quiz, p. 441

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

Chapter 9 Review, pp. 442–447

1. (b)
2. (c)
3. (b)
4. (d)
5. (b)
6. (d)
7. (d)
8. (b)
9. (a)
10. (c)
11. (a)
12. (c)
13. (b)
14. (b)
15. (d)
16. F
17. F
18. T
19. T
20. F
21. F
22. F
23. F
24. T
25. T
26. T
27. F
28. F
29. T
30. T
31. (a) iii
(b) iv
(c) v
(d) i
(e) ii

32. (a) fixed
(b) free
(c) free
(d) fixed
38. (a) $f_1 = 142 \text{ Hz}$
 $f_2 = 426 \text{ Hz}$
 $f_3 = 709 \text{ Hz}$
(b) $f_1 = 146 \text{ Hz}$
 $f_2 = 437 \text{ Hz}$
 $f_3 = 728 \text{ Hz}$
39. 0.97 m
48. 3.2 Hz; 6.4 Hz; 9.6 Hz
49. 0.92 m or 30.6 cm
51. (a) 146 Hz
(b) 1.17 m
57. 16.5 Hz

10.2 Questions, p. 460

4. 170 Hz
5. (a) 1.2 m
(b) 240 Hz, 360 Hz
8. (i) 215 Hz
(ii) 211 Hz
9. (a) 0.41 m
(b) 0.21 m
10. (a) 92.0 cm; 120 cm; 152 cm
(b) 372 Hz; 285 Hz; 225 Hz

10.3 Questions, p. 463

1. 22 dB
2. 2.0 s

10.7 Questions, p. 474

2. max: 0.3 s; min: 7 ms
3. (b) 3.1 mm

Chapter 10 Self-Quiz, p. 479

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

Chapter 10 Review, pp. 480–485

1. (d)
2. (c)
3. (c)
4. (a)
5. (c)
6. (d)
7. (d)
8. (a)
9. (b)
10. F
11. T
12. F
13. F
14. (a) ii
(b) iii
(c) i
15. 1000 Hz to 5500 Hz
35. 2.50 m
36. (a) 0.328 m
(b) 335 Hz
37. 0.750 m
38. (a) 147 Hz
(b) 1.30 m
55. 3.0 kHz

57. (a) 221 Hz
(b) $f = \frac{\sqrt{F_T}}{2L}$
59. (a) $f = \frac{\sqrt{\mu}}{2L}$
(b) $F_T = 4f^2 Lm$
(c) 0.24 m
(d) 0.19 m
(e) $8.6 \times 10^{-4} \text{ kg}$

Unit 4 Self-Quiz, pp. 488–489

1. (c) 14. (b) 27. F
2. (b) 15. T 28. T
3. (b) 16. T 29. F
4. (a) 17. F 30. T
5. (a) 18. T 31. F
6. (a) 19. T 32. F
7. (d) 20. F 33. T
8. (b) 21. T 34. F
9. (d) 22. T 35. T
10. (d) 23. F 36. F
11. (d) 24. T 37. F
12. (c) 25. F 38. T
13. (c) 26. T 39. F

Unit 4 Review, pp. 490–497

1. (c)
2. (a)
3. (c)
4. (b)
5. (a)
6. (d)
7. (a)
8. (a)
9. (a)
10. (c)
11. (a)
12. (b)
13. (d)
14. (b)
15. (d)
16. (c)
17. (d)
18. (b)
19. (b)
20. (d)
21. (b)
22. (a)
23. (c)
24. F
25. F
26. T
27. F
28. T
29. T
30. T
31. F
32. T
33. F
34. F
35. F
36. T
37. (a) iv
(b) ii
(c) i
(d) v
(e) iii
(f) x
(g) viii

- (h) ix
 (i) vii
 (j) vi
38. 1.94 m
 39. 17 m
 45. 0.06 kg/m
 46. 0.80 m/s
 47. 340 m
 49. 90 Hz
 51. $\frac{1}{2}$ wavelength
 52. 30 cm
 56. 2.5 cm
 61. 13 dB
 64. $\frac{1}{4}$ wavelength
 68. (a) 130 m/s
 (b) 0.0011 kg/m
 (c) 18 N
 98. (b) 1 : 5 or 3 : 2
 (c) $\frac{2}{3}\lambda$

Unit 5

Are You Ready?

pp. 500–501

12. (b)
 14. (a) series
 15. (a) lamp
 (b) resistor
 (c) connecting wire
 (d) battery
 (e) open switch
 18. (a) $V = IR$
 (b) $I = \frac{V}{R}$
 19. (a) 5
 (b) $\frac{21}{10}$; 2.1

11.1 Questions, p. 507

2. 9600 W
 3. 2.5 min
 4. 1.5×10^8 J; 42 kWh
 5. 1320 h; 1.8×10^9 J;
 5.0×10^2 kWh

11.3 Questions, p. 513

1. 560 V
 2. 1.1 J
 3. 1.6 C
 4. (a) 120 V
 (b) 3.3×10^{21} electrons
 5. 0.18 C
 7. (a) gain
 (b) drop
 (c) drop
 (d) gain
 (e) gain
 (f) drop

11.5 Questions, p. 518

2. 0.54 A
 3. 5.8×10^4 C
 4. 680 s; 11 min
 5. 0.71 s
 6. 3 h

11.7 Questions, p. 526

2. 56 Ω
 3. 9×10^{-5} A
 4. 0.1 A
 5. 0.65 A
 6. 16.7 V

11.8 Questions, p. 530

5. (a) 48.0 Ω
 (b) 12.0 Ω
 (c) 24.0 Ω
 (d) 36.0 Ω

11.9 Questions, p. 535

1. (a) $I_{\text{source}} = 0.33$ A; $I_1 = 0.33$ A;
 $I_2 = 0.17$ A; $I_3 = 0.17$ A
 $V_1 = 4.0$ V; $V_2 = 2.0$ V;
 $V_3 = 2.0$ V
 $R_{\text{source}} = 18.0$ Ω
 (b) $I_{\text{source}} = 0.17$ A; $I_1 = 0.17$ A;
 $I_2 = 0.083$ A; $I_3 = 0.083$ A;
 $I_4 = 0.083$ A; $I_5 = 0.083$ A;
 $I_6 = 0.17$ A
 $V_1 = 2.0$ V; $V_2 = 1.0$ V;
 $V_3 = 1.0$ V; $V_4 = 1.0$ V;
 $V_5 = 1.0$ V; $V_6 = 2.0$ V
 $R_{\text{source}} = 36.0$ Ω
 (c) $I_{\text{source}} = 0.30$ A;
 $I_1 = 0.30$ A;
 $I_2 = 0.10$ A; $I_3 = 0.10$ A;
 $I_4 = 0.20$ A
 $V_1 = 3.6$ V; $V_2 = 1.2$ V;
 $V_3 = 1.2$ V; $V_4 = 2.4$ V
 $R_{\text{source}} = 20.0$ Ω
 (d) $I_{\text{source}} = 0.25$ A; $I_1 = 0.25$ A;
 $I_2 = 0.13$ A; $I_3 = 0.13$ A;
 $I_4 = 0.13$ A; $I_5 = 0.13$ A
 $V_1 = 3.0$ V; $V_2 = 1.5$ V;
 $V_3 = 1.5$ V; $V_4 = 1.5$ V;
 $V_5 = 1.5$ V
 $R_{\text{source}} = 24.0$ Ω
2. $V_1 = 6.0$ V; $V_3 = 5.0$ V
 $I_1 = 0.20$ A; $I_3 = 0.20$ A;
 $I_{\text{source}} = 0.20$ A
 $R_2 = 20$ Ω ; $R_3 = 25$ Ω ;
 $R_{\text{total}} = 75$ Ω
3. $V_1 = 1.5$ V; $V_2 = 1.5$ V; $V_3 = 1.5$ V
 $I_2 = 0.20$ A; $I_3 = 0.30$ A;
 $I_{\text{source}} = 0.60$ A
 $R_1 = 15$ Ω ; $R_{\text{total}} = 2.5$ Ω
4. $V_{\text{source}} = 14.5$ V; $V_2 = 2.5$ V;
 $V_4 = 7.0$ V; $V_5 = 7.0$ V;
 $I_{\text{source}} = 0.50$ A; $I_1 = 0.20$ A;
 $I_5 = 0.40$ A
 $R_1 = 13$ Ω ; $R_2 = 8.3$ Ω ; $R_3 = 10$ Ω ;
 $R_5 = 18$ Ω ; $R_{\text{total}} = 29$ Ω

Chapter 11 Self-Quiz, p. 539

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

Chapter 11 Review, pp. 540–545

1. (b)
 2. (b)
 3. (c)
 4. (d)

5. (b)
 6. (c)
 7. (a)
 8. (d)
 9. (c)
 10. T
 11. F
 12. T
 13. F
 14. F
 15. T
 16. T
 17. F
 18. F
 19. $V_{\text{source}} = V_1 + V_2 + V_3$
 20. $\frac{1}{R_{\text{parallel}}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$
 22. 4200 MW
 23. 0.18 kWh
 24. 22 kWh; 78 MJ
 25. 4 W
 26. (a) 190 MW
 (b) 160 MJ
 27. 9.0 V
 28. 4.0 C
 29. 2600 C
 31. (a) 3.0×10^4 C
 (b) 3400 W
 (c) 14 A
 33. 7.4 mA
 34. 58 000 C
 35. 4 s
 38. (a) 6.0 V
 (b) 4.5 V
 39. (a) 3.2 mA
 (b) 3.8 mA
 40. 80 Ω
 41. 68 mV
 42. $R_1 = 9.1$ k Ω ; $R_2 = 15$ k Ω
 43. 8.7 Ω
 44. 1.2 Ω
 45. 15 Ω
 46. $R_1 = 19$ Ω ; $V_2 = 11$ V;
 $I_2 = 0.37$ A
 47. $I_1 = 4.0$ A; $I_2 = 170$ mA;
 $I_3 = 3.8$ A; $R_3 = 2.6$ Ω
 48. (a) 1600 MW
 49. 220 MW
 50. 15 h
 51. $E_{\text{input}} = 4.3 \times 10^5$ J
 $E_{\text{output}} = 4.8 \times 10^4$ J
 52. 360 h; 3.8 kWh
 53. 4.76 C
 54. (a) 17 Ω
 (b) 58 s
 55. (a) 5.4 C
 (b) 6.1 C
 56. (a) $R_3 = 12$ Ω ; $I_2 = 0.20$ A
 (b) 29 s
 62. (a) 0.67 A
 (b) 32 V
 63. (a) $R_1 = R_2 = 55$ Ω
 (b) 0.073 A
 64. (a) $R_4 = 2.50 \times 10^2$ Ω
 $I_1 = 0.250$ A
 $I_2 = 0.150$ A
 $I_4 = 0.100$ A

- (b) $V_2 = 16.7$ V
 $V_3 = 8.30$ V
 65. (a) $R_1 = 2.0 \times 10^2$ Ω
 $R_2 = 1.6 \times 10^2$ Ω
 $R_3 = 80$ Ω
 $R_4 = 2.0 \times 10^2$ Ω
 (b) 110 mA

12.2 Questions, p. 556

5. east

Chapter 12 Self-Quiz, p. 579

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

Chapter 12 Review, pp. 580–585

1. (d)
 2. (d)
 3. (d)
 4. (c)
 5. (b)
 6. (d)
 7. (a) iii
 (b) i
 (c) iv
 (d) ii

13.4 Questions, p. 604

1. (a) 180° and 0°
 (b) 90° and 270°
 3. 60 rotations per second

13.5 Questions, p. 609

7. 8.0 V; 4.5 A
 9. 8 : 1

13.6 Questions, p. 612

2. (a) 20 %
 (b) 0.2 %
 (c) 45 %

Chapter 13 Self-Quiz, p. 615

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

Chapter 13 Review, pp. 616–621

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

17. F
 18. coil A
 19. 115 windings
 26. step-up transformer
 27. (a) more than 50 coils
 (b) less than 50 coils
 28. (a) less than 100 coils
 (b) more than 100 coils
 29. (a) 100 V
 (b) 2 : 1
 30. (a) 450 V
 (b) 3 : 2
 31. (a) 80 V
 (b) 7 A
 32. (a) 30 V
 (b) 40 coils
 33. (a) 290 coils
 (b) 12 A
 34. $I = 7.5 \times 10^4$ A
 35. 53 kV
 36. 6.0 MW
 37. (a) 480 MW
 (b) 1.2 MW
 38. 16 %
 39. 0.72Ω
 40. 2600 MW
 45. 35 cm
 50. (a) 30 coils
 (b) $I_p = 20$ A; $I_s = 80$ A
 51. (a) 10.0 A
 (b) $V_s = 42$ V; $V_p = 14$ V
 52. (a) 175 V
 (b) $4.0 \times 10^2 \Omega$
 53. (a) 1000 coils
 (b) 1.3Ω
 54. 0.25 %
 55. 7.5Ω

56. 850 MW
 57. 400 windings
 58. $I_s = 13$ kA; $V_s = 2.0 \times 10^2$ kV
 59. 720 MW
 60. $I_s = 1.9$ kA
 $V_s = 630$ kV
 $V_p = 130$ kV
 $I_p = 9.5$ kA
 61. (c) $V_1 = 6.0$ V, $V_2 = 24$ V

Unit 5 Self-Quiz, pp. 624–625

- | | | |
|---------|---------|-------|
| 1. (c) | 13. (d) | 25. F |
| 2. (c) | 14. (a) | 26. T |
| 3. (d) | 15. (d) | 27. F |
| 4. (d) | 16. (a) | 28. F |
| 5. (b) | 17. (b) | 29. T |
| 6. (c) | 18. F | 30. T |
| 7. (a) | 19. F | 31. T |
| 8. (d) | 20. T | 32. T |
| 9. (b) | 21. T | 33. F |
| 10. (a) | 22. F | 34. T |
| 11. (c) | 23. T | 35. F |
| 12. (d) | 24. F | 36. F |

Unit 5 Review pp. 626–633

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

14. (b)
 15. (c)
 16. F
 17. F
 18. T
 19. T
 20. T
 21. F
 22. T
 23. F
 24. T
 25. T
 26. F
 27. T
 28. (a) v
 (b) viii
 (c) i
 (d) ii
 (e) iii
 (f) ix
 (g) vii
 (h) iv
 (i) vi

29. 4500 MW
 30. 28 MJ
 31. 3.3 W
 32. 4.5 C
 33. 7.2 mA
 34. 8.0 s
 36. (a) 6.4 mA
 (b) 4.2 mA
 37. 650 mV
 38. 15Ω
 42. (a) into the page
 (b) counter-clockwise
 (c) out of the page
 46. into the page

53. coil A
 56. 150 coils
 57. step-down transformer
 58. 36 kA
 59. 6.3 MW
 60. 3.6 MW
 61. 0.50Ω
 62. 3300 MW
 63. 450 MW
 64. 56 s
 66. 5.5 C
 67. (a) 7.1 C
 (b) 5.3 C
 68. (a) $R_3 = 16 \Omega$; $I_2 = 0.20$ A
 (b) 21 s
 72. (a) $R_1 = R_2 = 91 \Omega$
 (b) $I_3 = 36$ mA
 81. 16 cm
 84. (a) 120 V
 (b) 2 : 1
 85. (a) 128 V
 (b) 16.0 A
 86. (a) 30 coils
 (b) $I_p = 3.0 \times 10^1$ A,
 $I_s = 150$ A
 87. (a) 1800 coils
 (b) 0.83Ω
 88. 15Ω
 89. 690 MW
 90. 1300 MW