Complete Solutions Manual
to Accompany

PreStatistics

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Chapter 1 Arithmetic Operations Used in Statistics

Section 1.1 Rounding Numbers

Quick Check Exercises (1 – 14)

1. $0.528376 \approx 0.5284$
2. $0.3826184 \approx 0.382618$
3. $0.4572675 \approx 0.457$
4. $0.4977336 \approx 0.497734$
5. $20.479 \uparrow 21$
6. $166.551 \uparrow 167$
7. $1312.996 \uparrow 1313$
8. $3179 \uparrow 3179$
9. $106{,}294 \approx 110{,}000$
10. $6{,}942{,}060 \approx 7{,}000{,}000$
11. $72{,}195{,}589 \approx 72{,}200{,}000$
12. $309{,}462 \approx 309{,}000$
13. 0.0165 pound ≈ 0.02 pound; The weight of a one euro coin is approximately 0.02 pound.
14. $11{,}536{,}504 \approx 12{,}000{,}000$; The population of Ohio in 2014 was approximately 12,000,000 people.

Exercises (1 – 60)

1. $15.542 \approx 15.5$
2. $9.835 \approx 9.8$
3. $62.061 \approx 62.1$
4. $31.281 \approx 31.3$
5. $16.953 \approx 17.0$
6. $92.981 \approx 93.0$
7. $0.39915 \approx 0.399$
8. $0.98744 \approx 0.987$
9. $0.00494 \approx 0.005$
10. $0.00149 \approx 0.001$
11. $0.19957 \approx 0.200$
12. $0.10462 \approx 0.105$
13. $1.5658 \approx 1.57$
14. $8.8961 \approx 8.90$
15. $0.6211964 \approx 0.6212$
16. $0.4894485 \approx 0.4895$
17. $0.005555 \approx 0.006$
18. $0.077777 \approx 0.078$
19. $0.00028546 \approx 0.000285$
20. $0.000654821 \approx 0.000655$
21. $35.025 \uparrow 36$
22. $144.0019 \uparrow 145$
23. $952 \uparrow 952$
24. $1622 \uparrow 1622$
25. $83.9652 \uparrow 84$
26. $71.00015 \uparrow 72$
27. $49 \uparrow 49$
28. $82 \uparrow 82$
29. $50.151101 \uparrow 51$
30. $28.017 \uparrow 29$
31. $6258 \approx 6000$
32. $9487 \approx 9000$

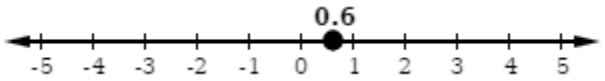
33. 91,565 ≈ 92,000
34. 18,711 ≈ 19,000
35. 125,732 ≈ 126,000
36. 259,783 ≈ 260,000
37. 665,280 ≈ 665,000
38. 95,040 ≈ 95,000
39. 125,970 ≈ 126,000
40. 77,520 ≈ 78,000
41. 1697 ≈ 1700
42. 6595 ≈ 6600
43. 2525 ≈ 3000
44. 3607 ≈ 4000
45. 615,995 ≈ 620,000
46. 177,100 ≈ 180,000
47. 17,100,720 ≈ 17,100,000
48. 27,518,000 ≈ 27,500,000
49. 30,045,015 ≈ 30,000,000
50. 14,307,150 ≈ 14,000,000
51. 4.57 mm ≈ 4.6 mm
52. 4.45 mm ≈ 4.5 mm
53. 0.0016970 28 fluid ounce ≈ 0.00170 fluid ounce
54. 0.00001807 79 pound ≈ 0.00001808 pound
55. 5,308,483 ≈ 5,300,000
56. 5,310,763 ≈ 5,300,000
57. 36,525 ≈ 37,000
58. 24,772 ≈ 25,000
59. 3768 km ≈ 3800 km
60. 6992 km ≈ 7000 km

Section 1.2 Types of Numbers and the Number Line

Quick Check Exercises (1 – 26)

1. 2.8913: rational, real
2. 12: natural, whole, integer, rational, real
3. 1.62818. .. : irrational, real
4. −12: integer, rational, real
5. $5.65\overline{65}$: rational, real
6. $\frac{\sqrt{2}}{2}$: irrational, real

7.



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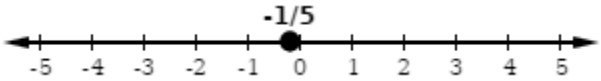

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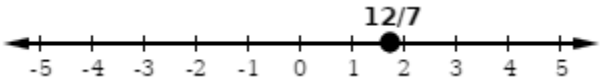

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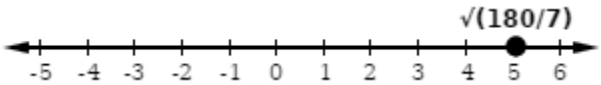
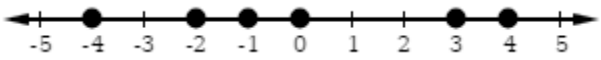
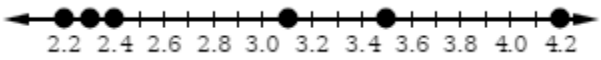


11. $-2.1 < \boxed{-1.9} < 3.2$, yes
12. $-2.1 < \boxed{-2.01} < 3.2$, yes
13. $-2.1 < \boxed{3.15} < 3.2$, yes
14. $-2.1 < 3.2 < \boxed{3.21}$, no
15. $distance = b - a = 2 - (-3) = 2 + 3 = 5$
16. $distance = b - a = 7 - (-4) = 7 + 4 = 11$
17. $distance = rightmost\ number - leftmost\ number = x - z = 7.3 - 2.9 = 4.4$
18. $distance = rightmost\ number - leftmost\ number = x - z = 6.8 - 3.1 = 3.7$
19. $-4, -2, -1, 0, 3, 4$

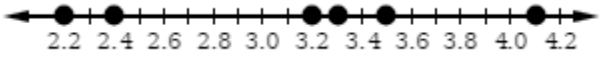


20. $-3, -2, -1, 0, 1, 2$

21. 2.2, 2.3, 2.4, 3.1, 3.5, 4.2



22. 2.2, 2.4, 3.2, 3.3, 3.5, 4.1



23. Flipping through channels while watching TV can be described by a natural number $\mathbb{N}$ and is classified as discrete.
24. The height of a child as he ages is given by a real number $\mathbb{R}$ and is classified as continuous.

25. The body fat percentage of a person as she exercises over time is given by a real number $\mathbb{R}$ and is classified as continuous.
26. Numbering of the Super Bowls is given by a natural number $\mathbb{N}$ and is classified as discrete.

Exercises (1 – 70)

1. False. Every integer can be written as a rational number.
2. False. The smallest whole number is 0.
3. True.
4. True.
5. False. Every negative number is a real number which can be either an integer, a rational number, or an irrational number.
6. False. Every fraction is a real number which can be either rational or irrational.
7. Natural numbers: $\sqrt{4}, 7, 9$
8. Whole numbers: $0, \sqrt{4}, 7, 9$
9. Integers: $-8, 0, \sqrt{4}, 7, 9$
10. Rational numbers: $-8, 0, \frac{2}{11}, \sqrt{4}, 7, 9$
11. Irrational numbers: $3.14159265 \ldots, \sqrt{14}$
12. Real numbers: $-8, 0, \frac{2}{11}, \sqrt{4}, 3.14159265 \ldots, \sqrt{14}, 7, 9$
13. b
14. c
15. d
16. a
17. c
18. a
19. c
20. a
21. d
22. c
23. b
24. a
25. $-4.51 < \boxed{-3.01} < 2.11$; yes
26. $-4.51 < 2.11 < \boxed{3.01}$; no
27. $-4.51 < 2.11 < \boxed{2.13}$; no
28. $-4.51 < \boxed{-2.13} < 2.11$; yes
29. $-4.51 < \boxed{0} < 2.11$; yes
30. $-4.51 < 2.11 < \boxed{5}$; no
31. $-4.51 < \boxed{2.10} < 2.11$; yes
32. $\boxed{-4.52} < -4.51 < 2.11$; no
33. $\boxed{-0.55} < 1.03 < 6.58$; no
34. $\boxed{-1.01} < 1.03 < 6.58$; no
35. $\boxed{0} < 1.03 < 6.58$; no
36. $1.03 < 6.58 < \boxed{8}$; no
37. $1.03 < \boxed{1.04} < 6.58$; yes
38. $1.03 < \boxed{1.05} < 6.58$; yes
39. $1.03 < \boxed{6.56} < 6.58$; yes
40. $1.03 < \boxed{6.57} < 6.58$; yes

41. $distance = rightmost\ number - leftmost\ number = 18 - 4 = 14$
42. $distance = rightmost\ number - leftmost\ number = 15 - 6 = 9$
43. $distance = rightmost\ number - leftmost\ number = 12 - (-6) = 12 + 6 = 18$
44. $distance = rightmost\ number - leftmost\ number = 11 - (-5) = 11 + 5 = 16$
45. $distance = rightmost\ number - leftmost\ number = 18.9 - 6.3 = 12.6$
46. $distance = rightmost\ number - leftmost\ number = 14.4 - 3.7 = 10.7$
47. $distance = rightmost\ number - leftmost\ number = \frac{1}{2} - \frac{1}{6} = \frac{1 \cdot 3}{2 \cdot 3} - \frac{1}{6} = \frac{3}{6} - \frac{1}{6} = \frac{2}{6} = \frac{1}{3}$
48. $distance = rightmost\ number - leftmost\ number = \frac{7}{8} - \frac{3}{4} = \frac{7}{8} - \frac{3 \cdot 2}{4 \cdot 2} = \frac{7}{8} - \frac{6}{8} = \frac{1}{8}$
49. $distance = rightmost\ number - leftmost\ number = 61.284 - 55.236 = 6.048$
50. $distance = rightmost\ number - leftmost\ number = 22.685 - 17.684 = 5.001$
51. $6, 9, 11, 13, 15, 16$
52. $1, 2, 4, 7, 8, 9$
53. $-5, -4, -2, 0, 4, 5$
54. $-6, -3, -2, 1, 4, 6$
55. $-20, -19, -18, -17, -15, -10$
56. $-10, -8, -7, -5, -3, -1$
57. $101, 104, 106, 108, 110, 120$
58. $43, 44, 46, 51, 52, 69$
59. $-1.6, -1.4, -0.5, 0.6, 1.2, 1.7$
60. $-2.8, -2.1, -0.3, 0.5, 0.8, 1.4$
61. Natural numbers between 1 and 5, including 1 and 5; discrete
62. Whole numbers from 0 onward; discrete
63. Real numbers; continuous
64. Real numbers; continuous (Note: pace of runner = average speed of runner)
65. Whole numbers; discrete
66. Whole numbers; discrete (Note that there were several years after independence that there was no president, so 0 would be included.)
67. Real numbers; continuous

68. Rational numbers; discrete
69. Real numbers; continuous
70. Real numbers; continuous

Section 1.3 Fractions, Decimals, and Percentages

Quick Check Exercises (1 – 17)

1. $\frac{9}{18} = 9 \div 18 = 0.5$
2. $\frac{12}{36} = 12 \div 36 = 0.333\overline{3} \approx 0.333$
3. $\frac{4}{11} = 4 \div 11 = 0.3\overline{636} \approx 0.364$
4. $\frac{7}{49} = 7 \div 49 \approx 0.1428\ldots \approx 0.143$
5. $0.258 \times 100 = 25.8\% \approx 26\%$
6. $0.678 \times 100 = 67.8\% \approx 68\%$
7. $0.008 \times 100 = 0.8\% \approx 1\%$
8. $0.8 \times 100 = 80\%$
9. $\frac{5}{8} = 5 \div 8 = 0.625 = 62.5\% \approx 63\%$
10. $\frac{11}{16} = 11 \div 16 = 0.6875 = 68.75\% \approx 69\%$
11. $\frac{60}{128} = 60 \div 128 = 0.46875 = 46.875\% \approx 47\%$
12. $\frac{138}{512} = 138 \div 512 = 0.2695\ldots \approx 26.95\% \approx 27\%$
13. $42.3\% = 42.3 \div 100 = 0.423$
14. $78.8\% = 78.8 \div 100 = 0.788$
15. $23\% = 23 \div 100 = 0.23$
16. $33\% = 33 \div 100 = 0.33$
17. $\frac{25{,}722}{205{,}776} = 0.125 = 12.5\%$

Exercises (1 – 50)

1. $\frac{5}{13} = 5 \div 13 = 0.3846 \ldots \approx 0.385$
2. $\frac{2}{7} = 2 \div 7 = 0.2857 \ldots \approx 0.286$
3. $\frac{9}{23} = 9 \div 23 = 0.3913 \ldots \approx 0.391$
4. $\frac{10}{16} = 10 \div 16 = 0.625$
5. $\frac{11}{23} = 11 \div 23 = 0.4782 \ldots \approx 0.478$
6. $\frac{18}{21} = 18 \div 21 = 0.8571 \ldots \approx 0.857$
7. $\frac{15}{210} = 15 \div 210 = 0.0714 \ldots \approx 0.071$
8. $\frac{16}{252} = 16 \div 252 = 0.0634 \ldots \approx 0.063$
9. $\frac{116}{120} = 116 \div 120 = 0.966\overline{6} \approx 0.967$
10. $\frac{40}{45} = 40 \div 45 = 0.888\overline{8} \approx 0.889$
11. $0.31 = 31\%$
12. $0.49 = 49\%$
13. $0.192 = 19.2\% \approx 19\%$
14. $0.454 = 45.4\% \approx 45\%$
15. $0.009 = 0.9\% \approx 1\%$
16. $0.003 = 0.3\% \approx 0\%$
17. $0.955 = 95.5\% \approx 96\%$
18. $0.699 = 69.9\% \approx 70\%$
19. $0.631 = 63.1\% \approx 63\%$
20. $0.844 = 84.4\% \approx 84\%$
21. $\frac{2}{10} = 0.2 = 20\%$
22. $\frac{19}{50} = 0.38 = 38\%$
23. $\frac{6}{56} \approx 0.1071 \approx 11\%$
24. $\frac{8}{75} \approx 0.106\overline{6} \approx 11\%$
25. $\frac{56}{60} \approx 0.933\overline{3} \approx 93\%$
26. $\frac{10}{12} \approx 0.833\overline{3} \approx 83\%$
27. $\frac{96}{252} \approx 0.3809 \approx 38\%$
28. $\frac{216}{220} \approx 0.9818 \approx 98\%$
29. $\frac{495}{924} \approx 0.5357 \approx 54\%$
30. $\frac{455}{1365} \approx 0.333\overline{3} \approx 33\%$
31. $48\% = 48 \div 100 = 0.48$
32. $84\% = 84 \div 100 = 0.84$
33. $12.6\% = 12.6 \div 100 = 0.126$
34. $87.1\% = 87.1 \div 100 = 0.871$
35. $55.5\% = 55.5 \div 100 = 0.555$
36. $77.7\% = 77.7 \div 100 = 0.777$
37. $9\% = 9 \div 100 = 0.09$
38. $2\% = 2 \div 100 = 0.02$
39. $0.6\% = 0.6 \div 100 = 0.006$
40. $0.3\% = 0.3 \div 100 = 0.003$
41. $0.08\% = 0.08 \div 100 = 0.0008$
42. $0.01\% = 0.01 \div 100 = 0.0001$
43. $\frac{5}{16} = 0.3125 \approx 31.3\%$
44. $\frac{8}{11} \approx 0.727\overline{2} \approx 72.7\%$
45. $\frac{7}{8} = 0.875 \approx 88\%$
46. $\frac{7}{23} \approx 0.3043 \approx 30\%$

47. $\frac{13}{16} = 0.8125 \approx 81.3\%$

48. $\frac{5}{16} = 0.3125 \approx 31.3\%$

49. $\frac{4}{15} \approx 0.266\overline{6} \approx 27\%$

50. $\frac{3}{120} = 0.025 \approx 3\%$

Section 1.4 Operations with Fractions

Quick Check Exercises (1 – 20)

1. Proper

2. Proper

3. Improper

4. Improper

5. $\frac{52}{80} = \frac{13 \cdot 4}{20 \cdot 4} = \frac{13}{20}$

6. $\frac{21}{66} = \frac{7 \cdot 3}{22 \cdot 3} = \frac{7}{22}$

7. $\frac{159}{42} = \frac{53 \cdot 3}{14 \cdot 3} = \frac{53}{14}$

8. $\frac{84}{70} = \frac{6 \cdot 14}{5 \cdot 14} = \frac{6}{5}$

9. $\frac{2}{7} \cdot \frac{3}{7} = \frac{2 \cdot 3}{7 \cdot 7} = \frac{6}{49}$

10. $\frac{9}{11} \cdot \frac{5}{7} = \frac{9 \cdot 5}{11 \cdot 7} = \frac{45}{77}$

11. $12 \cdot \frac{3}{8} = \frac{12}{1} \cdot \frac{3}{8} = \frac{12 \cdot 3}{1 \cdot 8} = \frac{36}{8} = \frac{9 \cdot 4}{2 \cdot 4} = \frac{9}{2}$

12. $10 \cdot \frac{3}{50} = \frac{10}{1} \cdot \frac{3}{50} = \frac{30}{50} = \frac{10 \cdot 3}{10 \cdot 5} = \frac{3}{5}$

13. $\frac{2}{13} \div \frac{1}{6} = \frac{2}{13} \cdot \frac{6}{1} = \frac{2 \cdot 6}{13 \cdot 1} = \frac{12}{13}$

14. $\frac{5}{12} \div \frac{2}{7} = \frac{5}{12} \cdot \frac{7}{2} = \frac{5 \cdot 7}{12 \cdot 2} = \frac{35}{24}$

15. $\frac{10}{11} \div 8 = \frac{10}{11} \cdot \frac{1}{8} = \frac{10 \cdot 1}{11 \cdot 8} = \frac{10}{88} = \frac{5 \cdot 2}{44 \cdot 2} = \frac{5}{44}$

16. $\frac{6}{7} \div 12 = \frac{6}{7} \cdot \frac{1}{12} = \frac{6 \cdot 1}{7 \cdot 12} = \frac{6}{84} = \frac{1 \cdot 6}{14 \cdot 6} = \frac{1}{14}$

17. $\frac{\frac{9}{2}}{\frac{2}{5}} = \frac{9}{2} \div \frac{2}{5} = \frac{9}{2} \cdot \frac{5}{2} = \frac{9 \cdot 5}{2 \cdot 2} = \frac{45}{4}$

18. $\frac{\frac{6}{11}}{\frac{7}{2}} = \frac{6}{11} \div \frac{7}{2} = \frac{6}{11} \cdot \frac{2}{7} = \frac{6 \cdot 2}{11 \cdot 7} = \frac{12}{77}$

19. $\frac{\frac{6}{5}}{8} = \frac{6}{5} \div 8 = \frac{6}{5} \cdot \frac{1}{8} = \frac{6 \cdot 1}{5 \cdot 8} = \frac{6}{40} = \frac{3 \cdot 2}{20 \cdot 2} = \frac{3}{20}$

20. $\frac{\frac{12}{9}}{11} = \frac{12}{9} \div 11 = \frac{12}{9} \cdot \frac{1}{11} = \frac{12 \cdot 1}{9 \cdot 11} = \frac{12}{99} = \frac{4 \cdot 3}{33 \cdot 3} = \frac{4}{33}$

Exercises (1 – 82)

1. Improper
2. Improper
3. Proper
4. Proper
5. Proper
6. Improper
7. Improper
8. Improper
9. Improper
10. Proper

11. $\frac{4}{20} = \frac{1 \cdot 4}{5 \cdot 4} = \frac{1}{5}$
12. $\frac{2}{14} = \frac{1 \cdot 2}{7 \cdot 2} = \frac{1}{7}$
13. $\frac{30}{50} = \frac{3 \cdot 10}{5 \cdot 10} = \frac{3}{5}$
14. $\frac{35}{40} = \frac{7 \cdot 5}{8 \cdot 5} = \frac{7}{8}$
15. $\frac{28}{48} = \frac{7 \cdot 4}{12 \cdot 4} = \frac{7}{12}$
16. $\frac{35}{49} = \frac{5 \cdot 7}{7 \cdot 7} = \frac{5}{7}$
17. $\frac{6}{33} = \frac{2 \cdot 3}{11 \cdot 3} = \frac{2}{11}$
18. $\frac{9}{27} = \frac{1 \cdot 9}{3 \cdot 9} = \frac{1}{3}$
19. $\frac{56}{63} = \frac{8 \cdot 7}{9 \cdot 7} = \frac{8}{9}$
20. $\frac{16}{36} = \frac{4 \cdot 4}{9 \cdot 4} = \frac{4}{9}$
21. $\frac{1}{6} + \frac{2}{3} = \frac{1}{2 \cdot 3} + \frac{2}{3} = \frac{1 + 2 \cdot 2}{6} = \frac{5}{6}$
22. $\frac{4}{5} + \frac{1}{7} = \frac{7 \cdot 4 + 5 \cdot 1}{35} = \frac{33}{35}$
23. $\frac{11}{44} + \frac{2}{4} = \frac{11}{4 \cdot 11} + \frac{2}{4} = \frac{1 + 2}{4} = \frac{3}{4}$
24. $\frac{3}{6} + \frac{2}{4} = \frac{3}{2 \cdot 3} + \frac{2}{2 \cdot 2} = \frac{1 + 1}{2} = 1$
25. $\frac{19}{74} + \frac{14}{37} = \frac{19}{2 \cdot 37} + \frac{14}{37} = \frac{19 + 2 \cdot 14}{74} = \frac{47}{74}$
26. $\frac{19}{43} + \frac{15}{86} = \frac{19}{43} + \frac{15}{2 \cdot 43} = \frac{2 \cdot 19 + 15}{86} = \frac{53}{86}$
27. $\frac{1}{21} + \frac{3}{7} = \frac{1}{3 \cdot 7} + \frac{3}{7} = \frac{1 + 3 \cdot 3}{21} = \frac{10}{21}$
28. $\frac{15}{23} + \frac{1}{46} = \frac{15}{23} + \frac{1}{2 \cdot 23} = \frac{2 \cdot 15 + 1}{46} = \frac{31}{46}$
29. $\frac{4}{7} + \frac{18}{21} = \frac{4}{7} + \frac{18}{3 \cdot 7} = \frac{3 \cdot 4 + 18}{21} = \frac{30}{21} = \frac{10}{7}$
30. $\frac{16}{42} + \frac{20}{21} = \frac{16}{2 \cdot 21} + \frac{20}{21} = \frac{16 + 2 \cdot 20}{42} = \frac{56}{42} = \frac{4}{3}$
31. $\frac{2}{20} + \frac{9}{10} - \frac{1}{5} = \frac{2}{2 \cdot 2 \cdot 5} + \frac{9}{2 \cdot 5} - \frac{1}{5} = \frac{2 + 2 \cdot 9 - 4 \cdot 1}{20} = \frac{16}{20} = \frac{4}{5}$
32. $\frac{13}{42} + \frac{2}{21} - \frac{1}{14} = \frac{13}{2 \cdot 3 \cdot 7} + \frac{2}{3 \cdot 7} - \frac{1}{2 \cdot 7} = \frac{13 + 2 \cdot 2 - 3 \cdot 1}{42} = \frac{14}{42} = \frac{1}{3}$
33. $\frac{3}{4} + \frac{1}{10} - \frac{1}{2} = \frac{3}{2 \cdot 2} + \frac{1}{2 \cdot 5} - \frac{1}{2} = \frac{5 \cdot 3 + 2 \cdot 1 - 10 \cdot 1}{20} = \frac{7}{20}$

34. $\frac{3}{7}+\frac{7}{56}-\frac{2}{7}=\frac{3}{7}+\frac{7}{7\cdot 8}-\frac{2}{7}=\frac{8\cdot 3+7-8\cdot 2}{56}=\frac{15}{56}$

35. $\frac{10}{11}+\frac{8}{44}-\frac{3}{44}=\frac{10}{11}+\frac{8}{4\cdot 11}-\frac{3}{4\cdot 11}=\frac{4\cdot 10+8-3}{44}=\frac{45}{44}$

36. $\frac{8}{82}+\frac{2}{41}-\frac{3}{82}=\frac{8}{2\cdot 41}+\frac{2}{41}-\frac{3}{2\cdot 41}=\frac{8+2\cdot 2-3}{82}=\frac{9}{82}$

37. $\frac{1}{17}+\frac{14}{34}-\frac{1}{4}=\frac{1}{17}+\frac{2\cdot 7}{2\cdot 17}-\frac{1}{2\cdot 2}=\frac{4\cdot 1+4\cdot 7-17\cdot 1}{68}=\frac{15}{68}$

38. $\frac{12}{13}+\frac{16}{26}-\frac{1}{13}=\frac{12}{13}+\frac{2\cdot 8}{2\cdot 13}-\frac{1}{13}=\frac{12+8-1}{13}=\frac{19}{13}$

39. $\frac{9}{88}+\frac{6}{11}-\frac{2}{88}=\frac{9}{8\cdot 11}+\frac{6}{11}-\frac{2}{8\cdot 11}=\frac{9+8\cdot 6-2}{88}=\frac{55}{88}=\frac{5}{8}$

40. $\frac{10}{55}+\frac{7}{11}-\frac{2}{11}=\frac{2\cdot 5}{5\cdot 11}+\frac{7}{11}-\frac{2}{11}=\frac{2+7-2}{11}=\frac{7}{11}$

41. $\frac{4}{5}\cdot\frac{7}{12}=\frac{4\cdot 7}{5\cdot 12}=\frac{28}{60}=\frac{7}{15}$

42. $\frac{1}{2}\cdot\frac{8}{15}=\frac{1\cdot 8}{2\cdot 15}=\frac{8}{30}=\frac{4}{15}$

43. $\frac{11}{13}\cdot\frac{10}{12}=\frac{11\cdot 10}{13\cdot 12}=\frac{110}{156}=\frac{55}{78}$

44. $\frac{8}{14}\cdot\frac{7}{13}=\frac{8\cdot 7}{14\cdot 13}=\frac{56}{182}=\frac{4}{13}$

45. $\frac{5}{9}\cdot\frac{5}{9}=\frac{5\cdot 5}{9\cdot 9}=\frac{25}{81}$

46. $\frac{4}{13}\cdot\frac{4}{13}=\frac{4\cdot 4}{13\cdot 13}=\frac{16}{169}$

47. $\frac{2}{3}\cdot 3=\frac{2\cdot 3}{3}=\frac{2}{1}=2$

48. $\frac{3}{8}\cdot 6=\frac{3\cdot 6}{8}=\frac{18}{8}=\frac{9}{4}$

49. $\frac{5}{16}\cdot\frac{4}{15}\cdot\frac{3}{14}=\frac{5\cdot 4\cdot 3}{16\cdot 15\cdot 14}=\frac{60}{3360}=\frac{1}{56}$

50. $\frac{7}{11}\cdot\frac{6}{10}\cdot\frac{5}{9}=\frac{7\cdot 6\cdot 5}{11\cdot 10\cdot 9}=\frac{210}{990}=\frac{7}{33}$

51. $\frac{1}{2}\div\frac{3}{5}=\frac{1}{2}\cdot\frac{5}{3}=\frac{5}{6}$

52. $\frac{3}{4}\div\frac{7}{8}=\frac{3}{4}\cdot\frac{8}{7}=\frac{24}{28}=\frac{6}{7}$

53. $\frac{7}{12}\div\frac{14}{16}=\frac{7}{12}\cdot\frac{16}{14}=\frac{112}{168}=\frac{2}{3}$

54. $\frac{4}{8} \div \frac{6}{10} = \frac{4}{8} \cdot \frac{10}{6} = \frac{40}{48} = \frac{5}{6}$

55. $\frac{2}{8} \div \frac{3}{5} = \frac{2}{8} \cdot \frac{5}{3} = \frac{10}{24} = \frac{5}{12}$

56. $\frac{2}{6} \div \frac{1}{2} = \frac{2}{6} \cdot \frac{2}{1} = \frac{4}{6} = \frac{2}{3}$

57. $\frac{2}{18} \div \frac{13}{16} = \frac{2}{18} \cdot \frac{16}{13} = \frac{32}{234} = \frac{16}{117}$

58. $\frac{5}{10} \div \frac{19}{20} = \frac{5}{10} \cdot \frac{20}{19} = \frac{100}{190} = \frac{10}{19}$

59. $\frac{6}{13} \div 2 = \frac{6}{13} \cdot \frac{1}{2} = \frac{6}{26} = \frac{3}{13}$

60. $\frac{5}{12} \div 4 = \frac{5}{12} \cdot \frac{1}{4} = \frac{5}{48}$

61. $\frac{\frac{2}{9}}{\frac{9}{10}} = \frac{2}{9} \div \frac{9}{10} = \frac{2}{9} \cdot \frac{10}{9} = \frac{20}{81}$

62. $\frac{\frac{2}{8}}{\frac{13}{15}} = \frac{2}{8} \div \frac{13}{15} = \frac{2}{8} \cdot \frac{15}{13} = \frac{30}{104} = \frac{15}{52}$

63. $\frac{\frac{1}{2}}{\frac{15}{18}} = \frac{1}{2} \div \frac{15}{18} = \frac{1}{2} \cdot \frac{18}{15} = \frac{18}{30} = \frac{3}{5}$

64. $\frac{\frac{8}{14}}{\frac{4}{6}} = \frac{8}{14} \div \frac{4}{6} = \frac{8}{14} \cdot \frac{6}{4} = \frac{48}{56} = \frac{6}{7}$

65. $\frac{\frac{5}{33}}{\frac{15}{33}} = \frac{5}{33} \div \frac{15}{33} = \frac{5}{33} \cdot \frac{33}{15} = \frac{5}{15} = \frac{1}{3}$

66. $\frac{\frac{8}{28}}{\frac{12}{28}} = \frac{8}{28} \div \frac{12}{28} = \frac{8}{28} \cdot \frac{28}{12} = \frac{8}{12} = \frac{2}{3}$

67. $\frac{\frac{6}{20}}{\frac{3}{4}} = \frac{6}{20} \div \frac{3}{4} = \frac{6}{20} \cdot \frac{4}{3} = \frac{24}{60} = \frac{2}{5}$

68. $\frac{\frac{3}{15}}{\frac{2}{10}} = \frac{3}{15} \div \frac{2}{10} = \frac{3}{15} \cdot \frac{10}{2} = \frac{30}{30} = 1$

69. $\frac{\frac{5}{17}}{\frac{15}{17}} = \frac{5}{17} \div \frac{15}{17} = \frac{5}{17} \cdot \frac{17}{15} = \frac{5}{15} = \frac{1}{3}$

70. $\frac{\frac{12}{25}}{\frac{24}{25}} = \frac{12}{25} \div \frac{24}{25} = \frac{12}{25} \cdot \frac{25}{24} = \frac{12}{24} = \frac{1}{2}$

71. $\frac{1}{3} + \frac{3}{10} = \frac{10+9}{30} = \frac{19}{30}$; Joan completed $\frac{19}{30}$ of the crossword puzzle.

72. $\frac{1}{4} + \frac{7}{10} = \frac{5+14}{20} = \frac{19}{20}$; Sandy completed $\frac{19}{20}$ of her chores.

73. $\frac{1}{3} + \frac{2}{5} = \frac{5+6}{15} = \frac{11}{15}$; Tom planted $\frac{11}{15}$ of his garden with red peppers and green beans.

74. $\frac{3}{8} + \frac{1}{2} = \frac{3+4}{8} = \frac{7}{8}$; The recipe calls for $\frac{7}{8}$ cup of the nuts.

75. $\frac{1}{4} + \frac{5}{12} = \frac{3+5}{12} = \frac{8}{12} = \frac{2}{3}$; Kenneth did $\frac{2}{3}$ of his laundry.

76. $\frac{3}{10} + \frac{2}{5} + \frac{1}{10} = \frac{3+4+1}{10} = \frac{8}{10} = \frac{4}{5}$; Alyssa drank $\frac{4}{5}$ cup of milk.

77. $16 \div \frac{8}{15} = \frac{16}{1} \cdot \frac{15}{8} = 30$; He will be able to serve 30 students.

78. $11 \div \frac{11}{16} = \frac{11}{1} \cdot \frac{16}{11} = 16$; It will take the frog 16 hours to make the 11-mile trek.

79. $7 \div \frac{1}{2} = \frac{7}{1} \cdot \frac{2}{1} = 14$; Maurice can make 14 batches.

80. $17 \div \frac{17}{20} = \frac{17}{1} \cdot \frac{20}{17} = 20$; Melaka can make 20 bows.

81. $8 \div \frac{4}{5} = \frac{8}{1} \cdot \frac{5}{4} = 10$; The athletes have to complete 10 laps to run 8 miles.

82. $15 \div \frac{3}{8} = \frac{15}{1} \cdot \frac{8}{3} = 40$; 40 of Jesse's friends will get a mug of hot chocolate.

Section 1.5 Absolute, Relative, and Percent Error

Quick Check Exercises (1 – 15)

1. $AE = |v_e - v| = |68 - 69.40| = |-1.4| = 1.4$
2. $AE = |v_e - v| = |72 - 72.46| = |-0.46| = 0.46$
3. $AE = |v_e - v| = |550 - 553| = |-3| = 3$
4. $AE = |v_e - v| = |6000 - 6777| = |-777| = 777$
5. $AE = |v_e - v| = |25 - 30| = |-5| = 5$; Vale's estimate was off by five treats.
6. $\text{RE} = \frac{|v_e - v|}{v} = \frac{|6000-6777|}{6777} = \frac{777}{6777} \approx 0.115$
7. $\text{RE} = \frac{|v_e - v|}{v} = \frac{|570-598|}{598} = \frac{28}{598} \approx 0.047$

8. $\text{RE} = \frac{|v_e - v|}{v} = \frac{|90 - 90.37|}{90.37} = \frac{0.37}{90.37} \approx 0.004$
9. $\text{RE} = \frac{|v_e - v|}{v} = \frac{|1.5 - 1.72|}{1.72} = \frac{0.22}{1.72} \approx 0.128$
10. $\text{RE} = \frac{|v_e - v|}{v} = \frac{|8.5 - 9.25|}{9.25} = \frac{0.75}{9.25} \approx 0.081$; The relative error of $RE = 0.081$ occurred because Matt's estimation was less than the actual weight.
11. $\text{PE} = \frac{|v_e - v|}{v} \cdot 100\% = \frac{|0.23 - 0.31|}{0.31} \cdot 100\% = \frac{0.08}{0.31} \cdot 100\% \approx 25.8\%$
12. $\text{PE} = \frac{|v_e - v|}{v} \cdot 100\% = \frac{|0.47 - 0.63|}{0.63} \cdot 100\% = \frac{0.16}{0.63} \cdot 100\% \approx 25.4\%$
13. $\text{PE} = \frac{AE}{v} \cdot 100\% = \frac{0.9}{6.2} \cdot 100\% \approx 14.5\%$
14. $\text{PE} = \frac{AE}{v} \cdot 100\% = \frac{2.23}{12.16} \cdot 100\% \approx 18.3\%$
15. Calculate estimate: $v_e = 247.4 - 1.8 \cdot 5 = 238.4$ lb;. actual weight: $v = 235.8$ lb;

    $PE = \frac{|v_e - v|}{v} \cdot 100\% = \frac{|238.4 - 235.8|}{235.8} \cdot 100\% = \frac{2.6}{235.8} \cdot 100\% \approx 1.1\%$

    The estimated weight had a 1.1% error. Since this percent error is less than 5%, the estimate was good.

Exercises (1 – 50)

1. $AE = |v_e - v| = |6 - 4| = 2$
2. $AE = |v_e - v| = |5 - 3| = 2$
3. $AE = |v_e - v| = |2.1 - 3| = |-0.9| = 0.9$
4. $AE = |v_e - v| = |3.2 - 4| = |-0.8| = 0.8$
5. $AE = |v_e - v| = |25.5 - 24.6| = 0.9$
6. $AE = |v_e - v| = |16.8 - 14.9| = 1.9$
7. $AE = |v_e - v| = |638 - 651| = |-13| = 13$
8. $AE = |v_e - v| = |246 - 310| = |-64| = 64$
9. $AE = |v_e - v| = |76.89 - 75.1| = 1.79$
10. $AE = |v_e - v| = |19.47 - 20.02| = |-0.55| = 0.55$
11. $\text{RE} = \frac{|v_e - v|}{v} = \frac{|12 - 10|}{10} = \frac{2}{10} = 0.2$
12. $\text{RE} = \frac{|v_e - v|}{v} = \frac{|16 - 20|}{20} = \frac{|-4|}{20} = \frac{4}{20} = 0.2$
13. $\text{RE} = \frac{|v_e - v|}{v} = \frac{|15.2 - 16|}{16} = \frac{|-0.8|}{16} = \frac{0.8}{16} = 0.05$
14. $\text{RE} = \frac{|v_e - v|}{v} = \frac{|24.5 - 25|}{25} = \frac{|-0.5|}{25} = \frac{0.5}{25} = 0.02$

15. $\text{RE} = \frac{|v_e - v|}{v} = \frac{|5.28 - 5.5|}{5.5} = \frac{|-0.22|}{5.5} = \frac{0.22}{5.5} = 0.04$

16. $\text{RE} = \frac{|v_e - v|}{v} = \frac{|4.56 - 4.8|}{4.8} = \frac{|-0.24|}{4.8} = \frac{0.24}{4.8} = 0.05$

17. $\text{RE} = \frac{|v_e - v|}{v} = \frac{|27.648 - 25.6|}{25.6} = \frac{2.048}{25.6} = 0.08$

18. $\text{RE} = \frac{|v_e - v|}{v} = \frac{|16.854 - 15.9|}{15.9} = \frac{0.954}{15.9} = 0.06$

19. $\text{RE} = \frac{|v_e - v|}{v} = \frac{|66.98 - 78.8|}{78.8} = \frac{|-11.82|}{78.8} = \frac{11.82}{78.8} = 0.15$

20. $\text{RE} = \frac{|v_e - v|}{v} = \frac{|40.392 - 45.9|}{45.9} = \frac{|-5.508|}{45.9} = \frac{5.508}{45.9} = 0.12$

21. Given: $v_e = 68\ beats\ per\ minute, v = 73\ beats\ per\ minute$

    (a) $AE = |v_e - v| = |68 - 73| = |-5| = 5$; The patient's estimated pulse rate was 5 beats per minute less than the actual.

    (b) $\text{RE} = \frac{|v_e - v|}{v} = \frac{|68 - 73|}{73} = \frac{5}{73} \approx 0.068$; The relative error of 0.068 was due to the patient's estimate of her pulse rate.

22. Given: $v_e = 30\ years, v = 26\ years$

    (a) $AE = |v_e - v| = |30 - 26| = 4$; The person's guess of the participant's age was 4 years greater than the participant's actual age.

    (b) $\text{RE} = \frac{|v_e - v|}{v} = \frac{|30 - 26|}{26} = \frac{4}{26} = 0.154$; The relative error of 0.154 was due to the person's estimate of a participant's age.

23. Given: $v_e = 400\ sq\ ft, v = 378\ sq\ ft$

    (a) $AE = |v_e - v| = |400 - 378| = 22$; Clarice's estimate was 22 square feet more than the actual square footage.

    (b) $\text{RE} = \frac{|v_e - v|}{v} = \frac{|400 - 378|}{378} = \frac{22}{378} = 0.058$; The relative error of 0.058 was due to Clarise's estimate of the area of the room.

24. Given: $v_e = 3.72\ miles, v = 3.58\ miles$

    (a) $AE = |v_e - v| = |3.72 - 3.58| = 0.14$; The pedometer's measurement of the mileage walked was 0.14 mile more than the actual.

    (b) $\text{RE} = \frac{|v_e - v|}{v} = \frac{|3.72 - 3.58|}{3.58} = \frac{0.14}{3.58} = 0.039$; The relative error of 0.039 was due to the pedometer's estimate of the mileage walked.

25. Given: $v_e = 30{,}000\ people, v = 31{,}634\ people$

(a) $AE = |v_e - v| = |30{,}000 - 31{,}634| = = |-1634| = 1634$; Debbie's estimate of the attendance was 1634 lower than the actual attendance.

(b) $RE = \frac{|v_e - v|}{v} = \frac{|30{,}000 - 31{,}634|}{31{,}634} = \frac{1634}{31{,}634} = 0.052$; The relative error of 0.052 was due to Debbie's estimate of the attendance.

26. Given: $v_e = 30\ years, v = 28.4\ years$

(a) $AE = |v_e - v| = |30 - 28.4| = 1.6$; Claude's estimate was 1.6 years older than the actual average age.

(b) $RE = \frac{|v_e - v|}{v} = \frac{|30 - 28.4|}{28.4} = \frac{1.6}{28.4} = 0.056$; The relative error of 0.056 was due to Claude's estimate of the average age in the class.

27. Given: $v_e = 1\ minute = 60\ seconds, v = 52.2\ seconds$

(a) $AE = |v_e - v| = |60 - 52.2| = 7.8$; Sasha overestimated the time by 7.8 seconds.

(b) $RE = \frac{|v_e - v|}{v} = \frac{|60 - 52.2|}{52.2} = \frac{7.8}{52.2} = 0.13$; The relative error of 0.13 was due to Sasha's estimate of time.

28. Given: $v_e = \$15, v = \$18.23$

(a) $AE = |v_e - v| = |15 - 18.23| = |-3.23| = 3.23$; Franklin underestimated the bill by \$3.23.

(b) $RE = \frac{|v_e - v|}{v} = \frac{|15 - 18.23|}{18.23} = \frac{3.23}{18.23} = 0.177$; The relative error of 0.177 was due to Franklin's estimate of the total cost of his meal.

29. Given: $v_e = 355\ ml, v = 358.7\ ml$

(a) $AE = |v_e - v| = |355 - 358.7| = |-3.7| = = 3.7$; The advertised standard volume for the can of soda was off by 3.7 milliliters compared to the actual volume of the selected can.

(b) $RE = \frac{|v_e - v|}{v} = \frac{|355 - 358.7|}{358.7} = \frac{3.7}{358.7} = 0.01$; The relative error of 0.01 was due to the variation in how much the advertised volume of the soda compared to the actual volume.

30. Given: $v_e = 1.5\ ounces, v = 1.517\ ounces$

(a) $AE = |v_e - v| = |1.5 - 1.517| = |-0.017| = 0.017$; The weight of the bag of potato chips measured was 0.017 ounces more than the advertised weight..

(b) $RE = \frac{|v_e - v|}{v} = \frac{|1.5 - 1.517|}{1.517} = \frac{0.017}{1.517} = 0.011$; The relative error of 0.011 was due to the variation of the advertised weight compared to the actual weight.

31. $PE = \frac{|v_e - v|}{v} \cdot 100\% = \frac{|4.5-5|}{5} \cdot 100\% = \frac{0.5}{5} \cdot 100\% = 10\%$

32. $PE = \frac{|v_e - v|}{v} \cdot 100\% = \frac{|2.85-3|}{3} \cdot 100\% = \frac{0.15}{3} \cdot 100\% = 5\%$

33. $PE = \frac{|v_e - v|}{v} \cdot 100\% = \frac{|28.52-24.8|}{24.8} \cdot 100\% = \frac{3.72}{24.8} \cdot 100\% = 15\%$

34. $PE = \frac{|v_e - v|}{v} \cdot 100\% = \frac{|18.84-15.7|}{15.7} \cdot 100\% = \frac{3.14}{15.7} \cdot 100\% \approx 20\%$

35. $PE = \frac{|v_e - v|}{v} \cdot 100\% = \frac{|0.057-0.05|}{0.05} \cdot 100\% = \frac{0.007}{0.05} \cdot 100\% = 14\%$

36. $PE = \frac{|v_e - v|}{v} \cdot 100\% = \frac{|0.092-0.08|}{0.08} \cdot 100\% = \frac{0.012}{0.08} \cdot 100\% = 15\%$

37. $PE = \frac{|v_e - v|}{v} \cdot 100\% = \frac{|635.06-562|}{562} \cdot 100\% = \frac{73.06}{562} \cdot 100\% = 13\%$

38. $PE = \frac{|v_e - v|}{v} \cdot 100\% = \frac{|284.16-256|}{256} \cdot 100\% = \frac{28.16}{256} \cdot 100\% = 11\%$

39. $PE = \frac{|v_e - v|}{v} \cdot 100\% = \frac{|1550.06-1598|}{1598} \cdot 100\% = \frac{47.94}{1598} \cdot 100\% = 3\%$

40. $PE = \frac{|v_e - v|}{v} \cdot 100\% = \frac{|1027.42-1093|}{1093} \cdot 100\% = \frac{65.58}{1093} \cdot 100\% = 6\%$

41. $v_e = \$1018.56, v = \$1061;$

    $PE = \frac{|v_e - v|}{v} \cdot 100\% = \frac{|1018.56-1061|}{1061} \cdot 100\% = \frac{42.44}{1061} \cdot 100\% = 4\%;$

    Since the percent error is $4\% < 5\%$, the good-faith estimate was a good estimate.

42. $v_e = \$464.63, v = \$479;$

    $PE = \frac{|v_e - v|}{v} \cdot 100\% = \frac{|464.63-479|}{479} \cdot 100\% = \frac{14.37}{479} \cdot 100\% = 3\%;$

    Since the percent error is $3\% < 5\%$, the "quick check" estimate was a good estimate.

43. $v_e = 618.53\ sq.ft., v = 562.3\ sq.ft.;$

    $PE = \frac{|v_e - v|}{v} \cdot 100\% = \frac{|618.53-562.3|}{562.3} \cdot 100\% = \frac{56.23}{562.3} \cdot 100\% = 10\%;$

    Since the percent error is $10\% > 5\%$, Bethany's measurements did not result in a good estimate.

44. $v_e = 4.9\ miles, v = 5\ miles;$

    $PE = \frac{|v_e - v|}{v} \cdot 100\% = \frac{|4.9-5|}{5} \cdot 100\% = \frac{0.1}{5} \cdot 100\% = 2\%;$

    Since the percent error is $2\% < 5\%$, the race director's estimate was a good estimate.

45. $v_e = 38{,}675, v = 45{,}500;$

    $PE = \frac{|v_e - v|}{v} \cdot 100\% = \frac{|38{,}675-45{,}500|}{45{,}500} \cdot 100\% = \frac{6825}{45{,}500} \cdot 100\% = 15\%;$ Since the percent error is $15\% > 5\%$, the initial estimate was not a good estimate.

46. $v_e = 40.95\ years, v = 45.5\ years;$

    $PE = \frac{|v_e - v|}{v} \cdot 100\% = \frac{|40.95-45.5|}{45.5} \cdot 100\% = \frac{4.55}{45.5} \cdot 100\% = 10\%;$

    Since the percent error is $10\% > 5\%$, the initial estimate was not a good estimate.

47. $v_e = 60\ seconds, v = 65.4\ seconds$;

$PE = \frac{|v_e - v|}{v} \cdot 100\% = \frac{|65.4-60|}{60} \cdot 100\% = \frac{5.4}{60} \cdot 100\% = 9\%$;

Since the percent error is $9\% > 5\%$, the initial estimate was not a good estimate.

48. $v_e = \$58.77, v = \$65.30$;

$PE = \frac{|v_e - v|}{v} \cdot 100\% = \frac{|58.77-65.30|}{65.30} \cdot 100\% = \frac{6.53}{65.30} \cdot 100\% = 10\%$;

Since the percent error is $10\% > 5\%$, the guess was not a good guess.

49. $v_e = 355\ ml, v = 351.45\ ml$;

$PE = \frac{|v_e - v|}{v} \cdot 100\% = \frac{|355-351.45|}{351.45} \cdot 100\% = \frac{3.55}{351.45} \cdot 100\% \approx 1.01\%$;

Since the percent error is $1.01\% < 5\%$, the advertised volume was an accurate estimate.

50. $v_e = 1.5\ ounces, v = 1.7125\ ounces$;

$PE = \frac{|v_e - v|}{v} \cdot 100\% = \frac{|1.5-1.7125|}{1.7125} \cdot 100\% = \frac{0.2125}{1.7125} \cdot 100\% \approx 12.4\%$;

Since the percent error is $12.4\% > 5\%$, the advertised weight was not an accurate estimate.

Section 1.6 Scientific Notation and E-Notation

Quick Check Exercises (1 – 20)

1. $5.71 \times 10^8 = 5.71E8$
2. $2.38 \times 10^{12} = 2.38E12$
3. $9.376 \times 10^{10} = 9.376E10$
4. $1.362 \times 10^7 = 1.362E7$
5. $8.417 \times 10^{-6} = 8.417E-6$
6. $3.579 \times 10^{-4} = 3.579E-4$
7. $4.208 \times 10^{-7} = 4.208E-7$
8. $1.701 \times 10^{-7} = 1.701E-7$
9. 0.0000015013
10. 0.000085279
11. 974,900,000
12. 71,370,000
13. 2,365,490,000
14. 0.0006478
15. 0.0000000051395
16. 56,830
17. 4.45×10^{-7}
18. 2.2794×10^{11}
19. 6.124×10^7
20. 7.53×10^{-10}

Exercise (1 – 64)

1. $5.04 \times 10^3 = 5.04E3$
2. $4.8 \times 10^3 = 4.8E3$
3. $3.25 \times 10^4 = 3.25E4$
4. $1.63 \times 10^4 = 1.63E4$
5. $3.62 \times 10^5 = 3.62E5$
6. $1.55 \times 10^5 = 1.55E5$
7. $3.628 \times 10^6 = 3.628E6$
8. $1.814 \times 10^6 = 1.814E6$