



# ***Solutions Manual***

*to Accompany*

## MATHEMATICS FOR ELECTRICITY AND ELECTRONICS

**FOURTH EDITION**

Arthur D. Kramer



**Solutions Manual to accompany: Mathematics  
for Electricity and Electronics, Fourth edition**

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Detailed solutions are shown for more difficult problems. For a group of similar problems, procedures are shown for the first one in the group and for any others that differ significantly.

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## CHAPTER 1 Basic Arithmetic

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### Exercise 1.1 Arithmetic Operations

- |        |         |   |   |
|--------|---------|---|---|
| 1. 16  | 16. 14  | 31. 1                                     | 44. tech $\frac{\$640}{40} = \$16/\text{hr};$             |
| 2. 15  | 17. 77  | 32. 1                                     | teacher $\frac{\$570}{30} = \$19/\text{hr}$               |
| 3. 4   | 18. 9   | 33. 10                                    |   |
| 4. 20  | 19. 45  | 34. 19                                    | 45. $(6000)(9000) =$                                      |
| 5. 120 | 20. 200 | 35. 55                                    | 54,000,000 mi   |
| 6. 160 | 21. 10  | 36. 150                                   | 46. $\frac{44 \text{ km}}{2 \text{ h}} = 22 \text{ km/h}$ |
| 7. 4   | 22. 250 | 37. 1500                                  | 47. 1 A   |
| 8. 57  | 23. 2   | 38. 510                                   | 48. 2 A   |
| 9. 36  | 24. 30  | 39. 1                                     | 49. 16 V  |
| 10. 7  | 25. 120 | 40. 5                                     | 50. 12 V  |
| 11. 40 | 26. 40  | 41. 3                                     | 51. 7   |
| 12. 5  | 27. 5   | 42. 5                                     | 52. 122   |
| 13. 50 | 28. 5   | 43. $\frac{180}{90} = 20 \text{ mi/gal};$ |   |
| 14. 2  | 29. 25  | $\frac{210}{10} = 21 \text{ mi/gal}$      |   |
| 15. 26 | 30. 9   |   |   |

### Exercise 1.2 Multiplying and Dividing Fractions

- |                    |                     |                     |                    |
|--------------------|---------------------|---------------------|--------------------|
| 1. $\frac{3}{5}$   | 12. $\frac{6}{13}$  | 23. $\frac{2}{5}$   | 34. $\frac{1}{8}$  |
| 2. $\frac{1}{3}$   | 13. $\frac{9}{35}$  | 24. $\frac{1}{12}$  | 35. 6              |
| 3. $\frac{4}{5}$   | 14. $\frac{1}{7}$   | 25. $\frac{28}{45}$ | 36. 3              |
| 4. $\frac{1}{2}$   | 15. $\frac{2}{15}$  | 26. $\frac{10}{11}$ | 37. $\frac{1}{3}$  |
| 5. $\frac{3}{4}$   | 16. $\frac{1}{24}$  | 27. 2               | 38. $\frac{1}{5}$  |
| 6. $\frac{2}{3}$   | 17. $\frac{4}{15}$  | 28. $\frac{1}{45}$  | 39. $\frac{1}{2}$  |
| 7. $\frac{1}{5}$   | 18. $\frac{11}{60}$ | 29. $\frac{5}{16}$  | 40. $\frac{2}{5}$  |
| 8. $\frac{1}{20}$  | 19. $\frac{4}{3}$   | 30. $\frac{11}{12}$ | 41. 8              |
| 9. $\frac{2}{9}$   | 20. 6               | 31. $\frac{5}{6}$   | 42. $\frac{5}{14}$ |
| 10. $\frac{3}{7}$  | 21. 2               | 32. $\frac{5}{21}$  | 43. 6              |
| 11. $\frac{2}{11}$ | 22. 5               | 33. $\frac{2}{21}$  | 44. $\frac{3}{2}$  |

45. 1  
 46. 4  
 47.  $\frac{15}{50} = \frac{3}{10}$  ft  
 48.  $\frac{3}{4}(100) = 75$  ft
49.  $(1000)\left(\frac{3}{5}\right)\left(\frac{1}{2}\right) = \$300$   
 50.  $(40,000)\left(\frac{1}{2}\right)\left(\frac{1}{4}\right) = \$5000$   
 51. 27 V  
 52. 60 V
53.  $\frac{1}{16}$  A  
 54.  $\frac{1}{50}$  A  
 55.  $\frac{9}{25}$  W  
 56.  $\frac{1}{20}$  W

**Exercise 1.3 Adding Fractions**

1.  $\frac{7}{7} = 1$   
 2.  $\frac{4}{5}$   
 3.  $\frac{5}{8}$   
 4.  $\frac{5}{6}$   
 5.  $\frac{13}{20}$   
 6.  $\frac{11}{14}$   
 7.  $\frac{19}{24}$   
 8.  $\frac{11}{12}$   
 9.  $\frac{14}{15}$   
 10.  $\frac{2}{5}$   
 11.  $\frac{31}{60}$   
 12.  $\frac{31}{36}$   
 13.  $\frac{57}{200}$   
 14.  $\frac{41}{75}$   
 15.  $\frac{1}{4}$   
 16.  $\frac{1}{10}$   
 17.  $\frac{1}{6}$   
 18.  $\frac{1}{60}$   
 19.  $\frac{9}{10}$   
 20.  $\frac{7}{8}$   
 21.  $\frac{11}{20}$   
 22.  $\frac{1}{20}$   
 23.  $\frac{85}{24}$
24.  $\frac{69}{35}$   
 25. 5  
 26.  $\frac{3}{4}$   
 27.  $\frac{33}{80}$   
 28.  $\frac{37}{100}$   
 29.  $\frac{127}{200}$   
 30.  $\frac{49}{120}$   
 31.  $\frac{7}{20}$   
 32.  $\frac{7}{100}$   
 33.  $\frac{63}{100}$   
 34.  $\frac{15}{4}$   
 35.  $\frac{31}{60}$   
 36.  $\frac{7}{24}$   
 37.  $\frac{2}{3}$   
 38.  $\frac{5}{6}$   
 39.  $\frac{7}{12}$   
 40.  $\frac{6}{25}$   
 41.  $\frac{1}{80}$   
 42.  $\frac{59}{100}$   
 43.  $\frac{13}{12}$   
 44.  $\frac{3}{20}$   
 45.  $\frac{14}{15}$   
 46.  $\frac{3}{8}$
47.  $\frac{41}{100}$   
 48.  $\frac{1}{50}$   
 49.  $\frac{11}{20}$   
 50.  $\frac{3}{4}$   
 51.  $\frac{3}{8}$   
 52.  $\frac{1}{4}$   
 53.  $\frac{33}{40}$   
 54.  $\frac{2}{5}$   
 55. 1 lb  
 56. up  $\frac{5}{8}$  lb  
 57.  $\frac{1}{4}$   
 58.  $\frac{1}{8}$   
 59.  $\frac{13}{4}$  in  
 60.  $\left[(5 \text{ ft } 3 \text{ in}) - (6\left(\frac{1}{2} \text{ in}\right))\right] \div 5 = 1 \text{ ft}$   
 61. 10  $\Omega$   
 62. 25  $\Omega$   
 63. 20  $\Omega$   
 64. 300  $\Omega$   
 65.  $\frac{20}{3}$   $\Omega$   
 66.  $\frac{40}{3}$   $\Omega$   
 67.  $\left(\frac{1}{10}\right)\left[3 \div \left(\frac{1}{2}\right)\right]\left(\frac{20}{3}\right) = 4$   
 68.  $\frac{7}{10} \left(\frac{9}{20}\right) = \frac{7}{20}$

**Exercise 1.4 Hand Calculator Operations**

1. 4  
 2. 197  
 3. 47  
 4. 1900  
 5. 130  
 6. 12  
 7. 412  
 8. 4  
 9. 2



10. 3  
11. 147  
12. 32  
13. 60  
14. 3  
15. 40  
16. 200

17. 1  
18. 2  
19. 1  
20. 1  
21. 4  
22. 2  
23. 12

24. 1  
25. 710 (OIL)  
26. 142857  
27. 666.7  $\Omega$   
28. 57.1  $\Omega$

### Review Exercises

1. 22  
2. 47  
3. 12  
4. 400  
5. 21  
6. 135  
7.  $\frac{15}{4}$   
8.  $\frac{1}{2}$   
9.  $\frac{3}{2}$   
10.  $\frac{2}{5}$   
11.  $\frac{15}{2}$   
12.  $\frac{1}{9}$   
13. 4  
14. 10  
15.  $\frac{5}{2}$   
16.  $\frac{4}{5}$   
17.  $\frac{11}{16}$   
18.  $\frac{1}{50}$   
19.  $\frac{1}{5}$

20.  $\frac{17}{6}$   
21. 2  
22. 2  
23.  $\frac{7}{24}$   
24.  $\frac{13}{40}$   
25.  $\frac{5}{36}$   
26. 25  
27.  $\frac{27}{100}$   
28.  $\frac{1}{28}$   
29.  $\frac{8}{7}$   
30.  $\frac{7}{16}$

31. 200  
32. 58  
33. 147  
34. 2  
35. 2  
36. 3

37. 25 mi/h  
38. \$160  
39.  $\left(\frac{1}{2}\right)(500) = 250$  ft

40.  $500 - 400 - 25 = \$75$

41.  $1000 + 250 = \$1250$

42.  $\left[7 - 15\left(\frac{4}{5}\right) \div 12\right] \div 16 = \frac{3}{8}$  ft

43.  $\frac{1}{2}$  A

44.  $\frac{1}{16}$  A

45. 10 V

46.  $\frac{24}{5}$  V

47.  $\frac{18}{5}$  W

48. 24 W

49. 27 V

50.  $\frac{2}{5}$  A

51. 20  $\Omega$

52. 60  $\Omega$

53. 20  $\Omega$

54. 37  $\Omega$

55.  $\frac{1}{5}\left(5 \div \frac{3}{5}\right)\left(\frac{5}{3}\right) = \frac{25}{9}$

56.  $\frac{\left(\frac{7}{20}\right)\left(\frac{1}{2}\right)}{\frac{9}{10}} = \frac{7}{36}$

## CHAPTER 2 Decimals and Percentages

---

### Exercise 2.1 Decimals

1. 10.09  
2. 65.129  
3. 0.91  
4. 69.384

5. 22.71  
6. 7.39  
7. 4.05  
8. 1.202

9. 0.0062  
10. 10.01  
11. 12  
12. 0.069

- |             |           |               |                                    |
|-------------|-----------|---------------|------------------------------------|
| 13. 6.25    | 24. 2.8   | 35. 10        | 44. 3.12 cm                        |
| 14. 0.02804 | 25. 32    | 36. 1000      | 45. $0.5555 \text{ cm}^2$          |
| 15. 0.00001 | 26. 50    | 37. 40        | 46. 0.08 in, $0.0004 \text{ in}^2$ |
| 16. 0.00006 | 27. 0.8   | 38. 0.55      | 47. 8.4 ft                         |
| 17. 30      | 28. 1.612 | 39. 7         | 48. 109.72 m                       |
| 18. 210     | 29. 12.3  | 40. 0.3       | 49. 40.1 V                         |
| 19. 0.12    | 30. 0.87  | 41. 0.08      | 50. 1.50 A                         |
| 20. 33.01   | 31. 0.02  | 42. 0.4       | 51. 17.0 cm                        |
| 21. 10      | 32. 0.15  | 43. 0.2083 mm | 52. 4.4 mm, $1.21 \text{ mm}^2$    |
| 22. 0.1     | 33. 4     |               |                                    |
| 23. 0.08    | 34. 0.121 |               |                                    |

**Exercise 2.2 Percentages**

- |                           |                               |                              |   |
|---------------------------|-------------------------------|------------------------------|---|
| 1. 0.75, 75%              | 22. $\frac{7}{20}$ , 0.35     | 43. $\frac{17}{200}$ , 0.085 | 64. 30 g  |
| 2. 0.5, 50%               | 23. $\frac{43}{50}$ , 0.86    | 44. $\frac{1}{16}$ , 0.0625  | 65. 85%   |
| 3. 0.4, 40%               | 24. $\frac{11}{20}$ , 0.55    | 45. $\frac{1}{1000}$ , 0.1%  | 66. 0.025%  |
| 4. 0.3, 30%               | 25. $\frac{99}{100}$ , 0.99   | 46. 0.002, 0.2%              | 67. \$38.00, \$42.75  |
| 5. 0.375, 37.5%           | 26. $\frac{49}{100}$ , 0.49   | 47. 3                        | 68. \$44.00   |
| 6. 0.875, 87.5%           | 27. 0.05, 5%                  | 48. 16                       | 69. \$64.00, \$68.80  |
| 7. 0.04, 4%               | 28. 0.12, 12%                 | 49. 15                       | 70. \$20.00, \$21.65  |
| 8. 0.09, 9%               | 29. 1.25, 125%                | 50. 30                       | 71. \$42.00, \$44.10  |
| 9. 0.5625, 56.25%         | 30. 2.4, 240%                 | 51. 1.35                     | 72. \$642   |
| 10. 0.15, 15%             | 31. $\frac{1}{20}$ , 5%       | 52. 1.19                     | 73. 12%   |
| 11. 15%, $\frac{3}{20}$   | 32. $\frac{2}{25}$ , 8%       | 53. 75                       | 74. 20%   |
| 12. 25%, $\frac{1}{4}$    | 33. $\frac{3}{2}$ , 150%      | 54. 12.5                     | 75. 110%, $\frac{1120}{1000}$ , $\frac{9}{8}$ , $1\frac{1}{6}$ , 1.19 |
| 13. 10%, $\frac{1}{10}$   | 34. $\frac{1}{1}$ , 100%      | 55. 81                       | 76. 0.03, $\frac{1}{40}$ , $\frac{0.5}{25}$ , 0.50%                   |
| 14. 60%, $\frac{3}{5}$    | 35. $\frac{6}{5}$ , 1.2       | 56. 12                       | 77. 165 $\Omega$  |
| 15. 12%, $\frac{3}{25}$   | 36. $\frac{2}{1}$ , 2.0       | 57. 1.65                     | 78. 532 $\Omega$  |
| 16. 16%, $\frac{4}{25}$   | 37. $\frac{7}{125}$ , 0.056   | 58. 0.4875                   | 79. 0.11 A, 1.21 A  |
| 17. 28%, $\frac{7}{25}$   | 38. $\frac{101}{200}$ , 0.505 | 59. 2.5                      | 80. 0.22 A, 0.88 A  |
| 18. 36%, $\frac{9}{25}$   | 39. 33%, 0.33                 | 60. 3.625                    | 81. 40% decrease  |
| 19. $\frac{1}{5}$ , 0.2   | 40. 0.0625, 6.25%             | 61. \$13.20                  | 82. 50% increase  |
| 20. $\frac{4}{5}$ , 0.8   | 41. $\frac{3}{16}$ , 18.75%   | 62. \$150.00                 | 83. 20% increase  |
| 21. $\frac{3}{20}$ , 0.15 | 42. $\frac{7}{8}$ , 87.5%     | 63. 0.95 $\text{ft}^3$       | 84. 25% decrease  |

**Exercise 2.3 Precision and Accuracy**

- |       |                            |                              |
|-------|----------------------------|------------------------------|
| 1. 3  | 22. 3                      | 43. 1000, 10̄00, 999         |
| 2. 3  | 23. 5, 5.2, 5.15           | 44. 9000, 8900, 8890         |
| 3. 2  | 24. 3, 3.1, 3.10           | 45. 461 m <sup>2</sup>       |
| 4. 2  | 25. 300, 320, 318          | 46. 5,570,000 m <sup>3</sup> |
| 5. 3  | 26. 100, 120, 121          | 47. 152 lb                   |
| 6. 4  | 27. 0.4, 0.44, 0.445       | 48. 27.1 ft/s, 18.5 mi/h     |
| 7. 3  | 28. 0.4, 0.44, 0.440       | 49. 18 V                     |
| 8. 1  | 29. 10,000, 9900, 9910     | 50. 30̄ mA                   |
| 9. 4  | 30. 10,000, 11,000, 10,900 | 51. 203 in <sup>2</sup>      |
| 10. 1 | 31. 80,000, 82,000, 81,900 | 52. 0.046 cm <sup>3</sup>    |
| 11. 4 | 32. 1000, 1100, 1070       | 53. 120 V                    |
| 12. 3 | 33. 100, 10̄0, 101         | 54. 0.11 A                   |
| 13. 4 | 34. 30, 29, 29.0           | 55. 1480̄ W                  |
| 14. 1 | 35. 20, 19, 18.9           | 56. (a) 1.3 Ω                |
| 15. 4 | 36. 0.09, 0.090, 0.0899    | (b) 1.28 Ω                   |
| 16. 3 | 37. 20, 20̄, 20.0          | 57. (a) \$43                 |
| 17. 4 | 38. 40, 39, 39.1           | (b) \$46                     |
| 18. 2 | 39. 300, 340, 336          | 58. (a) \$170                |
| 19. 2 | 40. 500, 450, 454          | (b) \$172                    |
| 20. 4 | 41. 300, 260, 260̄         |                              |
| 21. 4 | 42. 700, 680, 678          |                              |

**Exercise 2.4 Hand Calculator Operations**

- |             |              |                                      |
|-------------|--------------|--------------------------------------|
| 1. 2        | 15. 0.143    | 29. 0.00266                          |
| 2. 8280     | 16. 0.75     | 30. 20.7                             |
| 3. 21.1     | 17. 0.860    | 31. 197,000,000 mi <sup>2</sup>      |
| 4. 950      | 18. 2.69     | 32. 14.9 cm                          |
| 5. 2.0      | 19. 35.5     | 33. (a) 4.67%                        |
| 6. 3        | 20. 124      | (b) 19.1%                            |
| 7. 0.5      | 21. 1.90     | 34. (87,000)(0.153) + (7,850)(0.029) |
| 8. 2.5      | 22. 167,000  | = \$13,538.65                        |
| 9. 147      | 23. 110      | 35. 33.0 V                           |
| 10. 48.4    | 24. 505      | 36. 295 V                            |
| 11. 2.4     | 25. 8.27     | 37. 0.415 A                          |
| 12. 0.20    | 26. 0.0270   | 38. 0.338 A                          |
| 13. 0.68    | 27. 0.00482  |                                      |
| 14. 0.00844 | 28. 0.000900 |                                      |

## Review Exercises

1. 31.26
2. 0.0011
3. 4.04
4. 8.464
5. 220.1
6. 30
7. 0.25
8. 4
9. 0.006
10. 0.144
11. 20
12. 0.025
13. 44
14. 0.01
15. 0.8, 80%
16. 0.125, 12.5%
17. 0.15, 15%
18.  $\frac{3}{10}$ , 30%
19.  $\frac{4}{25}$ , 16%
20. 2, 200%
21.  $\frac{7}{20}$ , 0.35
22.  $\frac{1}{8}$ , 0.125
23.  $\frac{11}{200}$ , 0.055
24.  $\frac{9}{1000}$ , 0.9%
25. 0.005, 0.5%
26.  $\frac{3}{2}$ , 1.5
27. 1
28. 8
29. 8.4
30. 24.5
31. 39
32. 0.9
33. 82.5
34. 8.55
35. 0.5
36. 51
37. 33
38. 3.4
39. 0.95
40. 0.058
41. 31.0
42. 0.867
43. 66.9
44. 149
45. 25.3 in, 26.7 in<sup>2</sup>
46. \$1317.50, \$1240.00
47.  $(40,000)(0.4)\left(\frac{3}{4}\right) = \$12,000$
48.  $(317)(10)(0.75) = 2380$  Btu/h
49. \$59.84, \$64.33
50. \$110
51. 76
52. 0.0048 s
53. (a) 0.41 A  
(b) 2.5 A
54. 210  $\Omega$
55. 10%
56. 33%
57.  $(4700)\left(\frac{1}{3}\right)(0.75) = 1175 \approx 1200$   $\Omega$
58. 0.41 A
59. 21 mA
60. (a)  $\frac{5}{15}(100\%) = 33\%$   
(b)  $2.5/\left(\frac{2}{3}\right) = 1.67 \approx 1.7$   $\Omega$

## CHAPTER 3 Powers and Roots

## Exercise 3.1 Powers

1. 81
2. 64
3. 128
4. 125
5. 100,000
6. 625
7. 121
8. 8000
9.  $\frac{1}{16}$ , 0.0625
10.  $\frac{27}{1000}$ , 0.027
11.  $\frac{9}{25}$ , 0.36
12.  $\frac{1}{125}$ , 0.008
13.  $\frac{1}{10,000}$ , 0.0001
14.  $\frac{49}{100}$ , 0.49
15.  $\frac{25}{16}$ , 1.5625
16.  $\frac{81}{625}$ , 0.1296
17.  $0.36, \frac{9}{25}$
18.  $0.008, \frac{1}{125}$
19.  $2.25, \frac{9}{4}$
20.  $\frac{36}{25}$ , 1.44
21.  $\frac{8}{125}$ , 0.064
22.  $\frac{1}{8}$ , 0.125
23. 0.0001,  $\frac{1}{10,000}$
24.  $\frac{1}{625}$ , 0.0016
25. 0.000008,  $\frac{1}{125,000}$
26.  $0.027, \frac{27}{1000}$
27.  $\frac{1}{9}$ , 0.111 ...
28. 50
29. 1
30.  $\frac{7}{5}$ , 1.4
31.  $\frac{1}{40}$ , 0.025

32.  $\frac{12}{5}$ , 2.4  
 33.  $\frac{6}{125}$ , 0.048  
 34.  $\frac{1}{4}$ , 0.25  
 35.  $\frac{1}{8}$ , 0.125  
 36.  $\frac{67}{1000}$ , 0.067  
 37.  $\frac{1}{20}$ , 0.05  
 38.  $\frac{11}{100}$ , 0.11  
 39.  $\frac{25}{8}$ , 3.125  
 40.  $\frac{144}{25}$ , 5.76  
 41.  $\frac{9}{50}$ , 0.18  
 42.  $\frac{729}{100}$ , 7.29  
 43.  $\frac{1}{500}$ , 0.002  
 44.  $\frac{8}{25}$ , 0.32  
 45.  $\frac{5}{64} = 0.078125$   
 46.  $\frac{3}{125}$ , 0.024  
 47.  $\frac{17}{250}$ , 0.068  
 48.  $\frac{21}{20}$ , 1.05  
 49.  $\frac{75}{4}$ , 18.75  
 50.  $\frac{209}{4}$ , 52.25  
 51.  $\frac{1}{9}$ , 0.111 ...  
 52.  $\frac{1}{16}$ , 0.0625  
 53. 0.512 cm<sup>3</sup>  
 54. 8100 ft<sup>2</sup>  
 55. \$26,620  
 56. \$140.26  
 57. 2.25 mm<sup>2</sup>  
 58. 0.396 ft<sup>3</sup>  
 59. 20 Ω  
 60. 125 Ω  
 61. 17 W  
 62. 50.7 W  
 63. 0.06 W  
 64. 18 W

**Exercise 3.2 Powers of Ten**

1. 10<sup>3</sup>  
 2. 10<sup>6</sup>  
 3. 10<sup>0</sup>  
 4. 10<sup>9</sup>  
 5. 10<sup>-6</sup>  
 6. 10<sup>-3</sup>  
 7. 10<sup>-4</sup>  
 8. 10<sup>-1</sup>  
 9. 10<sup>-2</sup>  
 10. 10<sup>-5</sup>  
 11. 10<sup>-1</sup>  
 12. 10<sup>-3</sup>  
 13. 10<sup>-3</sup>  
 14. 10<sup>-4</sup>  
 15. 100,000  
 16. 100,000,000  
 17. 1,000,000  
 18. 1  
 19. 0.01,  $\frac{1}{100}$   
 20. 0.0001,  $\frac{1}{10,000}$   
 21. 0.1,  $\frac{1}{10}$   
 22. 0.001,  $\frac{1}{1000}$   
 23. 0.000001,  $\frac{1}{1,000,000}$   
 24. 0.0000000001,  $\frac{1}{1,000,000,000}$   
 25. 10  
 26. 1000  
 27. 10<sup>6</sup>  
 28. 10<sup>9</sup>  
 29. 10<sup>-5</sup>  
 30. 10<sup>-10</sup>  
 31. 10<sup>-6</sup>  
 32. 10<sup>-1</sup>  
 33. 10<sup>9</sup>  
 34. 10<sup>6</sup>  
 35. 10<sup>-9</sup>  
 36. 10<sup>0</sup>  
 37. 10<sup>3</sup>  
 38. 10<sup>4</sup>  
 39. 10<sup>-2</sup>  
 40. 10<sup>-5</sup>  
 41. 10<sup>1</sup> = 10  
 42. 10<sup>2</sup>  
 43. 10<sup>-2</sup>  
 44. 10<sup>-6</sup>  
 45. 10<sup>2</sup>  
 46. 10<sup>-6</sup>  
 47. 10<sup>-1</sup>  
 48. 10<sup>-4</sup>  
 49. 10<sup>4</sup>  
 50. 10<sup>7</sup>  
 51. 10<sup>2</sup>  
 52. 10<sup>0</sup> = 1  
 53. 10<sup>-3</sup>  
 54. 10<sup>0</sup> = 1  
 55. 10<sup>9</sup>  
 56. 10<sup>-6</sup>  
 57. 10<sup>-1</sup>  
 58. 10<sup>-8</sup>  
 59. 12 × 10<sup>2</sup>  
 60. 49 × 10<sup>0</sup> = 49  
 61. 24 × 10<sup>1</sup> = 24 × 10  
 62. 72 × 10<sup>2</sup>  
 63. 6 × 10<sup>-12</sup>  
 64. 45 × 10<sup>-4</sup>  
 65. 12 × 10<sup>-1</sup>  
 66. 4 × 10<sup>6</sup>  
 67. 3 × 10<sup>3</sup>  
 68. 5 × 10<sup>-3</sup>

- |                                    |  |  |                      |
|------------------------------------|--|--|----------------------|
| 69. $2.5 \times 10^7$              | 77. $7 \times 10^{-9}$ , 0.000000007                     | 82. $43 \times 10^{-2} = 4.3 \times 10^{-1}$ ,<br>0.43 | 89. 3.0 V            |
| 70. $5 \times 10^7$                | 78. $5 \times 10^{12}$ ,<br>5,000,000,000,000            | 83. $4.5 \times 10 = 45$                               | 90. 0.0099 V         |
| 71. $2.5 \times 10^{-2}$           | 79. $6.5 \times 10^4$ , $65 \times 10^3$ ,<br>65,000     | 84. 0  | 91. 0.05 A           |
| 72. $4.5 \times 10^5$              | 80. $6 \times 10^3 = 60 \times 10^2$<br>= 6000           | 85. 480 W  | 92. 0.11 A           |
| 73. $0.75 \times 10^6$             | 81. $29 \times 10^{-4} = 2.9 \times 10^{-3}$ ,<br>0.0029 | 86. 3.8 W  | 93. 2000 $\Omega$    |
| 74. $1 \times 10^5$                |  | 87. 45.5 A   | 94. 300,000 $\Omega$ |
| 75. $16 \times 10^3$ , 16,000      |  | 88. 100 A  |                      |
| 76. $40 \times 10^{-6}$ , 0.000040 |  |  |                      |

**Exercise 3.3 Square Roots and Cube Roots**

- |                   |                           |                            |                                      |
|-------------------|---------------------------|----------------------------|--------------------------------------|
| 1. 4              | 23. 0.1                   | 45. $16 \times 10^8$       | 68. $0.32 \times 10^{-2}$            |
| 2. 11             | 24. 0.2                   | 46. $27 \times 10^{12}$    | 69. $0.75 \times 10^5$               |
| 3. $\frac{5}{2}$  | 25. 10                    | 47. $0.64 \times 10^{10}$  | 70. $4 \times 10^2$                  |
| 4. $\frac{3}{10}$ | 26. 0.1                   | 48. $0.01 \times 10^2$     | 71. 70 ft                            |
| 5. $\frac{2}{3}$  | 27. 14                    | 49. $0.001 \times 10^9$    | 72. 100 mm, 10 cm                    |
| 6. $\frac{2}{9}$  | 28. 18                    | 50. $0.008 \times 10^{18}$ | 73. 3%                               |
| 7. 0.8            | 29. 28                    | 51. $9 \times 10^{11}$     | 74. 4%                               |
| 8. 0.6            | 30. 24                    | 52. $32 \times 10^{10}$    | 75. 2.5                              |
| 9. 0.1            | 31. 1.4                   | 53. $150 \times 10^6$      | 76. 0.1 ft                           |
| 10. 0.3           | 32. 2.2                   | 54. $0.2 \times 10^{14}$   | 77. 20 $\Omega$                      |
| 11. 200           | 33. 2.1                   | 55. $4 \times 10^3$        | 78. 25 $\Omega$                      |
| 12. 50            | 34. 1.8                   | 56. $5 \times 10^2$        | 79. 60 V                             |
| 13. 30            | 35. 12                    | 57. $12 \times 10$         | 80. 0.02 A                           |
| 14. 40            | 36. 18                    | 58. $7 \times 10^6$        | 81. 0.2 A                            |
| 15. 0.09          | 37. $0.6 = \frac{3}{5}$   | 59. $0.5 \times 10^2$      | 82. 48 V                             |
| 16. 0.12          | 38. $0.04 = \frac{1}{25}$ | 60. $0.8 \times 10^3$      | 83. 6.4 W                            |
| 17. 1.3           | 39. 2                     | 61. $2 \times 10^3$        | 84. 7.2 W                            |
| 18. 1.5           | 40. $\frac{1}{5} = 0.2$   | 62. $3 \times 10$          | 85. 0.05 A                           |
| 19. 3             | 41. $0.1 = \frac{1}{10}$  | 63. $6 \times 10^3$        | 86. 400 V                            |
| 20. 5             | 42. $\frac{1}{2} = 0.5$   | 64. $5 \times 10^4$        | 87. $\frac{16}{9} + \frac{2}{9} = 2$ |
| 21. $\frac{1}{2}$ | 43. $64 \times 10^9$      | 65. $0.2 \times 10^1$      | 88. $4(9) - 11 = 25$                 |
| 22. $\frac{2}{5}$ | 44. $36 \times 10^4$      | 66. $0.5 \times 10^{-1}$   |                                      |
|                   |                           | 67. $1.5 \times 10^{-5}$   |                                      |

**Exercise 3.4 Hand Calculator Operations**

- |          |           |           |         |
|----------|-----------|-----------|---------|
| 1. 58.1  | 3. 0.0101 | 5. 0.655  | 7. 79.7 |
| 2. 0.885 | 4. 56.6   | 6. 0.0364 | 8. 8.95 |

9. 0.242  
 10. 2.95  
 11. 57.0  
 12. 0.202  
 13. 15.0  
 14. 0.940  
 15. 10.1  
 16. 0.606  
 17. 57.4  
 18. 2.19  
 19. 97.9  
 20. 2.74  
 21. 148 cm<sup>3</sup>  
 22. 341 m/s  
 23. 0.794 W  
 24. 1320 W  
 25. 4830 Ω  
 26.  $9.66 \times 10^3 \Omega$

**Review Exercises**

1. 343  
 2. 121  
 3.  $\frac{1}{16}$ , 0.0625  
 4.  $\frac{8}{125}$ , 0.064  
 5. 0.216,  $\frac{27}{125}$   
 6. 0.064,  $\frac{8}{125}$   
 7. 1.21,  $\frac{121}{100}$   
 8. 0.001,  $\frac{1}{1000}$   
 9. 0.01,  $\frac{1}{100}$   
 10. 0.625,  $\frac{5}{8}$   
 11.  $\frac{2}{5}$ , 0.4  
 12. 0.004,  $\frac{1}{250}$   
 13. 1  
 14.  $\frac{1}{8}$ , 0.125  
 15. 0.29,  $\frac{29}{100}$   
 16. 0.0625,  $\frac{1}{16}$   
 17. 7  
 18.  $\frac{6}{5}$ , 1.2  
 19.  $\frac{2}{5}$ , 0.4  
 20. 2  
 21. 0.3,  $\frac{3}{10}$   
 22. 0.11,  $\frac{11}{100}$   
 23. 4  
 24. 0.3,  $\frac{3}{10}$   
 25. 1  
 26. 13  
 27. 0.06,  $\frac{3}{50}$   
 28. 0.9,  $\frac{9}{10}$   
 29. 7  
 30. 11  
 31.  $\frac{7}{5}$ , 1.4  
 32. 0.9,  $\frac{9}{10}$   
 33. 100,000,000  
 34. 0.00001,  $\frac{1}{100,000}$   
 35.  $\frac{1}{10,000}$ , 0.0001  
 36.  $10^3 = 1000$   
 37.  $10^2 = 100$   
 38.  $10^{-6} = 0.000001$ ,  $\frac{1}{1,000,000}$   
 39.  $10^4 = 10,000$   
 40.  $10^{-4} = 0.0001$ ,  $\frac{1}{10,000}$   
 41.  $10^{-5} = 0.00001$ ,  $\frac{1}{100,000}$   
 42.  $10^{-1} = 0.1$ ,  $\frac{1}{10}$   
 43.  $10^9 = 1,000,000,000$   
 44.  $10^{-1} = 0.1$ ,  $\frac{1}{10}$   
 45.  $10^6 = 1,000,000$   
 46.  $10^{-6} = 0.000001$ ,  $\frac{1}{1,000,000}$   
 47.  $14 \times 10^2$   
 48.  $24 \times 10^{-8}$   
 49.  $2 \times 10^{-3}$   
 50.  $4.5 \times 10^{-1}$   
 51.  $0.10 \times 10^{-9} = 1.0 \times 10^{-10}$   
 52.  $2.5 \times 10^0 = 2.5$   
 53.  $1 \times 10^8$   
 54. 10  
 55.  $16 \times 10^5$   
 56.  $1 \times 10^{-6}$   
 57.  $6.5 \times 10^3 = 65 \times 10^2$   
 58.  $12 \times 10^{-6} = 120 \times 10^{-7}$   
 59.  $81 \times 10^8$   
 60.  $6.75 \times 10^6$   
 61.  $9 \times 10^3$   
 62.  $0.6 \times 10$   
 63.  $4 \times 10^3$   
 64.  $0.2 \times 10^2$   
 65.  $7 \times 10^3$   
 66.  $9 \times 10^2$   
 67.  $0.1 \times 10^7$   
 68.  $0.8 \times 10^2$   
 69. 0.0140  
 70. 0.0301  
 71. 277  
 72. 0.308  
 73. 51.7  
 74. 0.136  
 75. 9.48  
 76. 0.326  
 77. 56 ft  
 78. \$102.50  
 79. 50 mm = 5 cm  
 80. 0.216 m<sup>3</sup>  
 81. 50 Ω