INSTRUCTOR'S SOLUTIONS MANUAL

MATH MADE VISIBLE

Math Made Visible, LLC

ELEMENTARY ALGEBRA
FOR COLLEGE STUDENTS
NINTH EDITION
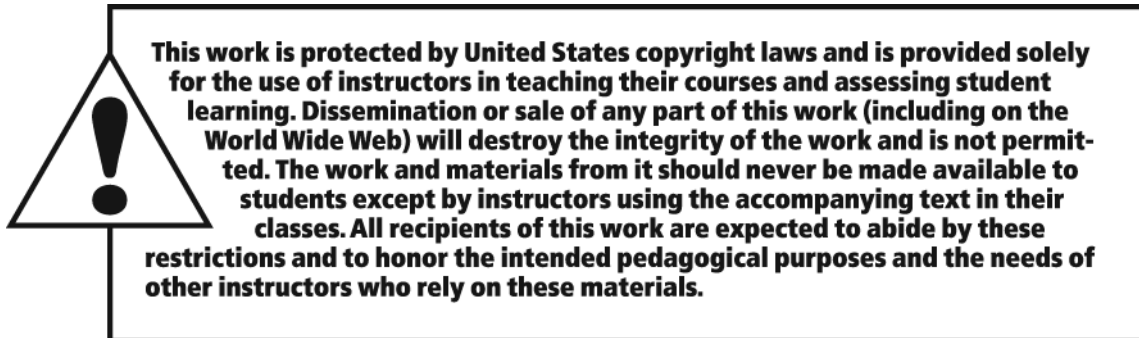
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Chapter 1

Exercise Set 1.1

1.-10. Answers will vary.

11. To prepare properly for this class, you need to do all the homework carefully and completely; preview the new material that is to be covered in class.

12. Answers will vary.

13. At least 2 hours of study and homework time for each hour of class time is generally recommended.

14. A mathematics text should be read slowly and carefully; do not just skim the text.

15.a. You need to do the homework in order to practice what was presented in class.

b. When you miss class, you miss important information. Therefore it is important that you attend class regularly.

16. It is important to know why you follow the specific steps to solve a problem so that you will be able to solve similar types of problems.

17. Answers will vary.

18. 1. Carefully write down any formulas or ideas that you need to remember.

2. Look over the entire exam quickly to get an idea of its length. Also make sure that no pages are missing.

3. Read the test directions carefully.

4. Read each question carefully. Show all of your work. Answer each question completely, and make sure that you have answered the specific question asked.

5. Work the questions you understand best first; then go back and work those you are not sure of. Do not spend too much time on any one problem or you may not be able to complete the exam. Be prepared to spend more time on problems worth more points.

6. Attempt each problem. You may get at least partial credit even if you do not obtain the correct answer. If you make no attempt at answering the question, you will lose full credit.

7. Work carefully step by step. Copy all signs and exponents correctly when working from step to step, and make sure to copy the original question from the test correctly.

8. Write clearly so that your instructor can read your work. If your instructor cannot read your work, you may lose credit. Also, if your writing is not clear, it is easy to make a mistake when working from one step to the next. When appropriate, make sure that your final answer stands out by placing a box around it.

9. If you have time, check your work and your answers.

10. Do not be concerned if others finish the test before you or if you are the last to finish. Use any extra time to check your work.

Exercise Set 1.2

1. The <u>median</u> of the data 2, 4, 7, 8, 9 is 7.

2. A general collection of numbers, symbols, and operations is called a(n) <u>expression</u>.

3. The symbol $\approx$ means <u>approximately</u> equal to.

4. The <u>mean</u> of the data 2, 4, 7, 8, 9 is 6.

5. One of the five important steps in problem solving, seeing if your answer makes sense, is referred to as <u>checking</u> a problem.

6. The mean and median are types of averages, also called measures of <u>central</u> tendency.

7. Graphical representation of data includes bar graphs, line graphs and <u>circle</u> graphs.

8. Parentheses and brackets are examples of <u>grouping</u> symbols.

9. In this book we use Pólya's five-step approach for <u>problem</u> solving.

10. Reading a problem at least twice, making a list of facts, and making a sketch are the problem-solving step called <u>understanding</u> the problem.

11.a. $\dfrac{78 + 97 + 59 + 74 + 74}{5} = \dfrac{382}{5} = 76.4$

The mean grade is 76.4.

b. 59, 74, 74, 78, 97. The middle value is 74. The median grade is 74.

12.a. $\dfrac{161+131+187+163+145}{5} = \dfrac{787}{5} = 157.4$

The mean score is 157.4.

  b. 131, 145, 161, 163, 187
The middle value is 161.
The median score is 161.

13.a. $\dfrac{96.56+108.78+87.23+85.90+79.55+65.88}{6} = \dfrac{523.90}{6} \approx 87.32$

The mean bill is about $87.32.

  b. $65.88, $79.55, $85.90, $87.23, $96.56, $108.78
The middle values are $85.90 and $87.23.
$\dfrac{85.90+87.23}{2} = \dfrac{173.13}{2} = 86.57$
The median bill is about $86.57.

14.a. $\dfrac{204.83+153.85+210.03+119.76+128.38}{5} = \dfrac{816.85}{5} = 163.37$

The mean bill is $163.37.

  b. $119.76, $128.38, $153.85, $204.83, $210.03
The middle value is $153.85.
The median bill is $153.85.

15.a. $\dfrac{8.3+25.5+46.1+55.9+91.1+151.6+221.7+268.6}{8} = \dfrac{868.8}{8} = 108.6$

The mean population for the 140 years is 108.6 thousand.

  b. 8.3, 25.5, 46.1, 55.9, 91.1, 151.6, 221.7, 268.6
The middle values are 55.9 and 91.1.
$\dfrac{55.9+91.1}{2} = \dfrac{147}{2} = 73.5$
The median population for the 140 years is 73.5 thousand.

16.a. $\dfrac{124,100+175,900+142,300+164,800+146,000+210,000+112,200+153,600}{8}$

$= \dfrac{1,228,900}{8}$

$= 153612.5$

The mean sale price for homes is $153,612.50.

  b. 112,200, 124,100, 142,300, 146,000, 153,600, 164,800, 175,900, 210,000
The middle values are 146,000 and 153,600.
$\dfrac{146,000+153,600}{2} = \dfrac{299,600}{2} = 149,800$
The median sale price of homes is $149,800.

17. Barbara's earnings = 5% of sales
Barbara's earnings = 0.05(9400)
                       = 470
Her week's earnings were $470.

18. feet per meter = $\dfrac{\text{number of feet}}{\text{number of meters}} = \dfrac{1454}{443} \approx 3.28$

There are about 3.28 feet in a meter.

19.a. sales tax = 7% of price
sales tax = 0.07(2300)
= 161
The sales tax was $161.00.

b. Total cost = price + tax
Total cost = 2300 + 161
= 2461
The total cost was $2461.00.

20.a. sales tax = 6.75% of price
sales tax = 0.0675(300)
= 20.25
The sales tax was $20.25.

b. Total cost = price + tax
Total cost = 300 + 20.25
= 320.25
The total cost was $320.25.

21. operations performed = (number of operations in billions)(amount of time in seconds)
= (2.3)(0.7)
= 1.61 billion
In 0.7 seconds, 1,610,000,000 operations can be performed.

22.a. total cost with payments = down payment + (number of months)(monthly payment)
total cost with payments = 200 + 24(33)
= 200 + 792
= 992
Making monthly payments, it costs $992.

b. savings = total cost with payments – total cost at purchase
savings = 992 – 950
= 42
He saves $42 by paying the total at the time of purchase.

23.a. time to use energy = $\dfrac{\text{kJ in hamburger}}{\text{kJ/min running}}$

$= \dfrac{1550}{80}$

$= 19.375$

It takes 19.375 minutes to use up the energy from a hamburger by running.

b. time to use energy = $\dfrac{\text{kJ in milkshake}}{\text{kJ/min walking}}$

$= \dfrac{2200}{25}$

$= 88$

It takes 88 minutes to use up the energy from a chocolate milkshake by walking.

c. time to use energy = $\dfrac{\text{kJ in glass of skim milk}}{\text{kJ/min cycling}}$

$= \dfrac{350}{35}$

$= 10$

It takes 10 minutes to use up the energy from a glass of skim milk by cycling.

24. a. Cost at Don's
= 20.00 (number of 30 min intervals)
= 20.00(6)
= $120
Cost at A.J.'s
= 50 (number of hours)
= 50(3)
= $150

Don's is the better deal.

b. savings = cost at A.J.'s – cost at Don's
savings = 150 – 120 = 30
You would save $30.

25. miles per gallon = $\dfrac{\text{number of miles}}{\text{number of gallons}}$

$= \dfrac{16,935.4 - 16,741.3}{10.5}$

$= \dfrac{194.1}{10.5}$

≈ 18.49

His car gets about 18.49 miles per gallon.

26.a. taxes = 1740 + 15% in excess of 17,400
taxes = 1740 + 0.15(53,298 – 17,400)
    = 1740 + 0.15(35,898)
    = 1740 + 5384.70
    = 7124.70

Their taxes were $7124.70.

b. taxes

$= 27,735 + 28\%$ in excess of 142,700

$= 27,735 + 0.28\big(156,212 - 142,700\big)$

$= 27,735 + 0.28\big(13,512\big)$

$= 27,735 + 3783.36$

$= 31,518.36$

Their taxes were $31,518.36.

27. savings = local cost – Internet cost
local cost $= 425 + \big(0.08\big)\big(425\big)$

$= 425 + 34$

$= 459$

Internet cost $= 4\big(62.30 + 6.20 + 8\big)$

$= 4\big(76.50\big)$

$= 306$

savings $= 459 - 306$

$= 153$

Eric saved $153.

28. Santana's salary per inning

$= \dfrac{\text{total amount paid}}{\text{number of innings pitched}}$

$= \dfrac{\$23,145,011}{117 \text{ innings}}$

$\approx \$197,820.61$ per inning

Rodriguez's salary per bat

$= \dfrac{\text{total salary}}{\text{number of at bats}}$

$= \dfrac{\$30,000,000}{529 \text{ at bats}}$

$\approx \$56,710.78$ per at bats

$197,820.61 - 56,710.78 = 141,109.83$

Santana received about $141,109.83 more per inning than Rodriguez did per at bat.

29. A single green block should be placed on the 3 on the right.

30. Cost = Flat Fee + 0.30(each quarter mile traveled)
    + 0.20(each 30 seconds stopped in traffic)

$= 2.00 + 0.30(12) + 0.20(3)$

$= 6.20$

His ride cost $6.20.

31.a. gallons per year = 365(gallons per day)
gallons per year = 365(11.25 gallons)
    = 4106.25
There are 4106.25 gallons of water wasted each year.

b. additional money spent = (cost)(gallons wasted)

$= \dfrac{5.20}{1000 \text{ gallons}} \cdot 4106.25 \text{ gallons}$

≈ 21.35
About $21.35 extra is spent because of the wasted water.

32.a. $\dfrac{1 \text{ mile}}{1 \text{ hour}} = \dfrac{1 \text{ mile}}{1 \text{ hour}} \cdot \dfrac{5280 \text{ feet}}{1 \text{ mile}}$

$= 5280$ feet per hour

b. $\dfrac{1 \text{ mile}}{1 \text{ hour}} = \dfrac{1 \text{ mile}}{1 \text{ hour}} \cdot \dfrac{5280 \text{ feet}}{1 \text{ mile}} \cdot \dfrac{1 \text{ hour}}{60 \text{ min}} \cdot \dfrac{1 \text{ min}}{60 \text{ sec}}$

$= \dfrac{5280}{3600}$ feet per second

≈ 1.47 feet per second

c. $\dfrac{60 \text{ miles}}{1 \text{ hour}} = \dfrac{60 \text{ miles}}{1 \text{ hour}} \cdot \dfrac{5280 \text{ feet}}{1 \text{ mile}} \cdot \dfrac{1 \text{ hour}}{3600 \text{ seconds}}$

≈ 88.0 feet per second

33.a. $\text{cost} = \text{deductible} + 20\% \,(\text{doctor bill} - \text{deductible})$

$$= 150 + 0.20\,(365 - 150)$$
$$= 150 + 0.20(215)$$
$$= 150 + 43$$
$$= 193$$

Mel will be responsible for $193.

  b. The insurance company would be responsible for the remainder of the bill which would be $365 - 193 = \$172$.

34.a. premiums savings = (number of years)(savings per year)

  premiums savings $= 7(10\% \text{ of } 630)$

. $= 7\,(63)$

                 $= 441$

He would save $441.

  b. savings after course = savings – cost of course

  savings after course $= 441 - 70$

                $= 371$

His net savings is $371.

35.a. Finland; 540

  b. Mexico; 420

  c. $540 - 420 = 120$

36.a. 20.1 inches

  b. 9.5 inches

  c. $\dfrac{20.1}{9.5} \approx 2.1 \text{ times greater}$

37.a. 1,200,000 motorcycles and 450,000 motorcycles

  b. $1,200,000 - 450,000 = 750,000$

  c. $\dfrac{1,200,000}{450,000} \approx 2.67$

            $\approx 2.67 \text{ times greater}$

38.a. 2003-2004 and 2011-2012

  b. 2010-2011

  c. 2007–2008

39.a. 82% of 1.8 million $= 0.82(1.8 \text{ million})$

            $= 1.476 \text{ million or } 1,476,000$

  b. 15% of 1.8 million $= 0.15(1.8 \text{ million})$

            $= 0.27 \text{ million or } 270,000$

  c. 3% of 1.8 million $= 0.03(1.8 \text{ million})$

            $= 0.054 \text{ million or } 54,000$

40.a. 83.125% of 160 $= 0.83125\,(160)$

            $= 133$

He answered 133 questions correctly.

  b. $160 - 133 = 27$

He answered 27 questions incorrectly.

41.a. $\text{mean} = \dfrac{\text{sum of grades}}{\text{number of exams}}$

$$60 = \frac{50 + 59 + 67 + 80 + 56 + \text{ last}}{6}$$

$$360 = 312 + \text{ last}$$
$$\text{last} = 360 - 312$$
$$= 48$$

Lamond needs at least a 48 on the last exam.

  b. $70 = \dfrac{312 + \text{ last}}{6}$

$$420 = 312 + \text{ last}$$
$$\text{last} = 420 - 312$$
$$= 108$$

Lamond would need 108 points on the last exam, so he cannot get a C.

42.a. To earn a B she would need to accumulate 5(80) = 400 points.

minimum grade on the fifth exam

= 400 – the sum of the first four exams

$= 400 - (95 + 88 + 82 + 85)$

$= 400 - 350$

$= 50$

Heather needs to earn a minimum of 50 on the next exam.

b. To earn a A she would need to accumulate 5(90) = 450 points.
minimum grade on the fifth exam
= 450 – the sum of the first four exams
= 450 – (95 + 88 + 82 + 85)
= 450 – 350
= 100
Heather needs to earn a 100 on the next exam.

43. a. $\dfrac{39,771}{30,627} \approx 1.3$

≈ 1.3 times greater

b. $\dfrac{56,665}{39,771} \approx 1.4$

≈ 1.4 times greater

c. $\dfrac{73,738}{56,665} \approx 1.3$

≈ 1.3 times greater

44. 6(78) = 468

45. Answers will vary.
One possible solution is:
50, 60, 70, 80, 90
$\text{mean} = \dfrac{50 + 60 + 70 + 80 + 90}{5}$
$= \dfrac{350}{5}$
$= 70$

46. The mean will decrease because the new value is less than the current mean.

6(10) = 60
$\text{mean} = \dfrac{60 + 5}{11}$
$= \dfrac{65}{11}$
≈ 5.91

47. The mean is greater. The median is the middle value of the five numbers, which is 5. The mean is the average of the five numbers, which includes one very high number (70) that will greatly affect the mean.
$\text{mean} = \dfrac{2 + 3 + 5 + 6 + 70}{5}$
$= \dfrac{86}{5}$
$= 17.2$

48. a. The meter reading is 16,504.

b. electrical cost
= (number of kilowatt hour used)(cost per kilowatt hour)
= (16,504 – 16064)(.243)
= 440(.243)
= 106.92
Your electrical cost would be $106.92.

Exercise Set 1.3

1. When two fractions are being <u>added</u> or subtracted we rewrite them so that they both have the same (common) denominator.

2. $5 + \dfrac{1}{3}$ is usually written as $5\dfrac{1}{3}$, which is called a <u>mixed</u> number.

3. Letters that represent numbers are called <u>variables</u>.

4. In the expression 2, 4, 6, 8, … the three dots, called an <u>ellipsis</u>, signify the sequence continues indefinitely.

5. $\dfrac{1}{3} \div \dfrac{1}{2} = \dfrac{2}{\underline{3}}$

6. Numbers or variables that are multiplied together are called <u>factors</u>.

7. In the fraction $\dfrac{3}{4}$, 4 is called the <u>denominator</u>.

8. 15 is the <u>GCF</u> of 30 and 75.

9. To perform the division $\dfrac{4}{7} \div \dfrac{2}{3}$ we rewrite it as $\dfrac{4}{7} \cdot \dfrac{3}{\underline{2}}$.

10. 40 is the <u>LCD</u> of the fractions $\dfrac{3}{8}$ and $\dfrac{7}{10}$.

11. $2 \cdot 2 \cdot 3$

12. $2 \cdot 3 \cdot 3$

13. $2 \cdot 2 \cdot 3 \cdot 5$

14. $2 \cdot 2 \cdot 2 \cdot 2 \cdot 5$

15. $2 \cdot 3 \cdot 5 \cdot 5$

16. $2 \cdot 2 \cdot 3 \cdot 3 \cdot 5$

17. The greatest common factor of 12 and 18 is 6.

18. The greatest common factor of 15 and 27 is 3.

19. The greatest common factor of 60 and 80 is 20.

20. The greatest common factor of 45 and 63 is 9.

21. The greatest common factor of 150 and 294 is 6.

22. The greatest common factor of 126 and 162 is 18.

23. The greatest common factor of 8 and 10 is 2.
$$\frac{8}{10} = \frac{8 \div 2}{10 \div 2} = \frac{4}{5}$$

24. The greatest common factor of 9 and 15 is 3.
$$\frac{9}{15} = \frac{9 \div 3}{15 \div 3} = \frac{3}{5}$$

25. The greatest common factor of 24 and 28 is 4.
$$\frac{24}{28} = \frac{24 \div 4}{28 \div 4} = \frac{6}{7}$$

26. The greatest common factor of 24 and 42 is 6.
$$\frac{24}{42} = \frac{24 \div 6}{42 \div 6} = \frac{4}{7}$$

27. The greatest common factor of 36 and 76 is 4.
$$\frac{36}{76} = \frac{36 \div 4}{76 \div 4} = \frac{9}{19}$$

28. The greatest common factor of 16 and 72 is 8.
$$\frac{16}{72} = \frac{16 \div 8}{72 \div 8} = \frac{2}{9}$$

29. The greatest common factor of 18 and 42 is 6.
$$\frac{18}{42} = \frac{18 \div 6}{42 \div 6} = \frac{3}{7}$$

30. The greatest common factor of 60 and 105 is 15.
$$\frac{60}{105} = \frac{60 \div 15}{105 \div 15} = \frac{4}{7}$$

31. 18 and 49 have no common factors other than 1. Therefore, the fraction is already simplified.

32. 35 and 36 have no common factors other than 1. Therefore, the fraction is already simplified.

33. The greatest common factor of 100 and 150 is 50.
$$\frac{100}{150} = \frac{100 \div 50}{150 \div 50} = \frac{2}{3}$$

34. The greatest common factor of 112 and 144 is 16.
$$\frac{112}{144} = \frac{112 \div 16}{144 \div 16} = \frac{7}{9}$$

35. $2\dfrac{13}{15} = \dfrac{30 + 13}{15} = \dfrac{43}{15}$

36. $15\dfrac{1}{3} = \dfrac{45 + 1}{3} = \dfrac{46}{3}$

37. $7\dfrac{2}{3} = \dfrac{21 + 2}{3} = \dfrac{23}{3}$

38. $14\dfrac{3}{4} = \dfrac{56 + 3}{4} = \dfrac{59}{4}$

39. $3\dfrac{5}{18} = \dfrac{54 + 5}{18} = \dfrac{59}{18}$

40. $2\dfrac{2}{9} = \dfrac{18 + 2}{9} = \dfrac{20}{9}$

41. $\dfrac{7}{4} = 1\dfrac{3}{4}$ because $7 \div 4 = 1$ R3

42. $\dfrac{18}{7} = 2\dfrac{4}{7}$ because $18 \div 7 = 2$ R4

43. $\dfrac{13}{4} = 3\dfrac{1}{4}$ because $13 \div 4 = 3$ R 1

44. $\dfrac{9}{2} = 4\dfrac{1}{2}$ because $9 \div 2 = 4$ R 1

45. $\dfrac{32}{7} = 4\dfrac{4}{7}$ because $32 \div 7 = 4$ R 4

46. $\dfrac{110}{20} = 5\dfrac{10}{20} = 5\dfrac{1}{2}$ because $110 \div 20 = 5$ R 10

47. $\dfrac{1}{3} \cdot \dfrac{4}{5} = \dfrac{1 \cdot 4}{3 \cdot 5} = \dfrac{4}{15}$

48. $\dfrac{6}{13} \cdot \dfrac{7}{17} = \dfrac{6 \cdot 7}{13 \cdot 17} = \dfrac{42}{221}$

49. $\dfrac{5}{12} \cdot \dfrac{4}{15} = \dfrac{\cancel{5}^{1}}{\cancel{12}_{3}} \cdot \dfrac{\cancel{4}^{1}}{\cancel{15}_{3}} = \dfrac{1 \cdot 1}{3 \cdot 3} = \dfrac{1}{9}$

50. $\dfrac{36}{48} \cdot \dfrac{16}{45} = \dfrac{\cancel{36}^{1}}{\cancel{48}_{1}} \cdot \dfrac{\cancel{16}^{4}}{\cancel{45}_{15}} = \dfrac{1 \cdot 4}{1 \cdot 15} = \dfrac{4}{15}$

51. $\dfrac{3}{4} \div \dfrac{1}{2} = \dfrac{3}{\cancel{4}_{2}} \cdot \dfrac{\cancel{2}^{1}}{1} = \dfrac{3}{2} \cdot \dfrac{1}{1} = \dfrac{3}{2}$ or $1\dfrac{1}{2}$

52. $\dfrac{3}{8} \div \dfrac{3}{4} = \dfrac{\cancel{3}^{1}}{\cancel{8}_{2}} \cdot \dfrac{\cancel{4}^{1}}{\cancel{3}_{1}} = \dfrac{1 \cdot 1}{2 \cdot 1} = \dfrac{1}{2}$

7

53. $\dfrac{15}{16} \cdot \dfrac{4}{3} = \dfrac{\overset{5}{\cancel{15}}}{\underset{4}{\cancel{16}}} \cdot \dfrac{\overset{1}{\cancel{4}}}{\cancel{3}_1} = \dfrac{5 \cdot 1}{4 \cdot 1} = \dfrac{5}{4}$ or $1\dfrac{1}{4}$

54. $\dfrac{3}{8} \cdot \dfrac{10}{11} = \dfrac{3}{\underset{4}{\cancel{8}}} \cdot \dfrac{\overset{5}{\cancel{10}}}{11} = \dfrac{3 \cdot 5}{4 \cdot 11} = \dfrac{15}{44}$

55. $\dfrac{10}{3} \div \dfrac{5}{9} = \dfrac{\overset{2}{\cancel{10}}}{\underset{1}{\cancel{3}}} \cdot \dfrac{\overset{3}{\cancel{9}}}{\cancel{5}_1} = \dfrac{2 \cdot 3}{1 \cdot 1} = \dfrac{6}{1} = 6$

56. $\dfrac{5}{9} \div 30 = \dfrac{\overset{1}{\cancel{5}}}{9} \cdot \dfrac{1}{\cancel{30}_6} = \dfrac{1 \cdot 1}{9 \cdot 6} = \dfrac{1}{54}$

57. $\dfrac{1}{24} \div \dfrac{3}{16} = \dfrac{1}{\underset{3}{\cancel{24}}} \cdot \dfrac{\overset{2}{\cancel{16}}}{3} = \dfrac{1 \cdot 2}{3 \cdot 3} = \dfrac{2}{9}$

58. $\dfrac{5}{12} \div \dfrac{4}{3} = \dfrac{5}{\underset{4}{\cancel{12}}} \cdot \dfrac{\overset{1}{\cancel{3}}}{4} = \dfrac{5 \cdot 1}{4 \cdot 4} = \dfrac{5}{16}$

59. $5\dfrac{3}{8} \div 1\dfrac{1}{4}$

$5\dfrac{3}{8} = \dfrac{40+3}{8} = \dfrac{43}{8}$

$1\dfrac{1}{4} = \dfrac{4+1}{4} = \dfrac{5}{4}$

$5\dfrac{3}{8} \div 1\dfrac{1}{4} = \dfrac{43}{8} \div \dfrac{5}{4}$

$\qquad = \dfrac{43}{\underset{2}{\cancel{8}}} \cdot \dfrac{\overset{1}{\cancel{4}}}{5}$

$\qquad = \dfrac{43 \cdot 1}{2 \cdot 5}$

$\qquad = \dfrac{43}{10}$ or $4\dfrac{3}{10}$

60. $4\dfrac{4}{5} \div \dfrac{8}{15}$

$4\dfrac{4}{5} = \dfrac{20+4}{5} = \dfrac{24}{5}$

$4\dfrac{4}{5} \div \dfrac{8}{15} = \dfrac{24}{5} \div \dfrac{8}{15}$

$\qquad = \dfrac{\overset{3}{\cancel{24}}}{\underset{1}{\cancel{5}}} \cdot \dfrac{\overset{3}{\cancel{15}}}{\cancel{8}_1}$

$\qquad = \dfrac{3 \cdot 3}{1 \cdot 1}$

$\qquad = 9$

61. $\dfrac{28}{13} \cdot \dfrac{2}{7} = \dfrac{\overset{4}{\cancel{28}}}{13} \cdot \dfrac{2}{\cancel{7}_1} = \dfrac{4 \cdot 2}{13 \cdot 1} = \dfrac{8}{13}$

62. $\left(2\dfrac{1}{5}\right)\left(\dfrac{7}{8}\right)$

$2\dfrac{1}{5} = \dfrac{10+1}{5} = \dfrac{11}{5}$

$\left(2\dfrac{1}{5}\right)\left(\dfrac{7}{8}\right) = \left(\dfrac{11}{5}\right)\left(\dfrac{7}{8}\right) = \dfrac{11 \cdot 7}{5 \cdot 8} = \dfrac{77}{40}$ or $1\dfrac{37}{40}$

63. $\dfrac{3}{8} + \dfrac{2}{8} = \dfrac{3+2}{8} = \dfrac{5}{8}$

64. $\dfrac{18}{36} + \dfrac{5}{36} = \dfrac{18+5}{36} = \dfrac{23}{36}$

65. $\dfrac{3}{14} - \dfrac{1}{14} = \dfrac{3-1}{14} = \dfrac{2}{14} = \dfrac{1}{7}$

66. $\dfrac{15}{16} - \dfrac{7}{16} = \dfrac{15-7}{16} = \dfrac{8}{16} = \dfrac{1}{2}$

67. $\dfrac{4}{5} + \dfrac{6}{15}$

$\dfrac{4}{5} = \dfrac{4}{5} \cdot \dfrac{3}{3} = \dfrac{12}{15}$

$\dfrac{4}{5} + \dfrac{6}{15} = \dfrac{12}{15} + \dfrac{6}{15} = \dfrac{12+6}{15} = \dfrac{18}{15} = \dfrac{6}{5}$ or $1\dfrac{1}{5}$

68. $\dfrac{7}{8} + \dfrac{5}{6}$

$\dfrac{7}{8} = \dfrac{7}{8} \cdot \dfrac{3}{3} = \dfrac{21}{24}$

$\dfrac{5}{6} = \dfrac{5}{6} \cdot \dfrac{4}{4} = \dfrac{20}{24}$

$\dfrac{7}{8} + \dfrac{5}{6} = \dfrac{21}{24} + \dfrac{20}{24} = \dfrac{21+20}{24} = \dfrac{41}{24}$ or $1\dfrac{17}{24}$

69. $\dfrac{9}{17} + \dfrac{2}{34}$

$\dfrac{9}{17} = \dfrac{9}{17} \cdot \dfrac{2}{2} = \dfrac{18}{34}$

$\dfrac{9}{17} + \dfrac{2}{34} = \dfrac{18}{34} + \dfrac{2}{34} = \dfrac{18+2}{34} = \dfrac{20}{34} = \dfrac{10}{17}$

70. $\dfrac{3}{7} + \dfrac{17}{35}$

$\dfrac{3}{7} = \dfrac{3}{7} \cdot \dfrac{5}{5} = \dfrac{15}{35}$

$\dfrac{3}{7} + \dfrac{17}{35} = \dfrac{15}{35} + \dfrac{17}{35} = \dfrac{15+17}{35} = \dfrac{32}{35}$

71. $\dfrac{1}{3}+\dfrac{1}{4}$

$\dfrac{1}{3}=\dfrac{1}{3}\cdot\dfrac{4}{4}=\dfrac{4}{12}$

$\dfrac{1}{4}=\dfrac{1}{4}\cdot\dfrac{3}{3}=\dfrac{3}{12}$

$\dfrac{1}{3}+\dfrac{1}{4}=\dfrac{4}{12}+\dfrac{3}{12}=\dfrac{4+3}{12}=\dfrac{7}{12}$

72. $\dfrac{1}{6}+\dfrac{1}{18}$

$\dfrac{1}{6}=\dfrac{1}{6}\cdot\dfrac{3}{3}=\dfrac{3}{18}$

$\dfrac{1}{6}+\dfrac{1}{18}=\dfrac{3}{18}+\dfrac{1}{18}=\dfrac{3+1}{18}=\dfrac{4}{18}=\dfrac{2}{9}$

73. $\dfrac{7}{12}-\dfrac{2}{9}$

$\dfrac{7}{12}=\dfrac{7}{12}\cdot\dfrac{3}{3}=\dfrac{21}{36}$

$\dfrac{2}{9}=\dfrac{2}{9}\cdot\dfrac{4}{4}=\dfrac{8}{36}$

$\dfrac{7}{12}-\dfrac{2}{9}=\dfrac{21}{36}-\dfrac{8}{36}=\dfrac{21-8}{36}=\dfrac{13}{36}$

74. $\dfrac{3}{7}-\dfrac{5}{12}$

$\dfrac{3}{7}=\dfrac{3}{7}\cdot\dfrac{12}{12}=\dfrac{36}{84}$

$\dfrac{5}{12}=\dfrac{5}{12}\cdot\dfrac{7}{7}=\dfrac{35}{84}$

$\dfrac{3}{7}-\dfrac{5}{12}=\dfrac{36}{84}-\dfrac{35}{84}=\dfrac{36-35}{84}=\dfrac{1}{84}$

75. $\dfrac{11}{60}+\dfrac{7}{150}$

$\dfrac{11}{60}\cdot\dfrac{5}{5}=\dfrac{55}{300}$

$\dfrac{7}{150}\cdot\dfrac{2}{2}=\dfrac{14}{300}$

$\dfrac{11}{60}+\dfrac{7}{150}=\dfrac{55}{300}+\dfrac{14}{300}=\dfrac{69}{300}=\dfrac{23}{100}$

76. $\dfrac{13}{126}+\dfrac{5}{84}$

$\dfrac{13}{126}\cdot\dfrac{2}{2}=\dfrac{26}{252}$

$\dfrac{5}{84}\cdot\dfrac{3}{3}=\dfrac{15}{252}$

$\dfrac{13}{126}+\dfrac{5}{84}=\dfrac{26}{252}+\dfrac{15}{252}=\dfrac{41}{252}$

77. $6\dfrac{1}{3}-3\dfrac{1}{2}$

$6\dfrac{1}{3}=\dfrac{18+1}{3}=\dfrac{19}{3}\cdot\dfrac{2}{2}=\dfrac{38}{6}$

$3\dfrac{1}{2}=\dfrac{6+1}{2}=\dfrac{7}{2}\cdot\dfrac{3}{3}=\dfrac{21}{6}$

$6\dfrac{1}{3}-3\dfrac{1}{2}=\dfrac{38}{6}-\dfrac{21}{6}=\dfrac{38-21}{6}=\dfrac{17}{6}$ or $2\dfrac{5}{6}$

78. $5\dfrac{3}{8}-3\dfrac{3}{4}$

$5\dfrac{3}{8}=\dfrac{40+3}{8}=\dfrac{43}{8}$

$3\dfrac{3}{4}=\dfrac{12+3}{4}=\dfrac{15}{4}\cdot\dfrac{2}{2}=\dfrac{30}{8}$

$5\dfrac{3}{8}-3\dfrac{3}{4}=\dfrac{43}{8}-\dfrac{30}{8}=\dfrac{43-30}{8}=\dfrac{13}{8}$ or $1\dfrac{5}{8}$

79. $9\dfrac{2}{5}-6\dfrac{1}{2}$

$9\dfrac{2}{5}=\dfrac{45+2}{5}=\dfrac{47}{5}\cdot\dfrac{2}{2}=\dfrac{94}{10}$

$6\dfrac{1}{2}=\dfrac{12+1}{2}=\dfrac{13}{2}\cdot\dfrac{5}{5}=\dfrac{65}{10}$

$9\dfrac{2}{5}-6\dfrac{1}{2}=\dfrac{94}{10}-\dfrac{65}{10}=\dfrac{94-65}{10}=\dfrac{29}{10}$ or $2\dfrac{9}{10}$

80. $4\dfrac{5}{9}-\dfrac{7}{8}$

$4\dfrac{5}{9}=\dfrac{36+5}{9}=\dfrac{41}{9}\cdot\dfrac{8}{8}=\dfrac{328}{72}$

$\dfrac{7}{8}\cdot\dfrac{9}{9}=\dfrac{63}{72}$

$4\dfrac{5}{9}-\dfrac{7}{8}=\dfrac{328}{72}-\dfrac{63}{72}=\dfrac{328-63}{72}=\dfrac{265}{72}=3\dfrac{49}{72}$

81. $5\dfrac{9}{10}+3\dfrac{1}{3}$

$5\dfrac{9}{10}=\dfrac{50+9}{10}=\dfrac{59}{10}\cdot\dfrac{3}{3}=\dfrac{177}{30}$

$3\dfrac{1}{3}=\dfrac{9+1}{3}=\dfrac{10}{3}\cdot\dfrac{10}{10}=\dfrac{100}{30}$

$5\dfrac{9}{10}+3\dfrac{1}{3}=\dfrac{177}{30}+\dfrac{100}{30}=\dfrac{177+100}{30}=\dfrac{277}{30}$ or $9\dfrac{7}{30}$

82. $8\dfrac{2}{7}+3\dfrac{1}{3}$

$8\dfrac{2}{7}=\dfrac{56+2}{7}=\dfrac{58}{7}\cdot\dfrac{3}{3}=\dfrac{174}{21}$

$3\dfrac{1}{3}=\dfrac{9+1}{3}=\dfrac{10}{3}\cdot\dfrac{7}{7}=\dfrac{70}{21}$

$8\dfrac{2}{7}+3\dfrac{1}{3}=\dfrac{174}{21}+\dfrac{70}{21}=\dfrac{174+70}{21}=\dfrac{244}{21}$ or $11\dfrac{13}{21}$

83. $\dfrac{5}{6}-\dfrac{3}{8}$

$\dfrac{5}{6}\cdot\dfrac{4}{4}=\dfrac{20}{24}$

$\dfrac{3}{8}\cdot\dfrac{3}{3}=\dfrac{9}{24}$

$\dfrac{5}{6}-\dfrac{3}{8}=\dfrac{20}{24}-\dfrac{9}{24}=\dfrac{20-9}{24}=\dfrac{11}{24}$

It is $\dfrac{11}{24}$ mile larger.

84. $\dfrac{1}{5}-\dfrac{1}{7}$

$\dfrac{1}{5}\cdot\dfrac{7}{7}=\dfrac{7}{35}$

$\dfrac{1}{7}\cdot\dfrac{5}{5}=\dfrac{5}{35}$

$\dfrac{7}{35}-\dfrac{5}{35}=\dfrac{7-5}{35}=\dfrac{2}{35}$

It is $\dfrac{2}{35}$ meter larger.

85. $\dfrac{7}{8}-\dfrac{5}{12}$

$\dfrac{7}{8}\cdot\dfrac{3}{3}=\dfrac{21}{24}$

$\dfrac{5}{12}\cdot\dfrac{2}{2}=\dfrac{10}{24}$

$\dfrac{21}{24}-\dfrac{10}{24}=\dfrac{21-10}{24}=\dfrac{11}{24}$

It is $\dfrac{11}{24}$ cm larger.

86. $\dfrac{11}{36}-\dfrac{3}{28}$

$\dfrac{11}{36}\cdot\dfrac{7}{7}=\dfrac{77}{252}$

$\dfrac{3}{28}\cdot\dfrac{9}{9}=\dfrac{27}{252}$

$\dfrac{77}{252}-\dfrac{27}{252}=\dfrac{77-27}{252}=\dfrac{50}{252}=\dfrac{25}{126}$

It is $\dfrac{25}{126}$ yd larger.

87. a. $\dfrac{3}{4}+\dfrac{2}{3}$

$\dfrac{3}{4}\cdot\dfrac{3}{3}=\dfrac{9}{12}$

$\dfrac{2}{3}\cdot\dfrac{4}{4}=\dfrac{8}{12}$

$\dfrac{3}{4}+\dfrac{2}{3}=\dfrac{9}{12}+\dfrac{8}{12}=\dfrac{17}{12}$ or $1\dfrac{5}{12}$

b. $\dfrac{3}{4}-\dfrac{2}{3}$

$\dfrac{3}{4}\cdot\dfrac{3}{3}=\dfrac{9}{12}$

$\dfrac{2}{3}\cdot\dfrac{4}{4}=\dfrac{8}{12}$

$\dfrac{3}{4}-\dfrac{2}{3}=\dfrac{9}{12}-\dfrac{8}{12}=\dfrac{1}{12}$

c. $\dfrac{3}{4}\cdot\dfrac{2}{3}=\dfrac{\overset{1}{\cancel{3}}}{\underset{2}{\cancel{4}}}\cdot\dfrac{\overset{1}{\cancel{2}}}{\underset{1}{\cancel{3}}}=\dfrac{1\cdot1}{2\cdot1}=\dfrac{1}{2}$

d. $\dfrac{3}{4}\div\dfrac{2}{3}=\dfrac{3}{4}\cdot\dfrac{3}{2}=\dfrac{3\cdot3}{4\cdot2}=\dfrac{9}{8}$ or $1\dfrac{1}{8}$

88. a. $\dfrac{5}{6}\div\dfrac{3}{8}=\dfrac{5}{\underset{3}{\cancel{6}}}\cdot\dfrac{\overset{4}{\cancel{8}}}{3}=\dfrac{5\cdot4}{3\cdot3}=\dfrac{20}{9}$ or $2\dfrac{2}{9}$

b. $\dfrac{5}{6} + \dfrac{3}{8}$

$\dfrac{5}{6} \cdot \dfrac{4}{4} = \dfrac{20}{24}$

$\dfrac{3}{8} \cdot \dfrac{3}{3} = \dfrac{9}{24}$

$\dfrac{5}{6} + \dfrac{3}{8} = \dfrac{20}{24} + \dfrac{9}{24} = \dfrac{29}{24}$ or $1\dfrac{5}{24}$

c. $\dfrac{5}{6} - \dfrac{3}{8}$

$\dfrac{5}{6} \cdot \dfrac{4}{4} = \dfrac{20}{24}$

$\dfrac{3}{8} \cdot \dfrac{3}{3} = \dfrac{9}{24}$

$\dfrac{5}{6} - \dfrac{3}{8} = \dfrac{20}{24} - \dfrac{9}{24} = \dfrac{11}{24}$

d. $\dfrac{5}{6} \cdot \dfrac{3}{8} = \dfrac{5}{{}_2\cancel{6}} \cdot \dfrac{\cancel{3}^1}{8} = \dfrac{5 \cdot 1}{2 \cdot 8} = \dfrac{5}{16}$

89. a. $2\dfrac{5}{6} \cdot 1\dfrac{2}{3}$

$2\dfrac{5}{6} = \dfrac{12 + 5}{6} = \dfrac{17}{6}$

$1\dfrac{2}{3} = \dfrac{3 + 2}{3} = \dfrac{5}{3}$

$2\dfrac{5}{6} \cdot 1\dfrac{2}{3} = \dfrac{17}{6} \cdot \dfrac{5}{3}$

$\qquad = \dfrac{17 \cdot 5}{6 \cdot 3}$

$\qquad = \dfrac{85}{18}$ or $4\dfrac{13}{18}$

b. $2\dfrac{5}{6} + 1\dfrac{2}{3}$

$2\dfrac{5}{6} = \dfrac{12 + 5}{6} = \dfrac{17}{6}$

$1\dfrac{2}{3} = \dfrac{3 + 2}{3} = \dfrac{5}{3} \cdot \dfrac{2}{2} = \dfrac{10}{6}$

$2\dfrac{5}{6} + 1\dfrac{2}{3} = \dfrac{17}{6} + \dfrac{10}{6} = \dfrac{17 + 10}{6} = \dfrac{27}{6} = \dfrac{9}{2}$ or $4\dfrac{1}{2}$

c. $2\dfrac{5}{6} \div 1\dfrac{2}{3}$

$2\dfrac{5}{6} = \dfrac{12 + 5}{6} = \dfrac{17}{6}$

$1\dfrac{2}{3} = \dfrac{3 + 2}{3} = \dfrac{5}{3}$

$2\dfrac{5}{6} \div 1\dfrac{2}{3} = \dfrac{17}{6} \div \dfrac{5}{3}$

$\qquad = \dfrac{17 \cdot \cancel{3}^1}{{}_2\cancel{6} \cdot 5}$

$\qquad = \dfrac{17 \cdot 1}{2 \cdot 5}$

$\qquad = \dfrac{17}{10}$ or $1\dfrac{7}{10}$

d. $2\dfrac{5}{6} - 1\dfrac{2}{3}$

$2\dfrac{5}{6} = \dfrac{12 + 5}{6} = \dfrac{17}{6}$

$1\dfrac{2}{3} = \dfrac{3 + 2}{3} = \dfrac{5}{3} \cdot \dfrac{2}{2} = \dfrac{10}{6}$

$2\dfrac{5}{6} - 1\dfrac{2}{3} = \dfrac{17}{6} - \dfrac{10}{6} = \dfrac{17 - 10}{6} = \dfrac{7}{6}$ or $1\dfrac{1}{6}$

90. a. $3\dfrac{1}{2} - 2\dfrac{3}{4}$

$3\dfrac{1}{2} = \dfrac{6 + 1}{2} = \dfrac{7}{2} \cdot \dfrac{2}{2} = \dfrac{14}{4}$

$2\dfrac{3}{4} = \dfrac{8 + 3}{4} = \dfrac{11}{4}$

$3\dfrac{1}{2} - 2\dfrac{3}{4} = \dfrac{14}{4} - \dfrac{11}{4} = \dfrac{14 - 11}{4} = \dfrac{3}{4}$

b. $3\dfrac{1}{2} \cdot 2\dfrac{3}{4}$

$3\dfrac{1}{2} = \dfrac{6 + 1}{2} = \dfrac{7}{2}$

$2\dfrac{3}{4} = \dfrac{8 + 3}{4} = \dfrac{11}{4}$

$3\dfrac{1}{2} \cdot 2\dfrac{3}{4} = \dfrac{7}{2} \cdot \dfrac{11}{4}$

$\qquad = \dfrac{7 \cdot 11}{2 \cdot 4}$

$\qquad = \dfrac{77}{8}$ or $9\dfrac{5}{8}$

c. $3\frac{1}{2} \div 2\frac{3}{4}$

$3\frac{1}{2} = \frac{6+1}{2} = \frac{7}{2}$

$2\frac{3}{4} = \frac{8+3}{4} = \frac{11}{4}$

$3\frac{1}{2} \div 2\frac{3}{4} = \frac{7}{2} \div \frac{11}{4}$

$\qquad = \frac{7}{\underset{1}{\cancel{2}}} \cdot \frac{\cancel{4}^2}{11}$

$\qquad = \frac{14}{11}$ or $1\frac{3}{11}$

d. $3\frac{1}{2} + 2\frac{3}{4}$

$3\frac{1}{2} = \frac{6+1}{2} = \frac{7}{2} = \frac{7}{2} \cdot \frac{2}{2} = \frac{14}{4}$

$2\frac{3}{4} = \frac{8+3}{4} = \frac{11}{4}$

$3\frac{1}{2} + 2\frac{3}{4} = \frac{14}{4} + \frac{11}{4} = \frac{14+11}{4} = \frac{25}{4}$ or $6\frac{1}{4}$

91. $55\frac{3}{16} - 46\frac{1}{4}$

$55\frac{3}{16} = \frac{880+3}{16} = \frac{883}{16}$

$46\frac{1}{4} = \frac{184+1}{4} = \frac{185}{4} = \frac{185}{4} \cdot \frac{4}{4} = \frac{740}{16}$

$53\frac{3}{16} - 46\frac{1}{4} = \frac{883}{16} - \frac{740}{16} = \frac{143}{16} = 8\frac{15}{16}$

Rebecca has grown $8\frac{15}{16}$ inches.

92. $2\frac{1}{4} + 2\frac{7}{8} + 1\frac{3}{4}$

$2\frac{1}{4} = \frac{8+1}{4} = \frac{9}{4} = \frac{9}{4} \cdot \frac{2}{2} = \frac{18}{8}$

$2\frac{7}{8} = \frac{16+7}{8} = \frac{23}{8}$

$1\frac{3}{4} = \frac{4+3}{4} = \frac{7}{4} = \frac{7}{4} \cdot \frac{2}{2} = \frac{14}{8}$

$2\frac{1}{4} + 2\frac{7}{8} + 1\frac{3}{4} = \frac{18}{8} + \frac{23}{8} + \frac{14}{8} = \frac{55}{8} = 6\frac{7}{8}$

From June through August, $6\frac{7}{8}$ miles of highway were paved.

93. $1 - \frac{46}{55} = \frac{55}{55} - \frac{46}{55} = \frac{55-46}{55} = \frac{9}{55}$

The fraction of putts not made was $\frac{9}{55}$.

94. $1 - \frac{7}{9} = \frac{9}{9} - \frac{7}{9} = \frac{9-7}{9} = \frac{2}{9}$

The probability that global warming is not occurring is $\frac{2}{9}$.

95. $1 - \frac{37}{100} = \frac{100}{100} - \frac{37}{100} = \frac{100-37}{100} = \frac{63}{100}$

$\frac{63}{100}$ freshmen did not finish their bachelor's degree in 4 years.

96. $1 - \frac{443}{1000} = \frac{1000}{1000} - \frac{443}{1000} = \frac{1000-443}{1000} = \frac{557}{1000}$

$\frac{557}{1000}$ homes did not use electricity.

97. $8\frac{3}{8} - 7\frac{15}{16}$

$8\frac{3}{8} = \frac{64+3}{8} = \frac{67}{8} \cdot \frac{2}{2} = \frac{134}{16}$

$7\frac{15}{16} = \frac{112+15}{16} = \frac{127}{16}$

$\frac{134}{16} - \frac{127}{16} = \frac{134-127}{16} = \frac{7}{16}$

It is $\frac{7}{16}$ meter larger.

98. $1\frac{5}{16} = \frac{16+5}{16} = \frac{21}{16}$

$1\frac{5}{16} \div 6 = \frac{21}{16} \cdot \frac{1}{6} = \frac{7}{16} \cdot \frac{1}{2} = \frac{7}{32}$

Each person will get $\frac{7}{32}$ pounds of pie.

99. $10\frac{1}{2} - 8\frac{1}{5}$

$10\frac{1}{2} = \frac{21}{2} \cdot \frac{5}{5} = \frac{105}{10}$

$8\frac{1}{5} = \frac{41}{5} \cdot \frac{2}{2} = \frac{82}{10}$

$\frac{105}{10} - \frac{82}{10} = \frac{105-82}{10} = \frac{23}{10} = 2\frac{3}{10}$

She improved by $2\frac{3}{10}$ minutes.

100. $13\dfrac{1}{2} = \dfrac{26+1}{2} = \dfrac{27}{2}$

$22\left(13\dfrac{1}{2}\right) = \dfrac{\overset{11}{\cancel{22}}}{1} \cdot \dfrac{27}{\underset{1}{\cancel{2}}} = \dfrac{11 \cdot 27}{1 \cdot 1} = \dfrac{297}{1} = 297$

The turkey should be baked for 297 minutes or 4 hours and 57 minutes.

101. $3\dfrac{1}{8} = \dfrac{24+1}{8} = \dfrac{25}{8}$

$3\dfrac{1}{8} \div 2 = 3\dfrac{1}{8} \div \dfrac{2}{1} = \dfrac{25}{8} \cdot \dfrac{1}{2} = \dfrac{25}{16}$ or $1\dfrac{9}{16}$

Each piece is $\dfrac{25}{16}$ or $1\dfrac{9}{16}$ inches long.

102. $29\dfrac{3}{8} = \dfrac{29 \cdot 8 + 3}{8} = \dfrac{235}{8}$

$32 = \dfrac{32}{1} \cdot \dfrac{8}{8} = \dfrac{256}{8}$

$32 - 29\dfrac{3}{8} = \dfrac{256}{8} - \dfrac{235}{8} = \dfrac{21}{8}$ or $2\dfrac{5}{8}$

The pants will need to be shortened by $2\dfrac{5}{8}$ inches.

103. $\dfrac{1}{16} \cdot 80 = \dfrac{1}{16} \cdot \dfrac{80}{1} = \dfrac{1}{1} \cdot \dfrac{5}{1} = 5$

Mr. Krisanda should be given 5 milligrams of the drug.

104. $5\dfrac{1}{2} = \dfrac{10+1}{2} = \dfrac{11}{2}$

$5\dfrac{1}{2} \cdot \dfrac{1}{4} = \dfrac{11}{2} \cdot \dfrac{1}{4} = \dfrac{11 \cdot 1}{2 \cdot 4} = \dfrac{11}{8}$ or $1\dfrac{3}{8}$

$1\dfrac{3}{8}$ cups of chopped onions are needed.

105. $15 \div \dfrac{3}{8} = \dfrac{15}{1} \cdot \dfrac{8}{3} = \dfrac{5}{1} \cdot \dfrac{8}{1} = \dfrac{5 \cdot 8}{1 \cdot 1} = \dfrac{40}{1} = 40$

Tierra can wash her hair 40 times.

106. a. $16\dfrac{2}{3} = \dfrac{48+2}{3} = \dfrac{50}{3} = \dfrac{50}{3} \cdot \dfrac{8}{8} = \dfrac{400}{24}$

$22\dfrac{2}{3} = \dfrac{66+2}{3} = \dfrac{68}{3} = \dfrac{68}{3} \cdot \dfrac{8}{8} = \dfrac{544}{24}$

$14\dfrac{1}{8} = \dfrac{112+1}{8} = \dfrac{113}{8} = \dfrac{113}{8} \cdot \dfrac{3}{3} = \dfrac{339}{24}$

$16\dfrac{2}{3} + 22\dfrac{2}{3} + 14\dfrac{1}{8} = \dfrac{400}{24} + \dfrac{544}{24} + \dfrac{339}{24}$

$\qquad = \dfrac{400 + 544 + 339}{24}$

$\qquad = \dfrac{1283}{24}$ or $53\dfrac{11}{24}$

Matt will need $53\dfrac{11}{24}$ yards of fence.

b. $60 = \dfrac{60 \cdot 24}{24} = \dfrac{1440}{24}$

$53\dfrac{11}{24} = \dfrac{1283}{24}$

$60 - 53\dfrac{11}{24} = \dfrac{1440}{24} - \dfrac{1283}{24}$

$\qquad = \dfrac{1440 - 1283}{24}$

$\qquad = \dfrac{157}{24}$ or $6\dfrac{13}{24}$

Matt will have $6\dfrac{13}{24}$ yards of fence left over.

107. $\dfrac{1}{4} + \dfrac{1}{4} + 1 = \dfrac{1}{4} + \dfrac{1}{4} + \dfrac{4}{4} = \dfrac{6}{4} = \dfrac{3}{2}$ or $1\dfrac{1}{2}$

The total thickness is $1\dfrac{1}{2}$ inches.

108. $4\dfrac{1}{2} = \dfrac{8+1}{2} = \dfrac{9}{2} = \dfrac{9}{2} \cdot \dfrac{6}{6} = \dfrac{54}{12}$

$1\dfrac{1}{6} = \dfrac{6+1}{6} = \dfrac{7}{6} = \dfrac{7}{6} \cdot \dfrac{2}{2} = \dfrac{14}{12}$

$1\dfrac{3}{4} = \dfrac{4+3}{4} = \dfrac{7}{4} = \dfrac{7}{4} \cdot \dfrac{3}{3} = \dfrac{21}{12}$

$4\dfrac{1}{2} + 1\dfrac{1}{6} + 1\dfrac{3}{4} = \dfrac{54}{12} + \dfrac{14}{12} + \dfrac{21}{12} = \dfrac{89}{12} = 7\dfrac{5}{12}$

The total weight is $7\dfrac{5}{12}$ tons.

109. $4\dfrac{2}{3} = \dfrac{12+2}{3} = \dfrac{14}{3}$

$28 \div \dfrac{14}{3} = \dfrac{28}{1} \cdot \dfrac{3}{14} = \dfrac{2}{1} \cdot \dfrac{3}{2} = \dfrac{6}{1} = 6$

There will be 6 whole strips of wood.

110. $4\dfrac{1}{2}=\dfrac{9}{2}=\dfrac{9}{2}\cdot\dfrac{12}{12}=\dfrac{108}{24}$

$2\dfrac{1}{3}=\dfrac{7}{3}=\dfrac{7}{3}\cdot\dfrac{8}{8}=\dfrac{56}{24}$

$\dfrac{1}{8}=\dfrac{1}{8}\cdot\dfrac{3}{3}=\dfrac{3}{24}$

$4\dfrac{1}{2}+2\dfrac{1}{3}+\dfrac{1}{8}=\dfrac{108}{24}+\dfrac{56}{24}+\dfrac{3}{24}=\dfrac{167}{24}$ or $6\dfrac{23}{24}$

The length of the shaft of the bolt must be

$6\dfrac{23}{24}$ inches.

111.a. $8=\dfrac{8}{1}\cdot\dfrac{12}{12}=\dfrac{96}{12}$

8 feet = 96 inches

$36\dfrac{1}{2}+14\dfrac{1}{8}+31\dfrac{3}{4}\approx 37+14+32\approx 83<96$

Yes, there will be sufficient room for this purchase.

b. Total height of TV + stand + credenza

$=36\dfrac{1}{2}$ in. $+14\dfrac{1}{8}$ in. $+31\dfrac{3}{4}$ in.

$36\dfrac{1}{2}=\dfrac{73}{2}=\dfrac{73}{2}\cdot\dfrac{4}{4}=\dfrac{292}{8}$

$14\dfrac{1}{8}=\dfrac{112+1}{8}=\dfrac{113}{8}$

$31\dfrac{3}{4}=\dfrac{127}{4}=\dfrac{127}{4}\cdot\dfrac{2}{2}=\dfrac{254}{8}$

$36\dfrac{1}{2}+14\dfrac{1}{8}+31\dfrac{3}{4}=\dfrac{292}{8}+\dfrac{113}{8}+\dfrac{254}{8}=\dfrac{659}{8}$ or

$82\dfrac{3}{8}$

Total height of the TV, the stand, and the credenza is $\dfrac{659}{8}$ or $82\dfrac{3}{8}$ inches.

112. $(5\cdot 2)\div 30=10\div 30=\dfrac{\overset{1}{\cancel{10}}}{1}\cdot\dfrac{1}{\underset{3}{\cancel{30}}}=\dfrac{1\cdot 1}{1\cdot 3}=\dfrac{1}{3}$

Each person gets $\dfrac{1}{3}$ liter.

113. Answers will vary.

For example, to find the LCM of 6, 3, and 10, list the multiples of each number, and the LCM will be the first multiple that all three numbers have in common.

3: 3, 6, 9, 12, 15, 18, 21, 24, 27, 30

6: 6, 12, 18, 24, 30

10: 10, 20, 30

The LCM of 6, 3, and 10 is 30.

114. Answers will vary.

To simplify a fraction, divide out the common factors. For example, to simplify the fraction $\dfrac{18}{24}$, you would divide out the common factors.

18: 1, 2, 3, 6, 9, 18

24: 1, 2, 3, 4, 6, 8, 12, 24

The greatest common factor is 6

$\dfrac{18}{24}=\dfrac{18\div 6}{24\div 6}=\dfrac{3}{4}$

115. a. $\dfrac{*}{a}+\dfrac{?}{a}=\dfrac{*+?}{a}$

b. $\dfrac{\odot}{?}-\dfrac{\square}{?}=\dfrac{\odot-\square}{?}$

c. $\dfrac{\triangle}{\square}+\dfrac{4}{\square}=\dfrac{\triangle+4}{\square}$

d. $\dfrac{x}{3}-\dfrac{2}{3}=\dfrac{x-2}{3}$

e. $\dfrac{12}{x}-\dfrac{4}{x}=\dfrac{12-4}{x}=\dfrac{8}{x}$

116.a. $\dfrac{\triangle}{a}\cdot\dfrac{\square}{b}=\dfrac{\triangle\square}{ab}$

b. $\dfrac{6}{3}\cdot\dfrac{\triangle}{\square}=\dfrac{2}{1}\cdot\dfrac{\triangle}{\square}=\dfrac{2\cdot\triangle}{1\cdot\square}=\dfrac{2\triangle}{\square}$

c. $\dfrac{x}{a}\cdot\dfrac{y}{b}=\dfrac{xy}{ab}$

d. $\dfrac{3}{8}\cdot\dfrac{4}{y}=\dfrac{3}{\underset{2}{\cancel{8}}}\cdot\dfrac{\overset{1}{\cancel{4}}}{y}=\dfrac{3\cdot 1}{2\cdot y}=\dfrac{3}{2y}$

e. $\dfrac{3}{x}\cdot\dfrac{x}{y}=\dfrac{3}{\underset{1}{\cancel{x}}}\cdot\dfrac{\overset{1}{\cancel{x}}}{y}=\dfrac{3\cdot 1}{1\cdot y}=\dfrac{3}{y}$

117. number of pills

$=\dfrac{(\text{mg per day})(\text{days per month})(\#\text{ of months})}{\text{mg per pill}}$

number of pills $=\dfrac{(450)(30)(6)}{300}=270$

Dr. Muechler should prescribe 270 pills.

118. a. flakes, 2 cups; milk, 6 tbsp

   b. flakes, 2 cups; milk, $7\frac{1}{3}$ tbsp

   c. flakes, 2 cups; milk, $\frac{1}{2}$ cup or 8 tbsp

   d. flakes, 2 cups; milk, $8\frac{2}{3}$ tbsp

   e. flakes are same, milk is different: $\frac{1}{3}$ cup is
   not twice 2 tbsp

119. Answers will vary.

120. $\frac{9+8+15+32+16}{5}=\frac{80}{5}=16$
The mean is 16.

121. In order, the values are: 8, 9, 15, 16, 32.
The median is 15.

122. Variables are letters used to represent numbers.

Exercise Set 1.4

1. $\sqrt{5}$ and $\sqrt{7}$ are examples of <u>irrational</u> numbers.

2. The set of negative integers is <u>{…–3, –2, –1}</u>.

3. Another name for the positive integers is the set of <u>counting</u> numbers.

4. The set {…, –2, –1, 0, 1, 2, 3, …} is more commonly referred to as the set of <u>integers</u>.

5. The set of real numbers can be displayed pictorially as a real number <u>line</u>.

6. The symbol Ø is used to denote the <u>empty</u> set.

7. {0, 1, 2, 3, …} is called the set of <u>whole</u> numbers.

8. Numbers than can be expressed as a fraction having integer numerator and non-zero integer denominator are called <u>rational</u> numbers.

9. An example of a real number that is not a rational number is $\sqrt{3}$.

10. In general, a collection of elements is called a <u>set</u>.

11. The natural numbers are {1, 2, 3, 4, …}.

12. The counting numbers are {1, 2, 3, 4, …}

13. The whole numbers are {0, 1, 2, 3, 4, …}.

14. The negative integers are {…, –3, –2, –1}.

15. The integers are {…, –3, –2, –1, 0, 1, 2, 3, …}.

16. The positive integers are {1, 2, 3, 4, …}.

17. True; the natural numbers are {1, 2, 3, 4, …}.

18. False; the natural numbers are {1, 2, 3, 4, …}.

19. False; the whole numbers are {0, 1, 2, …}.

20. True; the whole numbers are {0, 1, 2, …}.

21. False; the integers are {…, –2, –1, 0, 1, 2, …}.

22. True; the integers are {…, –2, –1, 0, 1, 2, …}.

23. True; 0.57 can be expressed as a quotient of two integers, $\frac{57}{100}$.

24. False; $\sqrt{3}$ cannot be expressed as the quotient of two integers.

25. False; $\sqrt{2}$ cannot be expressed as the quotient of two integers.

26. True; 0.666… can be expressed as a quotient of two integers, $\frac{2}{3}$.

27. True; $-\frac{1}{5}$ can be expressed as a quotient of two integers, $\frac{-1}{5}$ or $\frac{1}{-5}$.

28. False; $-\frac{2}{3}$ can be expressed as a quotient of two integers, $\frac{-2}{3}$ or $\frac{2}{-3}$.

29. True; $\sqrt{5}$ cannot be expressed as the quotient of two integers.

30. True; $-\sqrt{7}$ cannot be expressed as the quotient of two integers.

31. False; 0 is a whole number, but it is not a natural number.

32. True; every counting number can be expressed as a quotient of two integers.

33. True, either ∅ or { } is used.

34. False; the positive integers are not negative.

35. False; irrational numbers are real but not rational.

36. True; any negative integer can be represented on a real number line and is therefore real.

37. True; any rational number can be represented on a real number line and is therefore real.

38. True; the counting numbers are {1, 2, 3, …}, the whole numbers are {0, 1, 2, …}.

39. True; irrational numbers are real numbers which are not rational.

40. False; all irrational numbers are also real numbers.

41. False; any negative irrational number is a counterexample.

42. True; this is the definition of a real number.

43. True; the symbol $\mathbb{R}$ represents the set of real numbers.

44. True; this is the definition of a negative number.

45. False; every number greater than zero is positive but not necessarily an integer.

46. False; irrational numbers are real and so can be represented on a number line.

47. True; the integers are $\left\{ \underbrace{...,-2,-1}_{\text{negative integers}}, \underbrace{0}_{\text{zero}}, \underbrace{1,2,...}_{\text{positive integers}} \right\}$.

48. True; all are names for the set {1, 2, 3, …}.

49. a. 13 is a positive integer.

    b. –2 and 13 are rational numbers.

    c. –2 and 13 are real numbers.

    d. 13 is a whole number.

50. a. 0 is an integer.

    b. 0 and $2\frac{1}{2}$ are rational numbers.

    c. 0 and $2\frac{1}{2}$ are real numbers.

51. a. 3 and 77 are positive integers.

    b. 0, 3, and 77 are whole numbers.

    c. 0, –2, 3, and 77 are integers.

    d. $-\frac{5}{7}$, 0, – 2, 3, $6\frac{1}{4}$, 1.63, and 77 are rational numbers.

    e. $\sqrt{7}$ and $-\sqrt{3}$ are irrational numbers.

    f. $-\frac{5}{7}$, 0, – 2, 3, $6\frac{1}{4}$, $\sqrt{7}$, $-\sqrt{3}$, 1.63, and 77 are real numbers.

52. a. 7 and 9 are positive integers.

    b. 7, 0, and 9 are whole numbers.

c. –6, 7, 0, and 9 are integers.

d. –6, 7, 12.4, $-\frac{9}{5}$, $-2\frac{1}{4}$, 0, 9, 0.35, and $\frac{22}{7}$ are rational numbers.

e. $\sqrt{3}$ and $\sqrt{7}$ are irrational numbers.

f. –6, 7, 12.4, $-\frac{9}{5}$, $-2\frac{1}{4}$, $\sqrt{3}$, 0, 9, $\sqrt{7}$, 0.35, and $\frac{22}{7}$ are real numbers.

For Exercises 53–64, answers will vary. One possible answer is given.

53. 0, 1, 2

54. $\frac{1}{2}$, $-\frac{1}{2}$, 0.6

55. $-\sqrt{2}$, $-\sqrt{3}$, $-\sqrt{7}$

56. 1, $\frac{1}{2}$, $-\frac{3}{5}$

57. $-\frac{2}{3}$, $\frac{1}{2}$, 6.3

58. –5, 0, 4

59. –13, –5, –1

60. –1, –2, –3

61. $\sqrt{2}$, $\sqrt{3}$, $-\sqrt{5}$

62. 1.5, 3, $6\frac{1}{4}$

63. –7, 1, 5

64. $-\frac{1}{2}$, $-\frac{5}{8}$, $-\sqrt{5}$

65. {8, 9, 10, 11, …, 94}
94 – 8 +1 = 86 + 1 = 87
The set has 87 elements.

66. {–4, –3, –2, –1, 0, 1, …, 64}
$64-(-4)+1 = 64+4+1 = 69$
The set has 69 elements.

67. a. $A = \{1, 3, 4, 5, 8\}$

    b. $B = \{2, 5, 6, 7, 8\}$

    c. A and $B = \{5, 8\}$

    d. A or $B = \{1, 2, 3, 4, 5, 6, 7, 8\}$

68. a. $A = \{\Delta, P, ?, *\}$

   b. $B = \{*, \square, L, W, R\}$

   c. A and $B = \{*\}$

   d. A or $B = \{\Delta, P, ?, *, \square, L, W, R\}$

69. a. Set B continues beyond 4.

   b. Set A has 4 elements.

   c. Set B has an infinite number of elements.

   d. Set B is an infinite set.

70. a. There are an infinite number of decimal numbers between any 2 numbers.

   b. There are an infinite number of decimal numbers between any 2 numbers.

71. a. There are an infinite number of fractions between any 2 numbers.

   b. There are an infinite number of fractions between any 2 numbers.

72. a. $\cup : \{1,2,3,4,5,6,7,8,9\}; \cap : \{2,3,8\}$

   b. $\cup : \{a,b,c,d,g,h,i,j,m,p\}; \cap \{b,c,d\}$

   c. $\cup : \{$red, blue, green, yellow, pink, orange, purple$\}; \cap : \varnothing$

73. $5\dfrac{4}{5} = \dfrac{5 \cdot 5 + 4}{5} = \dfrac{25 + 4}{5} = \dfrac{29}{5}$

74. $\dfrac{16}{3} = 5\dfrac{1}{3}$ because $16 \div 3 = 5$ R 1

75. $\dfrac{7}{8} - \dfrac{1}{3}$

$$\dfrac{7}{8} = \dfrac{7}{8} \cdot \dfrac{3}{3} = \dfrac{21}{24}$$

$$\dfrac{1}{3} = \dfrac{1}{3} \cdot \dfrac{8}{8} = \dfrac{8}{24}$$

$$\dfrac{7}{8} - \dfrac{1}{3} = \dfrac{21}{24} - \dfrac{8}{24} = \dfrac{21 - 8}{24} = \dfrac{13}{24}$$

76. $\dfrac{3}{5} \div 6\dfrac{3}{4}$

$$6\dfrac{3}{4} = \dfrac{24 + 3}{4} = \dfrac{27}{4}$$

$$\dfrac{3}{5} \div 6\dfrac{3}{4} = \dfrac{3}{5} \div \dfrac{27}{4} = \dfrac{\overset{1}{\cancel{3}}}{5} \cdot \dfrac{4}{\underset{9}{\cancel{27}}} = \dfrac{1 \cdot 4}{5 \cdot 9} = \dfrac{4}{45}$$

Exercise Set 1.5

1. Regardless of the value of a, the value of $|a| - |a|$ is 0.

2. The symbol < means is <u>less</u> than.

3. The absolute value of the number a is expressed as $|a|$.

4. If we write $x > 0$, alternatively we could say that x is a <u>positive</u> number.

5. (True or False) If a and b are real numbers and $a < b$, then $b > a$. <u>True</u>

6. The symbol > means <u>greater</u> than.

7. The distance between 6 and –4 on the number line can be expressed as $\lfloor 6 - (-4) \rfloor$.

8. The distance the number –4 is from zero can be expressed as $\lfloor -4 \rfloor$.

9. The negative of the absolute value of a nonzero number will always be a <u>negative</u> number.

10. The absolute value of a number represents its <u>distance</u> from 0 on a real number line.

11. $|7| = 7$

12. $|54| = 54$

13. $|-15| = 15$

14. $|-6| = 6$

15. $|0| = 0$

16. $-|0| = 0$

17. $-|-5| = -(5) = -5$

18. $-|-34| = -(34) = -34$

19. $-|26| = -(26) = -26$

20. $-|92| = -(92) = -92$

21. a. $21 < 26$; 21 is to the left of 26 on a number line.
   b. $-21 > -26$; –21 is to the right of –26 on a number line.

22. a. $31 > 29$; 31 is to the right of 29 on a number line.
   b. $-31 < -29$; –31 is to the left of –29 on a number line.

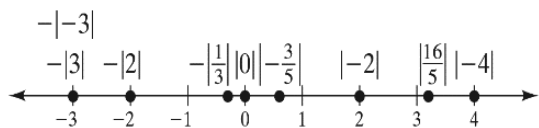**23. a.** $71 > 0$; 71 is to the right of 0 on a number line.
b. $-71 < 0$; –71 is to the left of 0 on a number line.

24. a. $-71 < 0$; –71 is to the left of 0 on a number line.
b. $37 > -21$; 37 is to the right of –21 on a number line.

25. $\dfrac{2}{3} < \dfrac{3}{4}$; $\dfrac{2}{3}$ is to the left of $\dfrac{3}{4}$ on a number line.

26. $\dfrac{3}{4} < \dfrac{5}{6}$; $\dfrac{3}{4}$ is to the left of $\dfrac{5}{6}$ on a number line.

27. $-\dfrac{2}{3} > -\dfrac{3}{4}$; $-\dfrac{2}{3}$ is to the right of $-\dfrac{3}{4}$ on a number line.

28. $-\dfrac{3}{4} > -\dfrac{5}{6}$; $-\dfrac{3}{4}$ is to the right of $-\dfrac{5}{6}$ on a number line.

29. $\dfrac{1}{2} > -\dfrac{2}{3}$; $\dfrac{1}{2}$ is to the right of $-\dfrac{2}{3}$ on a number line.

30. $-\dfrac{1}{2} < \dfrac{2}{3}$; $-\dfrac{1}{2}$ is to the left of $\dfrac{2}{3}$ on a number line.

31. $0.1 < 0.3$; 0.1 is to the left of 0.3 on a number line.

32. $-0.1 > -0.3$; –0.1 is to the right of –0.3 on a number line.

33. $-2.1 < -2$; –2.1 is to the left of –2 on a number line.

34. $-1.83 < -1.82$; –1.83 is to the left of –1.82 on a number line.

35. $0.08 < 0.1$; 0.08 is to the left of 0.1 on a number line.

36. $-0.08 > -0.1$; –0.08 is to the right of –0.1 on a number line.

37. $4.09 < 5.3$; 4.09 is to the left of 5.3 on a number line.

38. $-4.09 > -5.3$; –4.09 is to the right of –5.3 on a number line.

39. $0.49 > 0.43$; 0.49 is to the right of 0.43 on a number line.

40. $-1.0 < -0.7$; –1.0 is to the left of –0.7 on a number line.

41. $-0.086 > -0.095$; –0.086 is to the right of –0.095 on a number line.

42. $0.086 < 0.95$; 0.086 is to the left of 0.95 on a number line.

43. $0.001 < 0.002$; 0.001 is to the left of 0.002 on a number line.

44. $-0.006 > -0.007$; –0.006 is to the right of –0.007 on a number line.

45. $\dfrac{5}{8} > 0.6$ because $\dfrac{5}{8} = 0.625$ and 0.625 is to the right of 0.6 on a number line.

46. $2.7 < \dfrac{10}{3}$ since $\dfrac{10}{3} = 3\dfrac{1}{3}$ and $3\dfrac{1}{3}$ is to the right of 2.7 on a number line.

47. $-\dfrac{4}{3} < -\dfrac{2}{3}$; $-\dfrac{4}{3}$ is to the left of $-\dfrac{2}{3}$ on a number line.

48. $\dfrac{19}{2} > \dfrac{17}{2}$; $\dfrac{19}{2}$ is to the right of $\dfrac{17}{2}$ on a number line.

49. $-0.8 < -\dfrac{3}{5}$; –0.8 is to the left of –0.6 on a number line.

50. $-0.7 < -0.2$; –0.7 is to the left of –0.2 on a number line.

51. $0.3 < \dfrac{1}{3}$; 0.3 is to the left of .333... on a number line.

52. $\dfrac{9}{20} > .42$; .45 is to the right of .42 on a number line.

53. $-\dfrac{17}{30} > -\dfrac{16}{20}$; $-\dfrac{34}{60}$ is to the right of $-\dfrac{48}{60}$ on a number line.

54. $\dfrac{13}{15} < \dfrac{8}{9}$; $\dfrac{39}{45}$ is to the left of $\dfrac{40}{45}$ on a number line.

55. $-(-6) > -(-5)$; 6 is to the right of 5 on a number line.

56. $-\left(\dfrac{-12}{13}\right) > \dfrac{7}{8}$; $\dfrac{96}{104}$ is to the right of $\dfrac{91}{104}$ on a number line.

57. $5 > |{-2}|$ since $|{-2}| = 2$

58. $|{-12}| < |{-13}|$ since $|{-12}| = 12$ and $|{-13}| = 13$

59. $\frac{3}{4} < |-4|$ since $|-4| = 4$

60. $|-4| > -3$ since $|-4| = 4$

61. $|0| < |-4|$ since $|0| = 0$ and $|-4| = 4$

62. $|-2.1| > |-1.8|$ since $|-2.1| = 2.1$ and $|-1.8| = 1.8$.

63. $4 < \left|-\frac{9}{2}\right|$ since $\left|-\frac{9}{2}\right| = \frac{9}{2}$ or $4\frac{1}{2}$

64. $|-5| > -|-6|$ since $|-5| = 5$ and $-|-6| = -6$

65. $\left|-\frac{4}{5}\right| < \left|-\frac{5}{4}\right|$ since $\left|-\frac{4}{5}\right| = \frac{4}{5} = \frac{16}{20}$ and

$\left|-\frac{5}{4}\right| = \frac{5}{4} = \frac{25}{20}$

66. $\left|\frac{2}{5}\right| = |-0.40|$ since $\left|\frac{2}{5}\right| = \frac{2}{5} = 0.40$ and

$|-0.40| = 0.40$

67. $|-4.6| = \left|-\frac{23}{5}\right|$ since $|-4.6| = 4.6$ and

$\left|-\frac{23}{5}\right| = \frac{23}{5} = 4.6$

68. $\left|-\frac{8}{3}\right| < |-3.5|$ since $\left|-\frac{8}{3}\right| = \frac{8}{3} = 2\frac{2}{3}$ and $|-3.5| = 3.5$

69. $\frac{2}{3} + \frac{2}{3} + \frac{2}{3} + \frac{2}{3} = 4 \cdot \frac{2}{3}$ since

$\frac{2}{3} + \frac{2}{3} + \frac{2}{3} + \frac{2}{3} = \frac{2+2+2+2}{3} = \frac{8}{3}$ and

$4 \cdot \frac{2}{3} = \frac{4}{1} \cdot \frac{2}{3} = \frac{8}{3}$

70. $\frac{3}{4} + \frac{3}{4} > \frac{3}{4} \cdot \frac{3}{4}$ since $\frac{3}{4} + \frac{3}{4} = \frac{3+3}{4} = \frac{6}{4} = 1\frac{1}{2}$ and

$\frac{3}{4} \cdot \frac{3}{4} = \frac{3 \cdot 3}{4 \cdot 4} = \frac{9}{16}$

71. $\frac{1}{2} \cdot \frac{1}{2} < \frac{1}{2} \div \frac{1}{2}$ since $\frac{1}{2} \cdot \frac{1}{2} = \frac{1 \cdot 1}{2 \cdot 2} = \frac{1}{4}$ and

$\frac{1}{2} \div \frac{1}{2} = \frac{1}{2} \cdot \frac{2}{1} = \frac{1}{1} \cdot \frac{1}{1} = 1$

72. $5 \div \frac{2}{3} > \frac{2}{3} \div 5$ since $5 \div \frac{2}{3} = \frac{5}{1} \cdot \frac{3}{2} = \frac{15}{2} = 7\frac{1}{2}$ and

$\frac{2}{3} \div 5 = \frac{2}{3} \cdot \frac{1}{5} = \frac{2}{15}$

73. $\frac{7}{8} - \frac{1}{2} < \frac{7}{8} \div \frac{1}{2}$ since $\frac{7}{8} - \frac{1}{2} = \frac{7}{8} - \frac{4}{8} = \frac{3}{8}$ and

$\frac{7}{8} \div \frac{1}{2} = \frac{7}{8} \cdot \frac{2}{1} = \frac{14}{8}$

74. $3\frac{1}{5} + \frac{1}{3} > 3\frac{1}{5} \cdot \frac{1}{3}$ since $3\frac{1}{5} + \frac{1}{3} = \frac{16}{5} + \frac{1}{3}$

$= \frac{16}{5} \cdot \frac{3}{3} + \frac{1}{3} \cdot \frac{5}{5}$

$= \frac{48}{15} + \frac{5}{15}$

$= \frac{53}{15}$

$= 3\frac{8}{15}$

and $3\frac{1}{5} \cdot \frac{1}{3} = \frac{16}{3} \cdot \frac{1}{3} = \frac{16}{9} = 1\frac{7}{9}$

75. $-|-1|, \frac{3}{7}, \frac{4}{9}, 0.46, |-5|$ because

$-|-1| = -1, \frac{3}{7} \approx 0.429, \frac{4}{9} = 0.444...,$ and $|-5| = 5$.

76. $-1.74, -\frac{3}{4}, -|0.6|, -\frac{5}{9}, |-1.9|$ because

$-\frac{3}{4} = -0.75, -|0.6| = -0.6, -\frac{5}{9} = -0.555...,$

and $|-1.9| = 1.9$.

77. $\frac{5}{12}, 0.6, \frac{2}{3}, \frac{19}{25}, |-2.6|$ because

$\frac{5}{12} = 0.416416..., \frac{2}{3} = 0.666...,$

$\frac{19}{25} = 0.76$ and $|-2.6| = 2.6$.

78. $-|-5|, \frac{7}{12}, \left|\frac{-12}{5}\right|, 2.7, |-9|$ because

$-|-5| = -5, \frac{7}{12} = 0.58333..., \left|\frac{-12}{5}\right| = 2.4,$

and $|-9| = 9$.

79. 4 and -4 since $|4| = |-4| = 4$

80. 100 and -100 since $|100| = |-100| = 100$

For Exercises 81-88, answers will vary. One possible
answer is given.

81. There are no real numbers that are less than 4 and
greater than 8.

82. Three numbers greater than 4 and less than 6

are $4\frac{1}{2}$, 5, 5.5.

83. Three numbers less than –2 and greater than –6 are –3, –4, –5.

84. Three real numbers that are greater than –5 and greater than –9 are –4, 0, and 3.

85. Three numbers greater than –3 and greater than 3 are 4, 5, 6.

86. Three numbers that are less than –3 and less than 3 are –4, –5, and –6.

87. Three numbers greater than $|-2|$ and less than $|-6|$ are 3, 4, 5.

88. There are no real numbers that are greater than $|-3|$ and less than $|3|$.

89.a. Between does not include endpoints.

   b. Three real numbers between 4 and 6 are 4.1, 5, and $5\frac{1}{2}$.

   c. No, 4 is an endpoint.

   d. Yes, 5 is greater than 4 and less than 6.

   e. True

90.a. 1992

   b. 1999

   c. 1999-2009

91.a. dietary fiber and thiamin

   b. vitamin E, niacin, and riboflavin

92. Yes, 0. The absolute value of 0 is 0, which is not a positive number.

93. Yes. The absolute value of any real number a is the positive value of that number. Any real number subtracted by itself is 0.

For example, let $a = -4$. So, $|-4| - |-4| = 4 - 4 = 0$.

94. No, this is not true.

For example, let $a = -3$ and $b = -4$. $-3 > -4$, so $a > b$ is true. $|-3| = 3$ and $|-4| = 4$, so $|-3| < |-4|$. Therefore, $|a| > |b|$ is not always true when $a > b$.

95. No, this is not true.

For example, let $a = -4$ and b = -3. $|-3| = 3$ and $|-4| = 4$, and $|-4| > |-3|$, so $|a| > |b|$ is true. However, $-4 < -3$, so $a > b$ is not true. Therefore, $a > b$ is not always true when $|a| > |b|$.

96. The result of multiplying any positive number by a number between 0 and 1 is smaller than the original number. Thus, when you multiply a number between 0 and 1 by itself, the result is smaller than the original number.

97. The result of dividing a number by itself is 1. Thus, the result of dividing a number between 0 and 1 by itself is a number, 1, which is greater than the original number.

98. 3 and –3 since $|3| = |-3| = 3$

99. No, an absolute value of a number cannot be negative.

100.a. If $x \bullet 0$, then $|x| = x$.

   b. If $x < 0$, then $|x| = -x$.

   c. $|x| = \begin{cases} x, & x \geq 0 \\ -x, & x < 0 \end{cases}$

101.

102. $2\frac{3}{5} + 3\frac{1}{3}$

$2\frac{3}{5} = \frac{10+3}{5} = \frac{13}{5} \cdot \frac{3}{3} = \frac{39}{15}$

$3\frac{1}{3} = \frac{9+1}{3} = \frac{10}{3} \cdot \frac{5}{5} = \frac{50}{15}$

$2\frac{3}{5} + 3\frac{1}{3} = \frac{39}{15} + \frac{50}{15} = \frac{39+50}{15} = \frac{89}{15} = 5\frac{14}{15}$

103. The set of integer numbers is {…, –3, –2, –1, 0, 1, 2, 3, …}.

104. The set of whole numbers is {0, 1, 2, 3, …}.

105. a. 5 is a natural number.

   b. 5 and 0 are whole numbers.

   c. 5, –2, and 0 are integers.

   d. 5, –2, 0, $\frac{1}{3}$, $-\frac{5}{9}$, and 2.3 are rational numbers.

e. $\sqrt{3}$ and   are irrational numbers.

f. $5, -2, 0, \dfrac{1}{3}, \sqrt{3}, -\dfrac{5}{9}, 2.3$, and   are real numbers.

Mid-Chapter Test: Sections 1.1-1.5

1. At least two hours of study and homework for each hour of class time is generally recommended.

2. a. The mean is
$$\frac{78.83 + 96.57 + 62.23 + 88.79 + 101.75 + 55.62}{6}$$
$$= \frac{483.78}{6} = \$80.63.$$

b. To find the median place the numbers in order: 55.62, 62.23, 78.83, 88.79, 96.57, 101.75. Since there are an even amount of numbers, take the two in the middle and take their mean.
$$\frac{78.83 + 88.79}{2} = \frac{167.62}{2} = \$83.81.$$

3. New balance = Old balance + Deposits – Purchases

New balance = 652.70 + 230.75 – 3(19.62)
              = 652.70 + 230.75 – 58.86
              = 824.59
Her new balance is $824.59.

4. a. Rental cost from Natwora's
= 7.50(each 15-minute increment)
= $7.5(16)$
= 120

Rental cost for Gurney's
=18(each 30-minute increment)
=18(8)
=144

Natwora's is the better deal.

b. 144–120 = 24
You will save $24.

5. We must find out how many 1000 gallons was used. $\dfrac{33,700}{1000} = 33.7$
Water Bill = 1.85(number of 1000 gallons used)
           = 1.85(33.7)
           ≈ 62.345
The water bill would be $62.35.

6. $\dfrac{3}{7} \cdot \dfrac{7}{18} = \dfrac{\overset{1}{\cancel{3}}}{\cancel{7}} \cdot \dfrac{\overset{1}{\cancel{7}}}{\cancel{18}_{6}} = \dfrac{1 \cdot 1}{1 \cdot 6} = \dfrac{1}{6}$

7. $\dfrac{9}{16} \div \dfrac{15}{13} = \dfrac{\overset{3}{\cancel{9}}}{16} \cdot \dfrac{13}{\cancel{15}_{5}} = \dfrac{3 \cdot 13}{16 \cdot 5} = \dfrac{39}{80}$

8. $\dfrac{5}{8} + \dfrac{3}{5}$

$\dfrac{5}{8} \cdot \dfrac{5}{5} = \dfrac{25}{40}$

$\dfrac{3}{5} \cdot \dfrac{8}{8} = \dfrac{24}{40}$

$\dfrac{5}{8} + \dfrac{3}{5} = \dfrac{25}{40} + \dfrac{24}{40} = \dfrac{25+24}{40} = \dfrac{49}{40} = 1\dfrac{9}{40}$

9. $6\dfrac{1}{4} - 3\dfrac{1}{5}$

$6\dfrac{1}{4} = \dfrac{24+1}{4} = \dfrac{25}{4} \cdot \dfrac{5}{5} = \dfrac{125}{20}$

$3\dfrac{1}{5} = \dfrac{15+1}{5} = \dfrac{16}{5} \cdot \dfrac{4}{4} = \dfrac{64}{20}$

$6\dfrac{1}{4} - 3\dfrac{1}{5} = \dfrac{125}{20} - \dfrac{64}{20} = \dfrac{125-64}{20} = \dfrac{61}{20} = 3\dfrac{1}{20}$

10. $p = 2l + 2w$

$= 2\left(14\dfrac{2}{3}\right) + 2\left(12\dfrac{1}{2}\right)$

$= 2\left(\dfrac{44}{3}\right) + 2\left(\dfrac{25}{2}\right)$

$= \dfrac{88}{3} + \dfrac{50}{2}$

$= \left(\dfrac{88}{3} \cdot \dfrac{2}{2}\right) + \left(\dfrac{50}{2} \cdot \dfrac{3}{3}\right)$

$= \dfrac{176}{6} + \dfrac{150}{6}$

$= \dfrac{326}{6} = 54\dfrac{2}{6} = 54\dfrac{1}{3}$

He will need $54\dfrac{1}{3}$ feet of fencing.

11. False   **12.** True

13. False   **14.** True

15. False   **16.** $-\left|-\dfrac{7}{10}\right| = -\dfrac{7}{10}$

17. –0.005 > –0.006 because –0.005 is to the right of –0.006 on the number line.

18. $\dfrac{7}{8} > \dfrac{5}{6}$ because

$\dfrac{7}{8} = \dfrac{7}{8}\cdot\dfrac{3}{3} = \dfrac{21}{24}$ and $\dfrac{5}{6} = \dfrac{5}{6}\cdot\dfrac{4}{4} = \dfrac{20}{24}$.

19. $\left|-9\right| < \left|-19\right|$ because $\left|-9\right| = 9$ and $\left|-19\right| = 19$.

20. $\left|-\dfrac{3}{8}\right| = \left|-0.375\right|$ because $\left|-\dfrac{3}{8}\right| = \dfrac{3}{8} = 0.375$ and $\left|-0.375\right| = 0.375$.

Exercise Set 1.6

1. The sum of two negative numbers is always <u>negative</u>.

2. Another expression for "opposite" of a real number is additive <u>inverse</u>.

3. The expression $\left|x\right|$ is read "the <u>absolute</u> value of *x*."

4. The sum of two positive numbers is always <u>positive</u>.

5. In the statement (–8) + 5 = –3, the number –3 is called the <u>sum</u> of –8 and 5.

6. In the statement (–8) + 5 = –3, the numbers –8 and 5 are called <u>addends</u>.

7. $-\left|-8\right| = \underline{-8}$.

8. $\left|-8\right| = \underline{8}$.

9. When adding two fractions with different signs, we first find the least common <u>denominator</u>.

10. Two numbers that add up to zero are <u>opposites</u> of each other.

11. Yes, it is correct.

12. Yes, it is correct.

13. The opposite of 19 is –19 since 19 + (–19) = 0.

14. The opposite of 8 is –8 since 8 + –8 = 0.

15. The opposite of –28 is 28 since –28 + 28 = 0.

16. The opposite of 3 is –3 since 3 + (–3) = 0.

17. The opposite of 0 is 0 since 0 + 0 = 0.

18. The opposite of $-3\dfrac{1}{2}$ is $3\dfrac{1}{2}$ since

$-3\dfrac{1}{2} + 3\dfrac{1}{2} = 0.$

19. The opposite of $\dfrac{5}{3}$ is $-\dfrac{5}{3}$ since $\dfrac{5}{3} + \left(-\dfrac{5}{3}\right) = 0$.

20. The opposite of $-\dfrac{1}{4}$ is $\dfrac{1}{4}$ since $-\dfrac{1}{4} + \dfrac{1}{4} = 0$.

21. The opposite of $2\dfrac{3}{5}$ is $-2\dfrac{3}{5}$ since

$2\dfrac{3}{5} + \left(-2\dfrac{3}{5}\right) = 0$.

22. The opposite of –1 is 1 since –1 + 1 = 0.

23. The opposite of 3.72 is –3.72 since 3.72 + (–3.72) = 0.

24. The opposite of –0.721 is 0.721 since $-0.721 + 0.721 = 0$.

25. Numbers have same sign, so add absolute values. $\left|5\right| + \left|16\right| = 5 + 16 = 21$
Numbers are positive so sum is positive.
5 + 16 = 21

26. Numbers have same sign, so add absolute values. $\left|17\right| + \left|13\right| = 17 + 13 = 30$.
Numbers are positive so sum is positive.
$17 + 13 = 30$

27. Numbers have different signs so find difference between larger and smaller absolute values. $\left|4\right| - \left|-3\right| = 4 - 3 = 1$. $\left|4\right|$ is greater than $\left|-3\right|$ so the sum is positive.
4 + (–3) = 1

28. Numbers have different signs, so take difference between larger and smaller absolute values $\left|-12\right| - \left|9\right| = 12 - 9 = 3$. $\left|-12\right|$ greater than $\left|9\right|$ so sum is negative.
9 + (–12) = –3

29. Numbers have same sign, so add absolute values. $\left|-4\right| + \left|-2\right| = 4 + 2 = 6$.
Numbers are negative, so sum is negative.
–4 + (–2) = –6

30. Numbers have same sign, so add absolute values. $\left|-3\right| + \left|-5\right| = 3 + 5 = 8$. Numbers are negative, so sum is negative.
–3 + (–5) = –8

31. Numbers have different signs, so find difference between absolute values.
$$|6| - |-6| = 6 - 6 = 0$$
$$6 + (-6) = 0$$

32. Numbers have different signs, so take difference between absolute values.
$$|-8| - |8| = 0$$
$$-8 + 8 = 0$$

33. Numbers have different signs, so find difference between absolute values.
$$|-4| - |4| = 4 - 4 = 0$$
$$-4 + 4 = 0$$

34. Numbers have different signs, so find difference between absolute values.
$$|11| - |-11| = 11 - 11 = 0$$
$$11 + (-11) = 0$$

35. Numbers have same sign, so add absolute values. $|-8| + |-2| = 8 + 2 = 10$. Numbers are negative, so sum is negative.
$$-8 + (-2) = -10$$

36. Numbers have different signs, so take difference between larger and smaller absolute values. $|6| - |-5| = 6 - 5 = 1$. $|6|$ is greater than $|-5|$ so sum is positive.
$$6 + (-5) = 1$$

37. Numbers have different signs, so take difference between larger and smaller absolute values. $|-7| - |3| = 7 - 3 = 4$. $|-7|$ is greater than $|3|$ so sum is negative.
$$-7 + 3 = -4$$

38. Numbers have different signs, so take difference between larger and smaller absolute values. $|9| - |-6| = 9 - 6 = 3$. $|9|$ is greater than $|-6|$ so sum is positive.
$$-6 + 9 = 3$$

39. Numbers have same sign, so add absolute values.
$$|-8| + |-5| = 8 + 5 = 13$$
Numbers are negative, so sum is negative.
$$-8 + (-5) = -13$$

40. Numbers have different signs, so take difference between larger and smaller absolute values. $|13| - |-9| = 13 - 9 = 4$. $|13|$ is greater than $|-9|$ so sum is positive.
$$-9 + 13 = 4$$

41. $0 + 0 = 0$

42. $0 + (-0) = 0$

43. $-8 + 0 = -8$

44. $0 + (-3) = -3$

45. Numbers have same sign, so add absolute values.
$$|-18| + |-9| = 18 + 9 = 27 .$$
Numbers are negative, so sum is negative.
$$-18 + (-9) = -27$$

46. Numbers have different signs, so find difference between larger and smaller absolute values.
$$|17| - |-7| = 17 - 7 = 10$$
$|17|$ is greater than $|-7|$ so sum is positive.
$$-7 + 17 = 10$$

47. Numbers have same sign, so add absolute values.
$$|-33| + |-31| = 33 + 31 = 64$$
Numbers are negative, so sum is negative.
$$-33 + (-31) = -64$$

48. Numbers have same sign, so add absolute values. $|-27| + |-9| = 27 + 9 = 36$. Numbers are negative, so sum is negative.
$$-27 + (-9) = -36$$

49. Numbers have same sign, so add absolute values.
$$|7| + |9| = 7 + 9 = 16 .$$
Numbers are positive, so sum is positive.
$$7 + 9 = 16$$

50. Numbers have same sign, so add absolute values.
$$|12| + |3| = 12 + 3 = 15 .$$
Numbers are positive, so sum is positive.
$$12 + 3 = 15$$

51. Numbers have same sign, so add absolute values.
$$|-8| + |-4| = 8 + 4 = 12$$
Numbers are negative, so sum is negative.
$$-8 + (-4) = -12$$

52. Numbers have same sign, so add absolute values.
$$|-25| + |-36| = 25 + 36 = 61$$
Numbers are negative, so sum is negative.
$$-25 + (-36) = -61$$

53. Numbers have different signs, so find difference between larger and smaller absolute values. $|6| - |-3| = 6 - 3 = 3$. $|6|$ is greater than $|-3|$ so sum is positive.
$$6 + (-3) = 3$$

54. Numbers have different signs, so take difference between larger and smaller absolute values. $|52| - |-25| = 52 - 25 = 27$. $|52|$ is greater than $|-25|$ so sum is positive.
$52 + (-25) = 27$

55. Numbers have different signs, so take difference between larger and smaller absolute values. $|-19| + |13| = 19 - 13 = 6$. $|-19|$ is greater than $|13|$ so sum is negative.
$13 + (-19) = -6$

56. Numbers have different signs, so take difference between larger and smaller absolute values. $|-40| - |34| = 40 - 34 = 6$. $|-40|$ is greater than $|34|$ so sum is negative.
$34 + (-40) = -6$

57. Numbers have different signs, so find difference between larger and smaller absolute values. $|-220| - |180| = 220 - 180 = 40$. $|-220|$ is greater than $|180|$ so sum is negative.
$180 + (-220) = -40$

58. Numbers have different signs, so find difference between larger and smaller absolute values. $|-452| - |312| = 452 - 312 = 140$. $|-452|$ is greater than $|312|$ so sum is negative.
$-452 + 312 = -140$

59. Numbers have same sign, so add absolute values. $|-11| + |-20| = 11 + 20 = 31$. Numbers are negative, so sum is negative.
$-11 + (-20) = -31$

60. Numbers have same sign, so add absolute values. $|-33| + |-92| = 33 + 92 = 125$. Numbers are negative, so sum is negative.
$-33 + (-92) = -125$

61. Numbers have different signs, so find difference between larger and smaller absolute values. $|-67| - |28| = 67 - 28 = 39$. $|-67|$ is greater than $|28|$ so sum is negative.
$-67 + 28 = -39$

62. Numbers have different signs, so take difference between absolute values.
$|183| - |-183| = 183 - 183 = 0$
$183 + (-183) = 0$

63. Numbers have different signs, so find difference between larger and smaller absolute values. $|184| - |-93| = 184 - 93 = 91$. $|184|$ is greater than $|-93|$ so sum is positive.
$184 + (-93) = 91$

64. Numbers have different signs, so take difference between larger and smaller absolute values. $|176| - |-19| = 176 - 19 = 157$. $|176|$ is greater than $|-19|$ so sum is positive.
$-19 + 176 = 157$

65. Numbers have different signs, so find difference between larger and smaller absolute values. $|-90.4| - |80.5| = 90.4 - 80.5 = 9.9$. $|-90.4|$ is greater than $|80.5|$ so sum is negative.
$80.5 + (-90.4) = -9.9$

66. Numbers have same sign, so add absolute values. $|-24.6| + |-13.9| = 24.6 + 13.9 = 38.5$. Numbers are negative so sum is negative.
$-24.6 + (-13.9) = -38.5$

67. Numbers have same sign, so add absolute values. $|-124.7| + |-19.3| = 124.7 + 19.3 = 144.0$. Numbers are negative, so sum is negative.
$-124.7 + (-19.3) = -144.0$

68. Numbers have different signs, so find difference between larger and smaller absolute values. $|110.9| - |106.3| = 110.9 - 106.3 = 4.6$. $|-110.9|$ is greater than $|106.3|$ so sum is negative.
$106.3 + (-110.9) = -4.6$

69. Numbers have different signs, so find difference between larger and smaller absolute values. $|16.62| - |-12.4| = 16.62 - 12.4 = 4.22$. $|16.62|$ is greater than $|-12.4|$ so sum is positive.
$-12.4 + 16.62 = 4.22$

70. Numbers have different signs, so take difference between larger and smaller absolute values. $|13.01| - |-5.1| = 13.01 - 5.1 = 7.91$. $|13.01|$ is greater than $|-5.1|$ so sum is positive.
$13.01 + (-5.1) = 7.91$

71. Numbers have same sign, so add absolute values. $|-97.35| + |-9.8| = 97.35 + 9.8 = 107.15$. Numbers are negative, so sum is negative.
$-97.35 + (-9.8) = -107.15$

72. Numbers have same sign, so add absolute values. $|-73.5| + |-58.68| = 73.5 + 58.68 = 132.18$. Numbers are negative, so sum is negative.
$-73.5 + (-58.68) = -132.18$

73. $\dfrac{3}{5} + \dfrac{1}{7} = \dfrac{21}{35} + \dfrac{5}{35} = \dfrac{21+5}{35} = \dfrac{26}{35}$

74. $\dfrac{5}{8} + \dfrac{3}{5} = \dfrac{25}{40} + \dfrac{24}{40} = \dfrac{25+24}{40} = \dfrac{49}{40}$ or $1\dfrac{9}{40}$

75. $\dfrac{5}{12} + \dfrac{6}{7} = \dfrac{35}{84} + \dfrac{72}{84} = \dfrac{35+72}{84} = \dfrac{107}{84}$ or $1\dfrac{23}{84}$

76. $\dfrac{2}{9} + \dfrac{3}{10} = \dfrac{20}{90} + \dfrac{27}{90} = \dfrac{20+27}{90} = \dfrac{47}{90}$

77. Numbers have different signs, so find difference between larger and smaller absolute values.

$-\dfrac{8}{11} + \dfrac{4}{5} = -\dfrac{40}{55} + \dfrac{44}{55} = \left|\dfrac{44}{55}\right| - \left|-\dfrac{40}{55}\right| = \dfrac{44}{55} - \dfrac{40}{55} = \dfrac{4}{55}$

$\left|\dfrac{44}{55}\right|$ is greater than $\left|-\dfrac{40}{55}\right|$ so sum is positive.

$-\dfrac{8}{11} + \dfrac{4}{5} = \dfrac{4}{55}$

78. Numbers have different signs, so find difference between larger and smaller absolute values.

$-\dfrac{4}{9} + \dfrac{5}{27} = \left|-\dfrac{12}{27}\right| - \left|\dfrac{5}{27}\right| = \dfrac{12}{27} - \dfrac{5}{27} = \dfrac{12-5}{27} = \dfrac{7}{27}$

$\left|-\dfrac{12}{27}\right|$ is greater than $\left|\dfrac{5}{27}\right|$ so sum is negative.

$-\dfrac{4}{9} + \dfrac{5}{27} = -\dfrac{7}{27}$

79. Numbers have different signs, so find difference between larger and smaller absolute values.

$-\dfrac{7}{10} + \dfrac{11}{90} = \left|-\dfrac{63}{90}\right| - \left|\dfrac{11}{90}\right| = \dfrac{63}{90} - \dfrac{11}{90}$

$\qquad = \dfrac{63-11}{90} = \dfrac{52}{90} = \dfrac{26}{45}$

$\left|-\dfrac{63}{90}\right|$ is greater than $\left|\dfrac{11}{90}\right|$ so sum is negative.

$-\dfrac{7}{10} + \dfrac{11}{90} = -\dfrac{26}{45}$

80. Numbers have different signs, so find difference between larger and smaller absolute values.

$\dfrac{8}{9} + \left(-\dfrac{1}{3}\right) = \left|\dfrac{8}{9}\right| - \left|-\dfrac{3}{9}\right| = \dfrac{8}{9} - \dfrac{3}{9} = \dfrac{8-3}{9} = \dfrac{5}{9}$

$\left|\dfrac{8}{9}\right|$ is greater than $\left|-\dfrac{3}{9}\right|$ so sum is positive.

$\dfrac{8}{9} + \left(-\dfrac{1}{3}\right) = \dfrac{5}{9}$

81. Numbers have same sign, so add absolute values.

$-\dfrac{7}{30} + \left(-\dfrac{4}{5}\right) = \left|-\dfrac{7}{30}\right| + \left|-\dfrac{24}{30}\right| = \dfrac{7}{30} + \dfrac{24}{30}$

$= \dfrac{7+24}{30} = \dfrac{31}{30}$ or $1\dfrac{1}{30}$

Numbers are negative so sum is negative.

$-\dfrac{7}{30} + \left(-\dfrac{4}{5}\right) = -\dfrac{31}{30}$ or $-1\dfrac{1}{30}$

82. Numbers have same sign, so add absolute values.

$-\dfrac{7}{9} + \left(-\dfrac{1}{5}\right) = \left|-\dfrac{35}{45}\right| + \left|-\dfrac{9}{45}\right| = \dfrac{35}{45} + \dfrac{9}{45} =$

$\dfrac{35+9}{44} = \dfrac{44}{45}$

Numbers are negative so sum is negative.

$-\dfrac{7}{9} + \left(-\dfrac{1}{5}\right) = -\dfrac{44}{45}$

83. Numbers have same sign, so add absolute values.

$-\dfrac{4}{5} + \left(-\dfrac{5}{75}\right) = \left|-\dfrac{60}{75}\right| + \left|-\dfrac{5}{75}\right| = \dfrac{60}{75} + \dfrac{5}{75}$

$= \dfrac{60+5}{75} = \dfrac{65}{75} = \dfrac{13}{15}$

Numbers are negative so sum is negative.

$-\dfrac{4}{5} + \left(-\dfrac{5}{75}\right) = -\dfrac{13}{15}$

84. Numbers have same sign, so add absolute values.

$-\dfrac{1}{15} + \left(-\dfrac{5}{6}\right) = \left|-\dfrac{2}{30}\right| + \left|-\dfrac{25}{30}\right| = \dfrac{2}{30} + \dfrac{25}{30}$

$= \dfrac{2+25}{30} = \dfrac{27}{30} = \dfrac{9}{10}$

Numbers are negative so sum is negative.

$-\dfrac{1}{15} + \left(-\dfrac{5}{6}\right) = -\dfrac{9}{10}$

85. Numbers have different signs, so find difference between larger and smaller absolute values

$\dfrac{9}{25} + \left(-\dfrac{3}{50}\right) = \left|\dfrac{18}{50}\right| - \left|-\dfrac{3}{50}\right| = \dfrac{18}{50} - \dfrac{3}{50}$

$= \dfrac{18-3}{50} = \dfrac{15}{50} = \dfrac{3}{10}$

$\left|\dfrac{18}{50}\right|$ is greater than $\left|-\dfrac{3}{50}\right|$ so sum is positive.

$\dfrac{9}{25} + \left(-\dfrac{3}{50}\right) = \dfrac{3}{10}$

86. Numbers have different signs, so find difference between larger and smaller absolute values.

$$\frac{5}{36}+\left(-\frac{5}{24}\right)=\frac{10}{72}+\left(-\frac{15}{72}\right)=\left|-\frac{15}{72}\right|-\left|\frac{10}{72}\right|=$$

$$\frac{15}{72}-\frac{10}{72}=\frac{5}{72}$$

$\left|-\frac{15}{72}\right|$ is greater than $\left|\frac{10}{72}\right|$ so sum is negative.

$$\frac{5}{36}+\left(-\frac{5}{24}\right)=-\frac{5}{72}$$

87. Numbers have different signs, so find difference between larger and smaller absolute values.

$$-\frac{9}{24}+\frac{5}{7}=-\frac{63}{168}+\frac{120}{168}=\left|\frac{120}{168}\right|-\left|\frac{63}{168}\right|=$$

$$\frac{120}{168}-\frac{63}{168}=\frac{120-63}{168}=\frac{57}{168}=\frac{19}{56}$$

$\left|\frac{120}{168}\right|$ is greater than $\left|-\frac{63}{168}\right|$ so sum is positive.

$$-\frac{9}{24}+\frac{5}{7}=\frac{19}{56}$$

88. Numbers have different signs, so find difference between larger and smaller absolute values.

$$-\frac{9}{40}+\frac{4}{15}=-\frac{27}{120}+\frac{32}{120}=\left|\frac{32}{120}\right|-\left|-\frac{27}{120}\right|=$$

$$\frac{32}{120}-\frac{27}{120}=\frac{32-27}{120}=\frac{5}{120}=\frac{1}{24}$$

$\left|\frac{32}{120}\right|$ is greater than $\left|-\frac{27}{120}\right|$ so sum is positive.

$$-\frac{9}{40}+\frac{4}{15}=\frac{1}{24}$$

89. Numbers have same sign, so add absolute values.

$$-\frac{5}{12}+\left(-\frac{3}{10}\right)=-\frac{25}{60}+\left(-\frac{18}{60}\right)=\left|-\frac{25}{60}\right|+\left|-\frac{18}{60}\right|=$$

$$\frac{25}{60}+\frac{18}{60}=\frac{43}{60}$$

Numbers are negative so sum is negative.

$$-\frac{5}{12}+\left(-\frac{3}{10}\right)=-\frac{43}{60}$$

90. Numbers have different signs, so find difference between larger and smaller absolute values.

$$\frac{7}{16}+\left(-\frac{5}{24}\right)=\frac{21}{48}+\left(-\frac{10}{48}\right)=\left|\frac{21}{48}\right|-\left|-\frac{10}{48}\right|=$$

$$\frac{21}{48}-\frac{10}{48}=\frac{21-10}{48}=\frac{11}{48}$$

$\left|\frac{21}{48}\right|$ is greater than $\left|-\frac{10}{48}\right|$ so sum is positive.

$$\frac{7}{16}+\left(-\frac{5}{24}\right)=\frac{11}{48}$$

91. Numbers have same sign, so add absolute values.

$$-\frac{13}{14}+\left(-\frac{7}{42}\right)=-\frac{39}{42}+\left(-\frac{7}{42}\right)=\left|-\frac{39}{42}\right|+\left|-\frac{7}{42}\right|=$$

$$\frac{39}{42}+\frac{7}{42}=\frac{39+7}{42}=\frac{46}{42}=\frac{23}{21}$$

Numbers are negative so sum is negative.

$$-\frac{13}{14}+\left(-\frac{7}{42}\right)=-\frac{23}{21} \text{ or } -1\frac{2}{21}$$

92. Numbers have same sign, so add absolute values.

$$-\frac{11}{27}+\left(-\frac{7}{18}\right)=-\frac{22}{54}+\left(-\frac{21}{54}\right)=\left|-\frac{22}{54}\right|+\left|-\frac{21}{54}\right|=$$

$$\frac{22}{54}+\frac{21}{54}=\frac{22+21}{54}=\frac{43}{54}$$

Numbers are negative so sum is negative.

$$-\frac{11}{27}+\left(-\frac{7}{18}\right)=-\frac{43}{54}$$

93.a. Positive; $|587|$ is greater than $|-197|$ so sum will be positive.

b. $587+(-197)=390$

94.a. Negative; the sum of two negative numbers is always negative.

b. $-140+(-629)=-769$

95.a. Negative; the sum of 2 negative numbers is always negative.

b. $-84+(-289)=-373$

96.a. Negative; $|-647|$ is greater than $|352|$ so sum will be negative.

b. $-647+352=-295$

97.a. Negative; $|-947|$ is greater than $|495|$ so sum will be negative.

b. $-947+495=-452$

98.a. Sum will be 0, since numbers have opposite signs and equal absolute values.

  b. $762 + (-762) = 0$

99.a. Negative; the sum of 2 negative numbers is always negative.

  b. $-496 + (-804) = -1300$

100.a. Positive; $|1090|$ is greater than $|-354|$ so sum will be positive.

  b. $-354 + 1090 = 736$

101.a. Negative; $|-375|$ is greater than $|263|$ so sum will be negative.

  b. $-375 + 263 = -112$

102.a. Positive; $|1127|$ is greater than $|-84|$ so sum will be positive.

  b. $1127 + (-84) = 1043$

103.a. Negative; the sum of 2 negative numbers is always negative.

  b. $-1833 + (-2047) = -3880$

104.a. Positive; $|572|$ is greater than $|-426|$ so sum will be positive.

  b. $-426 + 572 = 146$

105.a. Positive; $|3124|$ is greater than $|-2013|$ so sum will be positive.

  b. $3124 + (-2013) = 1111$

106.a. Negative; the sum of two negative numbers is always negative.

  b. $-9095 + (-647) = -9742$

107.a. Negative; the sum of 2 negative numbers is always negative.

  b. $-1025 + (-1025) = -2050$

108.a. Positive; $|7513|$ is greater than $|-4361|$ so sum will be positive.

  b. $7513 + (-4361) = 3152$

109. True; the sum of two negative numbers is always negative.

110. True; if the negative number has the larger absolute value, the sum will be negative number.

111. True; the sum of two positive numbers is always positive.

112. False; the sum has the sign of the number with the larger absolute value.

113. False; the sum has the sign of the number with the larger absolute value.

114. True; by definition of opposites.

115. David's balance was –$94. His new balance can be found by adding. $-94 + (-183) = -277$
David owes $277.

116. $-142 + 87$
$|142| - |87| = 142 - 87 = 55$
$|-142|$ is greater than $|87|$ so the sum is negative. $-142 + 87 = -55$
Mrs. Chu still owes $55.

117. Total loss can be represented as $-18 + (-3)$. $|-18| + |-3| = 18 + 3 = 21$. The total loss in yardage is 21 yards.

118. $-56 + (-162) = -218$
Mrs. Jahn has overdrawn her account by $218.

119. The depth of the well can be found by adding $-27 + (-34) = -61$. The well is 61 feet deep.

120.a. $11,250 + (-18,560) = -7310$
The Frenches had a loss of $7310 the first month.

  b. $17,980 + (-12,750) = 5230$
The Frenches had a gain of $5230 the second month.

  c. $19,420 + (-16,980) = 2440$
The Frenches had a gain of $2440 the third month.

121. The height of the mountain peak above sea level can be found by
adding $33,480 + (-19,684) = 13,796$. The mountain peak is 13,796 feet above sea level.

122. $-3000 + 37,400 = 34,400$
The profit for the year was $34,400.

123.a. $-12,000$
The deficit is $12,000.

b. 2011: 32,000; 2012: 36,000; 2013: 26,000
32 + 36 + 26 = 94
From 2011 through 2013, there was a surplus of
$94,000.

124. 4.2 + 5.2 + 0.2 + (–13.5) + (–3.0) = –6.9
The percent change was –6.9%.

125. $(-8)+(-6)+(-12)=(-14)+(-12)=-26$

126. $5+(-7)+(-8)=(-2)+(-8)=-10$

127. $29+(-46)+37=(-17)+37=20$

128. $4+(-5)+6+(-8)=(-1)+6+(-8)$
$$=5+(-8)$$
$$=-3$$

129. $(-12)+(-10)+25+(-3)=(-22)+25+(-3)$
$$=3+(-3)$$
$$=0$$

130. $(-4)+(-2)+(-15)+(-27)=(-6)+(-15)+(-27)$
$$=(-21)+(-27)$$
$$=-48$$

131. $\dfrac{1}{2}+\left(-\dfrac{1}{3}\right)+\dfrac{1}{5}=\left(\dfrac{3}{6}-\dfrac{2}{6}\right)+\dfrac{1}{5}$
$$=\dfrac{1}{6}+\dfrac{1}{5}$$
$$=\dfrac{5}{30}+\dfrac{6}{30}$$
$$=\dfrac{11}{30}$$

132. $-\dfrac{3}{8}+\left(-\dfrac{2}{9}\right)+\left(-\dfrac{1}{2}\right)=\left(-\dfrac{27}{72}-\dfrac{16}{72}\right)+\left(-\dfrac{1}{2}\right)$
$$=-\dfrac{43}{72}-\dfrac{1}{2}$$
$$=-\dfrac{43}{72}-\dfrac{36}{72}$$
$$=-\dfrac{79}{72}\text{ or }-1\dfrac{7}{72}$$

133. $1+2+3+\cdots+10=(1+10)+(2+9)\cdots+(5+6)$
$$=(5)(11)$$
$$=55$$

134. $1+2+3+\cdots+20$
$$=(1+20)+(2+19)+\cdots+(10+11)$$
$$=(10)(21)$$
$$=210$$

135. $2\dfrac{3}{8}=\dfrac{16+3}{8}=\dfrac{19}{8}$
$$\left(\dfrac{4}{7}\right)\left(2\dfrac{3}{8}\right)=\dfrac{\overset{1}{\cancel{4}}}{7}\cdot\dfrac{19}{\underset{2}{\cancel{8}}}=\dfrac{1\cdot19}{7\cdot2}$$
$$=\dfrac{19}{14}=1\dfrac{5}{14}$$

136. $3=\dfrac{3}{1}\cdot\dfrac{16}{16}=\dfrac{48}{16}$
$$3-\dfrac{5}{16}=\dfrac{48}{16}-\dfrac{5}{16}=\dfrac{48-5}{16}=\dfrac{43}{16}=2\dfrac{11}{16}$$

137. False, –0.25 is less than zero and not an integer.

138. $|-3|>2$ since $|-3|=3$

139. $8<|-12|$ since $|-12|=12$

Exercise Set 1.7

1. In the equation 4 – 7 = –3, 4 is called the
<u>minuend</u>.

2. In the equation 4 – 7 = –3, 7 is called the
<u>subtrahend</u>.

3. In the equation 4 – 7 = –3, –3 is called the
<u>difference</u>.

4. $a - b$ could be rewritten as <u>$a + (-b)$</u>.

5. When subtracting a number, we add its <u>opposite</u>.

6. When a number is subtracted from itself, the
number is <u>zero</u>.

7. When many numbers are being added and
subtracted, we always work from <u>left</u> to right.

8. The opposite of the number $a + b$ is <u>$-a - b$</u>.

9. $-a - (-b)$ could be rewritten as <u>$-a + b$</u>.

10. $a - (-b)$ could be rewritten as <u>$a + b$</u>.

11. Yes it is correct.

12. Yes it is correct.

13. $9-(+3)=9+(-3)=6$

14. $12-(+7)=12+(-7)=5$

15. $12 - 5 = 12 + (-5) = 7$

16. $9 - 4 = 9 + (-4) = 5$

17. $8 - 9 = 8 + (-9) = -1$

18. $-6 - 3 = -6 + (-3) = -9$

19. $9 - (-3) = 9 + 3 = 12$

20. $17 - (-5) = 17 + 5 = 22$

21. $-8 - 8 = -8 + (-8) = -16$

22. $-4 - (-3) = -4 + 3 = -1$

23. $0 - 9 = 0 + (-9) = -9$

24. $19 - (-9) = 19 + 9 = 28$

25. $8 - 8 = 8 + (-8) = 0$

26. $10 - 10 = 10 + (-10) = 0$

27. $-3 - 1 = -3 + (-1) = -4$

28. $-4 - (-4) = -4 + 4 = 0$

29. $-8 - (-5) = -8 + 5 = -3$

30. $4 - 9 = 4 + (-9) = -5$

31. $6 - (-3) = 6 + 3 = 9$

32. $6 - 10 = 6 + (-10) = -4$

33. $-9 - 11 = -9 + (-11) = -20$

34. $37 - 40 = 37 + (-40) = -3$

35. $0 - (-9.8) = 0 + 9.8 = 9.8$

36. $-6.3 - 4.7 = -6.3 + (-4.7) = -11.0$

37. $-4.8 - (-5.1) = -4.8 + 5.1 = 0.3$

38. $-5.7 - (-3.1) = -5.7 + 3.1 = -2.6$

39. $44 - 7 = 44 + (-7) = 37$

40. $9 - 9 = 9 + (-9) = 0$

41. $-8 - (-12) = -8 + 12 = 4$

42. $-6 - (-2) = -6 + 2 = -4$

43. $18 - (-4) = 18 + 4 = 22$

44. $-25 - 16 = -25 + (-16) = -41$

45. $-9 - 2 = -9 + (-2) = -11$

46. $-85 - (-8) = -85 + 8 = -77$

47. $-90.7 - 40.3 = -90.7 + (-40.3) = -131.0$

48. $-52.6 - 37.9 = -52.6 + (-37.9) = -90.5$

49. $-45 - 39 = -45 + (-39) = -84$

50. $-500 - (-400) = -500 + 400 = -100$

51. $70 - (-70) = 70 + 70 = 140$

52. $130 - (-90) = 130 + 90 = 220$

53. $42.3 - 49.7 = 42.3 + (-49.7) = -7.4$

54. $81.3 - 92.5 = 81.3 + (-92.5) = -11.2$

55. $-3.01 - (-3.1) = -3.01 + 3.1 = 0.09$

56. $-7.04 - (-7.4) = -7.04 + 7.4 = 0.36$

57. $4 - 15 = 4 + (-15) = -11$

58. $1 - 7 = 1 + (-7) = -6$

59. $21 - 21 = 21 + (-21) = 0$

60. $13 - 13 = 13 + (-13) = 0$

61. $13 - 24 = 13 + (-24) = -11$

62. $-23 - (-23) = -23 + 23 = 0$

63. $-6.3 - (-12.4) = -6.3 + 12.4 = 6.1$

64. $-9.8 - 17.3 = -9.8 + (-17.3) = -27.1$

65. $10.3 - (-7.9) = 10.3 + 7.9 = 18.2$

66. $-5.2 - (-11.7) = -5.2 + 11.7 = 6.5$

67. $-3.07 - 8.4 = -3.07 + (-8.4) = -11.47$

68. $15.23 - (-4.1) = 15.23 + 4.1 = 19.33$

69.
$$\frac{2}{3} - \frac{1}{2} = \frac{2}{3} + \left(-\frac{1}{2}\right)$$
$$= \frac{4}{6} + \left(-\frac{3}{6}\right)$$
$$= \frac{4 + (-3)}{6}$$
$$= \frac{1}{6}$$

70.
$$\frac{3}{5} - \frac{1}{4} = \frac{3}{5} + \left(-\frac{1}{4}\right)$$
$$= \frac{12}{20} + \left(-\frac{5}{20}\right)$$
$$= \frac{12 + (-5)}{20}$$
$$= \frac{7}{20}$$

71.
$$\frac{2}{15} - \frac{5}{6} = \frac{2}{15} + \left(-\frac{5}{6}\right)$$
$$= \frac{4}{30} + \left(-\frac{25}{30}\right)$$
$$= \frac{4 + (-25)}{30}$$
$$= -\frac{21}{30}$$
$$= -\frac{7}{10}$$

72.
$$\frac{5}{12} - \frac{7}{8} = \frac{5}{12} + \left(-\frac{7}{8}\right)$$
$$= \frac{10}{24} + \left(-\frac{21}{24}\right)$$
$$= \frac{10 + (-21)}{24}$$
$$= -\frac{11}{24}$$

73.
$$-\frac{7}{10} - \frac{5}{12} = -\frac{7}{10} + \left(-\frac{5}{12}\right)$$
$$= -\frac{42}{60} + \left(-\frac{25}{60}\right)$$
$$= \frac{-42 + (-25)}{60}$$
$$= -\frac{67}{60} \text{ or } -1\frac{7}{60}$$

74.
$$-\frac{1}{4} - \frac{2}{3} = -\frac{1}{4} + \left(-\frac{2}{3}\right)$$
$$= -\frac{3}{12} + \left(-\frac{8}{12}\right)$$
$$= \frac{-3 + (-8)}{12}$$
$$= -\frac{11}{12}$$

75.
$$-\frac{4}{15} - \frac{3}{20} = -\frac{4}{15} + \left(-\frac{3}{20}\right)$$
$$= -\frac{16}{60} + \left(-\frac{9}{60}\right)$$
$$= \frac{-16 + (-9)}{60}$$
$$= -\frac{25}{60} = -\frac{5}{12}$$

76.
$$-\frac{5}{4} - \frac{7}{11} = -\frac{5}{4} + \left(-\frac{7}{11}\right)$$
$$= -\frac{55}{44} + \left(-\frac{28}{44}\right)$$
$$= \frac{-55 + (-28)}{44}$$
$$= -\frac{83}{44} \text{ or } -1\frac{39}{44}$$

77.
$$-\frac{7}{12} - \frac{5}{40} = -\frac{7}{12} + \left(-\frac{5}{40}\right)$$
$$= -\frac{70}{120} + \left(-\frac{15}{120}\right)$$
$$= \frac{-70 + (-15)}{120}$$
$$= -\frac{85}{120} = -\frac{17}{24}$$

78.
$$-\frac{5}{6} - \frac{3}{32} = -\frac{5}{6} + \left(-\frac{3}{32}\right)$$
$$= -\frac{80}{96} + \left(-\frac{9}{96}\right)$$
$$= \frac{-80 + (-9)}{96}$$
$$= -\frac{89}{96}$$

79.
$$\frac{5}{8} - \frac{6}{48} = \frac{5}{8} + \left(-\frac{6}{48}\right)$$
$$= \frac{30}{48} + \left(-\frac{6}{48}\right)$$
$$= \frac{30 + (-6)}{48}$$
$$= \frac{24}{48} = \frac{1}{2}$$

80.
$$\frac{17}{18} - \frac{13}{20} = \frac{17}{18} + \left(-\frac{13}{20}\right)$$
$$= \frac{170}{180} + \left(-\frac{117}{180}\right)$$
$$= \frac{53}{180}$$

81.
$$-\frac{4}{9} - \left(-\frac{3}{5}\right) = -\frac{4}{9} + \frac{3}{5}$$
$$= -\frac{20}{45} + \frac{27}{45}$$
$$= \frac{-20 + 27}{45}$$
$$= \frac{7}{45}$$

82.
$$\frac{5}{20} - \left(-\frac{1}{8}\right) = \frac{5}{20} + \frac{1}{8}$$
$$= \frac{10}{40} + \frac{5}{40}$$
$$= \frac{10 + 15}{40}$$
$$= \frac{15}{40} = \frac{3}{8}$$

83.
$$\frac{3}{16} - \left(-\frac{5}{8}\right) = \frac{3}{16} + \frac{5}{8}$$
$$= \frac{3}{16} + \frac{10}{16}$$
$$= \frac{3 + 10}{16}$$
$$= \frac{13}{16}$$

84.
$$-\frac{5}{12} - \left(-\frac{3}{8}\right) = -\frac{5}{12} + \frac{3}{8}$$
$$= -\frac{10}{24} + \frac{9}{24}$$
$$= \frac{-10 + 9}{24}$$
$$= -\frac{1}{24}$$

85.
$$\frac{4}{7} - \frac{7}{9} = \frac{4}{7} + \left(-\frac{7}{9}\right)$$
$$= \frac{36}{63} + \left(-\frac{49}{63}\right)$$
$$= \frac{36 + (-49)}{63}$$
$$= -\frac{13}{63}$$

86.
$$\frac{5}{8} - \frac{7}{15} = \frac{5}{8} + \left(-\frac{7}{15}\right)$$
$$= \frac{75}{120} + \left(-\frac{56}{120}\right)$$
$$= \frac{75 + (-56)}{120}$$
$$= \frac{19}{120}$$

87.
$$-\frac{5}{12} - \left(-\frac{3}{10}\right) = -\frac{5}{12} + \frac{3}{10}$$
$$= -\frac{25}{60} + \frac{18}{60}$$
$$= \frac{-25 + 18}{60}$$
$$= -\frac{7}{60}$$

88.
$$-\frac{9}{10} - \left(-\frac{5}{16}\right) = -\frac{9}{10} + \frac{5}{16}$$
$$= -\frac{72}{80} + \frac{25}{80}$$
$$= \frac{-72 + 25}{80}$$
$$= -\frac{47}{80}$$

89. a. Positive; $378 - 279 = 378 + (-279)$
|378| is greater than |–279| so the sum will be positive.

b. $378 + (-279) = 99$

c. Yes; by part a) we expect a positive sum. The size of the sum is the difference between the absolute values of the 2 numbers.

90. a. Negative; $483 - 569 = 483 + (-569)$

$|-569|$ is greater than $|483|$ so sum will be negative.

b. $483 + (-569) = -86$

c. Yes; by part a) we expect a negative sum. Size of sum is difference between larger and smaller absolute values.

91. a. Negative; $-482 - 137 = -482 + (-137)$ The sum of 2 negative numbers is always negative.

b. $-482 + (-137) = -619$

c. Yes; the sum of two negative numbers should be (and is) a larger negative number.

92. a. Positive; $178 - (-377) = 178 + 377$

The sum of 2 positive numbers is always positive.

b. $178 + 377 = 555$

c. Yes; by part a) we expect a positive answer. The size of the sum is the sum of the absolute values of the numbers.

93. a. Positive; $843 - (-745) = 843 + 745$.

The sum of 2 positive numbers is always positive.

b. $843 + 745 = 1588$

c. Yes; by part a) we expect a positive answer. The size of the sum is the sum of the absolute values of the numbers.

94. a. Positive; $864 - (-762) = 864 + 762$.

The sum of two positive numbers is always positive.

b. $864 + 762 = 1626$

c. Yes; by part a) we expect a positive answer. The size of the sum is the sum of the absolute values of the two numbers.

95. a. Positive; $-408 - (-604) = -408 + 604$.

$|604|$ is greater than $|-408|$ so the sum will be positive.

b. $-408 + 604 = 196$

c. Yes; by part a) we expect a positive answer. The size of the answer is the difference between the larger and smaller absolute values.

96. a. Negative; $-623 - 111 = -623 + (-111)$.

The sum of two negative numbers is always negative.

b. $-623 + (-111) = -734$

c. Yes; the sum of two negative numbers should be (and is) a larger negative number.

97. a. Negative; $-1024 - (-576) = -1024 + 576$.

$|-1024|$ is greater than $|576|$ so the sum will be negative.

b. $-1024 + 576 = -448$

c. Yes; by part a) we expect a negative answer. The size of the answer is the difference between the larger and the smaller absolute values.

98. a. Negative; $-104.7 - 27.6 = -104.7 + (-27.6)$. The sum of two negative numbers is always negative.

b. $-104.7 + (-27.6) = -132.3$

c. Yes; the sum of two negative numbers should be (and is) a larger negative number.

99. a. Positive; $165.7 - 49.6 = 165.7 + (-49.6)$.

$|165.7|$ is greater than $|-49.6|$ so the sum will be positive.

b. $165.7 + (-49.6) = 116.1$

c. Yes; by part a) we expect a negative answer. The size of the answer is the difference between the larger and the smaller absolute values.

100. a. Negative; $-40.2 - (-12.6) = -40.2 + 12.6$.

$|-40.2|$ is greater than $|12.6|$ so sum will be negative.

b. $-40.2 + 12.6 = -27.6$

c. Yes; by part a) we expect a negative answer. The size of the answer is the difference between the larger and smaller absolute values.

101. a. Negative; $295 - 364 = 295 + (-364)$.

Since $\left|-364\right|$ is greater than $\left|295\right|$ the answer will be negative.

b. $295 + (-364) = -69$

c. Yes; by part a) we expect a negative answer. The size of the answer is the difference between the larger and the smaller absolute values.

102. a. Negative; $-932 - (-433) = -932 + 433$.

$\left|-932\right|$ is greater than $\left|433\right|$ so the sum will be negative.

b. $-932 + 433 = -499$

c. Yes; by part a) we expect a negative answer. The size of the answer is the difference between the larger and smaller absolute values.

103. a. Negative; $-1023 - 647 = -1023 + (-647)$. The sum of two negative numbers is always negative.

b. $-1023 + (-647) = -1670$

c. Yes; the sum of two negative numbers should be (and is) a larger negative number.

104. a. Negative; $-4120 - 2432 = -4120 + (-2432)$. The sum of 2 negative numbers is always negative.

b. $-4120 + (-2432) = -6552$

c. Yes; the sum of two negative numbers should be (and is) a larger negative number.

105. a. Zero; $-7.62 - (-7.62) = -7.62 + 7.62$.

The sum of two opposite numbers is always zero.

b. $-7.62 + 7.62 = 0$

c. Yes; by part a) we expect zero.

106. a. Negative; $-103.2 - 36.7 = -103.2 + (-36.7)$. The sum of two negative numbers is always negative.

b. $-103.2 + (-36.7) = -139.9$

c. Yes; the sum of two negative numbers should be (and is) a larger negative number.

107. $7 + 5 - (+8) = 7 + 5 + (-8) = 12 + (-8) = 4$

108. $15 - (+9) - (+5) = 15 + (-9) + (-5) = 6 + (-5) = 1$

109. $-6 + (-6) + 16 = -12 + 16 = 4$

110. $9 - 4 + (-2) = 9 + (-4) + (-2) = 5 + (-2) = 3$

111. $-13 - (+5) + 3 = -13 + (-5) + 3 = -18 + 3 = -15$

112. $7 - (+4) - (-3) = 7 + (-4) + 3 = 3 + 3 = 6$

113. $-9 - (-3) + 4 = -9 + 3 + 4 = -6 + 4 = -2$

114. $15 + (-7) - (-3) = 15 + (-7) + 3 = 8 + 3 = 11$

115. $5 - (-9) + (-1) = 5 + 9 + (-1) = 14 + (-1) = 13$

116. $12 + (-5) - (-4) = 12 + (-5) + 4 = 7 + 4 = 11$

117. $17 + (-8) - (+14) = 17 + (-8) + (-14)$
$= 9 + (-14)$
$= -5$

118. $-7 + 6 - 3 = -7 + 6 + (-3) = -1 + (-3) = -4$

119. $-36 - 5 + 9 = -36 + (-5) + 9 = -41 + 9 = -32$

120. $45 - 3 - 7 = 45 + (-3) + (-7) = 42 + (-7) = 35$

121. $25 - 19 + 3 = 25 + (-19) + 3 = 6 + 3 = 9$

122. $-4 - 1 + 5 = -4 + (-1) + 5 = -5 + 5 = 0$

123. $-4 - 6 + 5 - 7 = (-4) + (-6) + 5 + (-7)$
$= -10 + 5 + (-7)$
$= -5 + (-7)$
$= -12$

124. $-9 - 3 - (-4) + 5 = -9 + (-3) + 4 + 5$
$= -12 + 4 + 5$
$= -8 + 5$
$= -3$

125. $17 + (-3) - 9 - (-7) = 17 + (-3) + (-9) + 7$
$= 14 + (-9) + 7$
$= 5 + 7$
$= 12$

126. $32 + 5 - 7 - 12 = 32 + 5 + (-7) + (-12)$
$= 37 + (-7) + (-12)$
$= 30 + (-12)$
$= 18$

127. $-9+(-7)+(-5)-(-3)=-9+(-7)+(-5)+3$
$$=-16+(-5)+3$$
$$=-21+3$$
$$=-18$$

128. $6-9-(-3)+12=6+(-9)+3+12$
$$=-3+3+12$$
$$=0+12$$
$$=12$$

129. $49.0-28.1=49.0+(-28.1)=20.9$

Stockton and Freeport are 20.9 miles apart.

130. $47.7-22.6=47.7+(-22.6)=25.1$

Findlay and Tiffin are 25.1 miles apart.

131. $14,505-(-282)=14,505+282=14,787$

The difference is 14,787 feet.

132. $10,152-(-184)=10,152+184=10,336$

The difference is 10,366 feet.

133. $2\dfrac{1}{4}-\dfrac{3}{8}=2\dfrac{1}{4}+\left(-\dfrac{3}{8}\right)$
$$=\dfrac{9}{4}+\left(-\dfrac{3}{8}\right)$$
$$=\dfrac{18}{8}+\left(-\dfrac{3}{8}\right)$$
$$=\dfrac{18+(-3)}{8}$$
$$=\dfrac{15}{8}=1\dfrac{7}{8}$$

After the second day $1\dfrac{7}{8}$ inches of water

remains.

134. $1605.7-(-267.4)=1605.7+267.4=1873.1$
The vertical distance the package traveled was
1873.1 feet.

135. $44-(-56)=44+56=100$

Thus the temperature dropped 100°F.

136. a. $58.5+67.3=125.8$
In one hour they will be 125.8 miles apart.

b. $67.3-58.5=67.3+(-58.5)=8.8$
In one hour, they will be 8.8 miles apart.

137. a. $288+(-10)=278$
In 2012, his score was 278.

b. $7-(-10)=7+10=17$
Stricker's score was 17 strokes more.

138. $32\dfrac{1}{2}-2\dfrac{3}{4}=32\dfrac{1}{2}+\left(-2\dfrac{3}{4}\right)$
$$=\dfrac{65}{2}+\left(-\dfrac{11}{4}\right)$$
$$=\dfrac{130}{4}+\left(-\dfrac{11}{4}\right)$$
$$=\dfrac{130+(-11)}{4}$$
$$=\dfrac{119}{4}=29\dfrac{3}{4}$$

The new inseam will be $29\dfrac{3}{4}$ inches.

139. Let $x=3$ and $y=8$.
$x-y=3-8=-5$
$y-x=8-3=5$
$x-(-y)=3-(-8)=3+8=11$
Since all the answers are different, the
expressions are all different.

140. A negative followed by a negative is a positive,
so subtracting a negative number is the same as
adding a positive number.
$3-(-9)=3+9$

Add a negative number is the same as
subtracting a positive number.
$9+(-4)=9-4$

$3-(-9)+(-4)=3+9-4=12-4=8$

141. $1-2+3-4+5-6+7-8+9-10$
$=(1-2)+(3-4)+(5-6)+(7-8)+(9-10)$
$=(-1)+(-1)+(-1)+(-1)+(-1)$
$=-5$

142. $1-2+3-4+5-6+\cdots+99-100$
$=(1-2)+(3-4)+(5-6)+\cdots+(99-100)$
$=(-1)+(-1)+(-1)+\cdots(-1)$
$=-50$

143. a. 8 units

b. $-3-(-11)=-3+11=8$

144. $\left[50-(0.10\cdot 50)\right]+0.10\left[50-(0.10\cdot 50)\right]$

$=\left[50-5\right]+0.10\left[50-5\right]$

$=45+4.5$

$=49.50$

or

$\left[50+(0.10\cdot 50)\right]-0.10\left[50+(0.10\cdot 50)\right]$

$=\left[50+5\right]-0.10\left[50+5\right]$

$=55-5.5$

$=49.50$

The value is the same either way, $49.50.

145. a. $3+2+2+1+1=9$

The ball travels 9 feet vertically.

    b. $-3+2+(-2)+1+(-1)=-3$

The net distance is -3 feet.

146. The counting numbers are $\{1,\,2,3,\,...\}$.

147. The set of rational numbers together with the set of irrational numbers forms the set of real numbers.

148. $|-3|>-5$ since $|-3|=3$

149. $-|-9|<-|-5|$ since $-|-9|=-9$ and $-|-5|=-5$

150. $\dfrac{5}{6}-\dfrac{7}{8}=\dfrac{5}{6}+\left(-\dfrac{7}{8}\right)$

$\qquad\quad =\dfrac{20}{24}+\left(-\dfrac{21}{24}\right)$

$\qquad\quad =\dfrac{20+(-21)}{24}$

$\qquad\quad =-\dfrac{1}{24}$

Exercise Set 1.8

1. The product of a positive real number with a negative real number is <u>negative</u>.

2. 16 divided by 0 is <u>undefined</u>.

3. 0 divided by 8 is <u>zero</u>.

4. The fraction $\dfrac{a}{-b}$ may be rewritten as $-\dfrac{a}{b}$.

5. The fraction $-\dfrac{a}{-b}$ may be rewritten as $\dfrac{a}{b}$.

6. If x is 9 and y is -7, then the value of xy is <u>-63</u>.

7. The product of two negative numbers is a <u>positive</u> number.

8. If x is 9 and y is -7, then the value of $x(-y)$ is <u>63</u>.

9. When two real numbers are multiplied, the result is called the <u>product</u> of the two numbers.

10. When two real numbers are divided, the result is called the <u>quotient</u>.

11. The sign of the product $(8)(4)(-5)$ is negative.

12. The sign of the product $(-9)(-12)(20)$ is positive.

13. The sign of the product $(-102)(-16)(24)(19)$ is positive.

14. The sign of the product $(1054)(-92)(-16)(-37)$ is negative.

15. The sign of the product $(-40)(-16)(30)(50)(-13)$ is negative.

16. The sign of the product $(-1)(3)(-462)(-196)(-312)$ is positive.

17. Since the numbers have like signs, the product is positive. $(8)(3)=24$

18. Since the numbers have like signs, the product is positive. $7\cdot 8=56$

19. Since the number have unlike signs, the product is negative. $5(-3)=-15$

20. Since the numbers have unlike signs, the product is negative. $6(-2)=-12$

21. Since the numbers have like signs, the product is positive. $(-9)(-6)=54$

22. Since the numbers have like signs, the product is positive. $(-6)(-3)=18$

23. Since the numbers have unlike signs, the product is negative. $-7\cdot 3=-21$

24. Since the numbers have unlike signs, the product is negative. $-9\cdot 5=-45$

25. Since the numbers have unlike signs, the product is negative. $-3.2(3)=-9.6$

26. Since the numbers have unlike signs, the product is negative. $-7(5.4)=-37.8$

27. Since the numbers have unlike signs, the product is negative. $-4.67\cdot 1=-4.67$

28. Since the numbers have unlike signs, the product is negative. $(3.29)(-1)=-3.29$

29. Zero multiplied by any real number equals zero. $-6.7\cdot 0=0$

30. Zero multiplied by any real number equals zero.
$0(-5) = 0$

31. Zero multiplied by any real number equals zero.
$(-9(0)(-6) = 0(-6) = 0$

32. Since there is one negative number (an odd number), the product will be negative.
$5(-4)(2) = (-20)(2) = -40$

33. Since there is one negative number (an odd number), the product will be negative.
$(21)(-1)(4) = (-21)(4) = -84$

34. Since there are two negative numbers (an even number), the product will be positive.
$2(8)(-1)(-3) = 16(-1)(-3) = -16(-3) = 48$

35. Since there are three negative numbers (an odd number), the product will be negative.
$-1(-3)(3)(-8) = 3(3)(-8) = 9(-8) = -72$

36. Since there are three negative numbers (an odd number), the product will be negative.
$$(2)(-4)(-5)(-1) = (-8)(-5)(-1)$$
$$= (40)(-1)$$
$$= -40$$

37. Since there are two negative numbers (an even number), the product will be positive.
$$(-4)(5)(-7)(10) = (-20)(-7)(10)$$
$$= (140)(10) = 1400$$

38. Since there is one negative number (an odd number), the product will be negative.
$(-3)(2)(5)(3) = (-6)(5)(3) = (-30)(3) = -90$

39. Zero multiplied by any real number equals zero.
$(-1)(3)(0)(-7) = (-3)(0)(-7) = 0(-7) = 0$

40. Since there are two negative numbers (an even number), the product will be positive.
$$(-6)(6)(4)(-4) = (-36)(4)(-4)$$
$$= (-144)(-4)$$
$$= 576$$

41. $\left(\dfrac{-1}{2}\right)\left(\dfrac{3}{5}\right) = \dfrac{(-1)(3)}{2 \cdot 5} = \dfrac{-3}{10} = -\dfrac{3}{10}$

42. $\left(\dfrac{1}{3}\right)\left(\dfrac{-3}{5}\right) = \left(\dfrac{1}{{}_{1}\cancel{3}}\right)\left(\dfrac{-\cancel{3}^{1}}{5}\right) = \dfrac{(1)(-1)}{1 \cdot 5} = \dfrac{-1}{5} = -\dfrac{1}{5}$

43. $\left(\dfrac{-5}{9}\right)\left(\dfrac{-7}{15}\right) = \left(\dfrac{-\cancel{5}^{1}}{9}\right)\left(\dfrac{-7}{\cancel{15}_{3}}\right) = \dfrac{(-1)(-7)}{9 \cdot 3} = \dfrac{7}{27}$

44. $\left(\dfrac{-9}{10}\right)\left(\dfrac{7}{-8}\right) = \dfrac{(-9)(7)}{(10)(-8)} = \dfrac{-63}{-80} = \dfrac{63}{80}$

45. $\left(\dfrac{6}{-3}\right)\left(\dfrac{4}{-2}\right) = (-2)(-2) = 4$

46. $\left(\dfrac{9}{-10}\right)\left(\dfrac{6}{-7}\right) = \left(\dfrac{9}{-\cancel{10}_{5}}\right)\left(\dfrac{\cancel{6}^{3}}{-7}\right)$
$$= \dfrac{(9)(3)}{(-5)(-7)}$$
$$= \dfrac{27}{35}$$

47. $\left(\dfrac{3}{4}\right)\left(\dfrac{-2}{15}\right) = \left(\dfrac{{}^{1}\cancel{3}}{{}_{2}\cancel{4}}\right)\left(\dfrac{-\cancel{2}^{1}}{\cancel{15}_{5}}\right)$
$$= \dfrac{(1)(-1)}{(2)(5)}$$
$$= \dfrac{-1}{10} = -\dfrac{1}{10}$

48. $\left(\dfrac{4}{5}\right)\left(\dfrac{-3}{10}\right) = \left(\dfrac{{}^{2}\cancel{4}}{5}\right)\left(\dfrac{-3}{\cancel{10}_{5}}\right) = \dfrac{2(-3)}{5(5)} = -\dfrac{6}{25}$

49. Since the numbers have unlike signs, the quotient is negative. $\dfrac{-42}{6} = -7$

50. Since the numbers have unlike signs, the quotient is negative $\dfrac{-18}{9} = -2$

51. Since the numbers have like signs, the quotient is positive. $-16 \div (-4) = \dfrac{-16}{-4} = 4$

52. Since the numbers have like signs, the quotient is positive. $(-25) \div (-5) = \dfrac{-25}{-5} = 5$

53. Since the numbers have like signs, the quotient is positive. $\dfrac{-36}{-9} = 4$

54. Since the numbers have like signs, the quotient is positive. $\dfrac{-15}{-1} = 15$

55. Since the numbers have unlike signs, the quotient is negative. $\dfrac{36}{-2} = -18$

56. Since the numbers have unlike signs, the quotient is negative. $\dfrac{30}{-6} = -5$

57. Since the numbers have like signs, the quotient is positive. $\dfrac{-19.8}{-2} = 9.9$

58. Since the numbers have like signs, the quotient is positive. $-15.6/(-3) = \dfrac{-15.6}{-3} = 5.2$

59. Since the numbers have unlike signs, the quotient is negative. $40/(-4) = \dfrac{40}{-4} = -10$

60. Since the numbers have unlike signs, the quotient is negative. $\dfrac{63}{-7} = -9$

61. Since the numbers have unlike signs, the quotient is negative. $\dfrac{-66}{2} = -33$

62. Since the numbers have like signs, the quotient is positive. $\dfrac{-25}{-5} = 5$

63. Since the numbers have unlike signs, the quotient is negative. $\dfrac{48}{-12} = -4$

64. Since the numbers have unlike signs, the quotient is negative. $\dfrac{-10}{10} = -1$

65. Since the numbers have like signs, the quotient is positive. $\dfrac{-30}{-5} = 6$

66. Since the numbers have like signs, the quotient is positive. $\dfrac{-36}{-6} = 6$

67. Zero divided by any nonzero number is zero.
$\dfrac{0}{4} = 0$

68. Zero divided by any nonzero number is zero.
$\dfrac{0}{-13} = 0$

69. Since the numbers have like signs, the quotient is positive. $-64.8 \div (-4) = \dfrac{-64.8}{-4} = 16.2$

70. Since the numbers have like signs, the quotient is positive. $-86.4/(-2) = \dfrac{-86.4}{-2} = 43.2$

71. Since the numbers have unlike signs, the quotient is negative. $\dfrac{30.8}{-5.2} \approx -5.92$

72. Since the numbers have unlike signs, the quotient is negative. $\dfrac{-67.64}{7.3} \approx -9.27$

73.
$$\frac{3}{12} \div \left(\frac{-5}{8}\right) = \frac{3}{12} \cdot \left(\frac{8}{-5}\right)$$
$$= \frac{1}{\cancel{4}_1} \cdot \left(\frac{\cancel{8}^2}{-5}\right)$$
$$= \frac{1 \cdot 2}{1(-5)}$$
$$= \frac{2}{-5} = -\frac{2}{5}$$

74.
$$4 \div \left(-\frac{6}{13}\right) = \frac{\overset{2}{\cancel{4}}}{1} \cdot \frac{-13}{\cancel{6}_3}$$
$$= \frac{(2)(-13)}{1(3)}$$
$$= \frac{-26}{3} = -\frac{26}{3} \text{ or } -8\frac{2}{3}$$

75. $\dfrac{-5}{12} \div (-3) = \dfrac{-5}{12} \cdot \dfrac{1}{-3} = \dfrac{-5(1)}{12(-3)} = \dfrac{-5}{-36} = \dfrac{5}{36}$

76. $\dfrac{-3}{7} \div (-5) = \dfrac{-3}{7} \cdot \dfrac{1}{-5} = \dfrac{(-3)(1)}{(7)(-5)} = \dfrac{-3}{-35} = \dfrac{3}{35}$

77.
$$\frac{-15}{21} \div \left(\frac{-15}{21}\right) = \frac{-\overset{1}{\cancel{15}}}{\underset{1}{\cancel{21}}} \cdot \frac{\overset{1}{\cancel{21}}}{-\cancel{15}_1}$$
$$= \frac{(-1)(1)}{(1)(-1)}$$
$$= \frac{-1}{-1}$$
$$= 1$$

78. $\dfrac{-4}{9} \div \left(\dfrac{-6}{7}\right) = \dfrac{-\overset{2}{\cancel{4}}}{9} \cdot \dfrac{7}{-\underset{3}{\cancel{6}}}$

$= \dfrac{(-2)(7)}{(9)(-3)}$

$= \dfrac{-14}{-27} = \dfrac{14}{27}$

79. $-12 \div \dfrac{5}{12} = \dfrac{-12}{1} \cdot \dfrac{12}{5}$

$= \dfrac{(-12)(12)}{(1)(5)}$

$= \dfrac{-144}{5}$

$= -\dfrac{144}{5} \text{ or } -28\dfrac{4}{5}$

80. $-16 \div \dfrac{11}{16} = \dfrac{-16}{1} \cdot \dfrac{16}{11}$

$= \dfrac{(-16)(16)}{(1)(11)}$

$= -\dfrac{256}{11} \text{ or } -23\dfrac{3}{11}$

81. Since the numbers have unlike signs, the product is negative. $-4(8) = -32$

82. Since the numbers have like signs, the quotient is positive. $\dfrac{-18}{-2} = 9$

83. Since the numbers have like signs, the quotient is positive. $\dfrac{-100}{-5} = 20$

84. Since the numbers have like signs, the quotient is positive. $-50 \div (-10) = \dfrac{-50}{-10} = 5$

85. Since the numbers have unlike signs, the product is negative. $-7(2) = -14$

86. Since the numbers have unlike signs, the product is negative. $6.4(-8) = -51.2$

87. Since the numbers have unlike signs, the quotient is negative. $27.9 \div (-3) = \dfrac{27.9}{-3} = -9.3$

88. Since the numbers have unlike signs, the quotient is negative. $\dfrac{130}{-10} = -13$

89. Since the numbers have unlike signs, the quotient is negative. $\dfrac{-100}{5} = -20$

90. Since there are three negative signs (an odd number), the product is negative.
$4(-2)(-1)(-5) = (-8)(-1)(-5)$
$= (8)(-5) = -40$

91. Since the numbers have like signs, the quotient is positive. $\dfrac{-90}{-90} = 1$

92. Since there is one negative sign (an odd number) the product is negative.
$(6)(1)(-3)(4) = (6)(-3)(4) = (-18)(4) = -72$

93. Zero divided by any nonzero number is zero.
$0 \div 8.6 = \dfrac{0}{8.6} = 0$

94. Zero divided by any nonzero number is zero.
$\dfrac{0}{1} = 0$

95. Any nonzero number divided by zero is undefined. $\dfrac{5}{0}$ is undefined.

96. Any nonzero number divided zero is undefined.
$\dfrac{-2.7}{0}$ is undefined.

97. Zero divided by any nonzero number is zero.
$0 \div (-7) = \dfrac{0}{-7} = 0$

98. Any nonzero number divided by zero is undefined. $\dfrac{6}{0}$ is undefined.

99. Any nonzero number divided by zero is undefined. $\dfrac{8}{0}$ is undefined.

100. Zero divided by any nonzero number is zero.
$\dfrac{0}{12} = 0$

101. **a.** Since the numbers have unlike signs, the product will be negative.

b. $92(-38) = -3496$

c. Yes; as expected the product is negative.

102. a. Since the numbers have unlike signs, the quotient will be negative.

    b. $\dfrac{-168}{42} = -4$

    c. Yes; as expected the quotient is negative.

103. a. Since the numbers have unlike signs, the quotient will be negative.

    b. $-240/15 = \dfrac{-240}{15} = -16$

    c. Yes; as expected the quotient is negative.

104. a. Zero divided by any nonzero number is zero.

    b. $0/12 = \dfrac{0}{12} = 0$

    c. Yes; as expected, the quotient is zero.

105. a. Since the numbers have unlike signs, the quotient will be negative.

    b. $243 \div (-27) = \dfrac{243}{-27} = -9$

    c. Yes; as expected the quotient is negative.

106. a. Since the numbers have unlike signs, the product will be negative.

    b. $(323)(-115) = -37,145$

    c. Yes; as expected the product is negative.

107. a. Since the numbers have like signs, the product will be positive.

    b. $(-49)(-126) = 6174$

    c. Yes; as expected the product is positive.

108. a. The product will be zero; zero multiplied by any real number is zero.

    b. $(1530)(0) = 0$

    c. Yes; as expected the product is zero.

109. a. The quotient will be zero; zero divided by any nonzero number is zero.

    b. $\dfrac{0}{5335} = 0$

    c. Yes; as expected the answer is zero.

110. a. Since the numbers have like signs, the quotient will be positive.

    b. $-86.4 \div (-36) = \dfrac{-86.4}{-36} = 2.4$

    c. Yes; as expected the answer is positive.

111. a. Undefined; any nonzero number divided by 0 is undefined.

    b. $8.2 \div 0 = \dfrac{8.2}{0}$ is undefined

    c. Yes; as expected the quotient is undefined.

112. a. The quotient will be zero; zero divided by any nonzero number is zero.

    b. $-37.74 \div 0 = \dfrac{-37.74}{0}$ is undefined

    c. Yes; as expected the quotient is undefined.

113. a. Since the numbers have like signs, the quotient will be positive.

    b. $8 \div 2.5 = \dfrac{8}{2.5} = 3.2$

    c. Yes; as expected the quotient is positive.

114. a. Since there are no negative numbers, the product will be positive.

    b. $(1.1)(9.72)(6.3) = 67.3596$

    c. Yes; as expected the product is positive.

115. a. Since there are two negative numbers (an even number), the product will be positive.

    b. $(-3.0)(4.2)(-18) = 226.8$

    c. Yes; as expected the product is positive.

116. a. Since the numbers have unlike signs, the quotient will be negative.

    b. $-288.86/1.43 = \dfrac{-288.86}{1.43} = -202$

    c. Yes; as expected the quotient is negative.

117. False; the product of two numbers with like signs is a positive number

118. True; the product of two numbers with unlike signs is a negative number.

119. False; the quotient of two numbers with unlike signs is a negative number.

120. True; the quotient of two numbers with like signs is a positive number.

121. True; the product of an even number of negative numbers is a positive number.

122. False; zero divided by any nonzero number is zero.

123. False; the product of an odd number of negative numbers is a negative number.

124. False; six divided by 0 is undefined.

125. False; zero divided by 1 is zero.

126. True; the product of 0 and any real number is 0.

127. True; any nonzero number divided by zero is undefined.

128. True: any nonzero number divided by zero is undefined.

129. $3(-15) = -45$
The total loss was 45 yards.

130. $3(-160) = -480$
Its new depth is 480 feet below sea level.

131. **a.** $\frac{1}{5}(520) = \frac{520}{5} = 104$
She paid back $104.

 b. $-520 + 104 = -416$
Her new balance is –$416.

132. $4(40) - 500 = 160 + (-500) = -340$
He will still owe $340.

133. Find out how much is left after giving the husbands each $50.
$775.40 - (4 \cdot 50) = 775.40 - 200 = 575.40$
Now take the remainder and divide it by 4.
$\frac{575.40}{4} = 143.85$
Each woman receives $143.85.

134. $\frac{1}{3}(-30) = \frac{-30}{3} = \frac{-10}{1} = -10$
The wind chill temperature was –10°F on Tuesday.

135. **a.** $5(-4) = -20$
Josue lost 20 points.

 b. $100 - 20 = 80$
His test score is 80.

136. **a.** $10(-15) = -150$
–150 represents the total drop in temperature.

 b. $678 - 150 = 528$
The temperate of the metal was 528° at the end of ten hours.

137. **a.** $220 - 50 = 170$
60% of $170 = 0.6(170) = 102$
75% of $170 = 0.75(170) = 127.5$
Target heart rate is 102 to 128 beats per minute.

 b. Answers will vary.

138. $3^4 = 3 \cdot 3 \cdot 3 \cdot 3 = 81$

139. $(-5)^3 = (-5)(-5)(-5) = 25(-5) = -125$

140. $\left(\frac{2}{3}\right)^3 = \frac{2}{3} \cdot \frac{2}{3} \cdot \frac{2}{3} = \frac{2 \cdot 2 \cdot 2}{3 \cdot 3 \cdot 3} = \frac{8}{27}$

141. $1^{100} = 1$

142. $(-1)^{81} = -1$ since 81 is odd

143. The product $(-1)(-2)(-3)(-4)\cdots(-10)$ will be positive because there are an even number (10) of negative numbers.

144. The product will be negative since there are an odd number (17) of negatives.

145. **c.** The country will start with D. Most students will select Denmark. They will most likely select kangaroo which leads to orange.

146. $|-3.6| > |-2.7|$

147. $-\frac{7}{12} + \left(-\frac{1}{10}\right) = -\frac{35}{60} + \left(-\frac{6}{60}\right)$
$= \frac{-35 + (-6)}{60}$
$= -\frac{41}{60}$

148. $-20 - (-18) = -20 + 18 = -2$

149. $6 - 3 - 4 - 2 = 3 - 4 - 2 = -1 - 2 = -3$

150. $5 - (-2) + 3 - 7 = 5 + 2 + 3 - 7$
$= 7 + 3 - 7$
$= 10 - 7$
$= 3$

Exercise Set 1.9

1. When an expression has only additions and subtractions, it is evaluated from <u>left</u> to right.

2. After evaluating grouping symbols, the next order of operation is to <u>evaluate</u> exponents.

3. Parentheses, brackets and braces are examples of <u>grouping</u> symbols.

4. In the expression 7^5, 7 is called the <u>base</u>.

5. In the expression 7^5, 5 is called the <u>exponent</u>.

6. When grouping symbols are nested, begin evaluating at the <u>innermost</u> group.

7. $2^3 = 2 \cdot 2 \cdot 2 = 8$

8. $3^2 = 3 \cdot 3 = 9$

9. $1^5 = 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 = 1$

10. $1^7 = 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 = 1$

11. $5^1 = 5$

12. $7^1 = 7$

13. $(-1)^2 = (-1)(-1) = 1$

14. $(-1)^4 = (-1)(-1)(-1)(-1) = 1$

15. $(-1)^3 = (-1)(-1)(-1) = -1$

16. $(-1)^5 = (-1)(-1)(-1)(-1)(-1) = -1$

17. $-3^2 = -(3)(3) = -9$

18. $-4^2 = -(4)(4) = -16$

19. $(-3)^2 = (-3)(-3) = 9$

20. $(-4)^2 = (-4)(-4) = 16$

21. $-5^2 = -(5)(5) = -25$

22. $(-5)^2 = (-5)(-5) = 25$

23. $(-6)^2 = (-6)(-6) = 36$

24. $-6^2 = -(6)(6) = -36$

25. $-2^4 = -(2)(2)(2)(2) = -16$

26. $(-2)^4 = (-2)(-2)(-2)(-2) = 16$

27. $\left(\dfrac{3}{4}\right)^2 = \dfrac{3}{4} \cdot \dfrac{3}{4} = \dfrac{9}{16}$

28. $\left(\dfrac{4}{5}\right)^2 = \dfrac{4}{5} \cdot \dfrac{4}{5} = \dfrac{16}{25}$

29. $\left(-\dfrac{3}{4}\right)^2 = \left(-\dfrac{3}{4}\right)\left(-\dfrac{3}{4}\right) = \dfrac{9}{16}$

30. $\left(-\dfrac{4}{5}\right)^2 = \left(-\dfrac{4}{5}\right)\left(-\dfrac{4}{5}\right) = \dfrac{16}{25}$

31. $\left(\dfrac{3}{4}\right)^3 = \left(\dfrac{3}{4}\right)\left(\dfrac{3}{4}\right)\left(\dfrac{3}{4}\right) = \dfrac{27}{64}$

32. $\left(\dfrac{4}{5}\right)^3 = \left(\dfrac{4}{5}\right)\left(\dfrac{4}{5}\right)\left(\dfrac{4}{5}\right) = \dfrac{64}{125}$

33. $\left(-\dfrac{3}{4}\right)^3 = \left(-\dfrac{3}{4}\right)\left(-\dfrac{3}{4}\right)\left(-\dfrac{3}{4}\right) = -\dfrac{27}{64}$

34. $\left(-\dfrac{4}{5}\right)^3 = \left(-\dfrac{4}{5}\right)\left(-\dfrac{4}{5}\right)\left(-\dfrac{4}{5}\right) = -\dfrac{64}{125}$

35. **a.** negative
    b. $-7^2 = -(7)(7) = -49$

36. **a.** negative
    b. $-8^2 = -(8)(8) = -64$

37. **a.** positive
    b. $(-7)^2 = (-7)(-7) = 49$

38. **a.** positive
    b. $(-8)^2 = (-8)(-8) = 64$

39. **a.** positive
    b. $-\left(-7^2\right) = -\left(-(7)(7)\right) = -(-49) = 49$

40. **a.** positive
    b. $-\left(-8^2\right) = -\left(-(8)(8)\right) = -(-64) = 64$

41. **a.** negative
    b. $-(-7)^2 = -(-7)(-7) = -49$

42. **a.** negative
    b. $-(-8)^2 = -(-8)(-8) = -64$

43. **a.** negative
    b. $(-1.2)^3 = (-1.2)(-1.2)(-1.2) = -1.728$

44. a. negative

   b. $(-2.1)^3 = (-2.1)(-2.1)(-2.1) = -9.261$

45. a. positive

   b. $\left(-\dfrac{5}{8}\right)^2 = \left(-\dfrac{5}{8}\right)\left(-\dfrac{5}{8}\right) = \dfrac{25}{64}$

46. a. positive

   b. $\left(-\dfrac{3}{5}\right)^2 = \left(-\dfrac{3}{5}\right)\left(-\dfrac{3}{5}\right) = \dfrac{9}{25}$

47. $3 + 3 \cdot 6 = 3 + 18 = 21$

48. $7 - 5^2 + 8 = 7 - 25 + 8 = -18 + 8 = -10$

49. $6 - 6 + 8 = 0 + 8 = 8$

50. $\begin{aligned}(8^2 \div 4) - (20 - 4) &= (64 \div 4) - (20 - 4) \\ &= 16 - 16 \\ &= 0\end{aligned}$

51. $\begin{aligned}-7 + 2 \cdot 6^2 - 8 &= -7 + 2 \cdot 36 - 8 \\ &= -7 + 72 - 8 \\ &= 65 - 8 \\ &= 57\end{aligned}$

52. $\begin{aligned}6 + 2 \cdot 3^2 - 10 &= 6 + 2 \cdot 9 - 10 \\ &= 6 + 18 - 10 \\ &= 24 - 10 \\ &= 14\end{aligned}$

53. $-3^3 + 27 = -27 + 27 = 0$

54. $(-2)^3 + 8 \div 4 = -8 + 8 \div 4 = -8 + 2 = -6$

55. $(4 - 5) \cdot (5 - 1)^2 = (-1) \cdot (4)^2 = -1 \cdot 16 = -16$

56. $-10 - 6 - 3 - 2 = -16 - 3 - 2 = -19 - 2 = -21$

57. $3 \cdot 7 + 4 \cdot 2 = 21 + 8 = 29$

58. $\begin{aligned}4^2 - 3 \cdot 4 - 6 &= 16 - 3 \cdot 4 - 6 \\ &= 16 - 12 - 6 \\ &= 4 - 6 \\ &= -2\end{aligned}$

59. $5 - 2(7 + 5) = 5 - 2(12) = 5 - 24 = -19$

60. $8 + 3(6 + 4) = 8 + 3(10) = 8 + 30 = 38$

61. $\begin{aligned}-32 - 5(7 - 10)^2 &= -32 - 5(-3)^2 \\ &= -32 - 5(9) \\ &= -32 - 45 \\ &= -77\end{aligned}$

62. $\begin{aligned}-40 - 3(4 - 8)^2 &= -40 - 3(-4)^2 \\ &= -40 - 3(16) \\ &= -40 - 48 \\ &= -88\end{aligned}$

63. $\begin{aligned}\dfrac{3}{4} + 2\left(\dfrac{1}{5}\right)^2 &= \dfrac{3}{4} + 2\left(\dfrac{1}{25}\right) \\ &= \dfrac{3}{4} + \dfrac{2}{25} \\ &= \dfrac{75}{100} + \dfrac{8}{100} \\ &= \dfrac{83}{100}\end{aligned}$

64. $\begin{aligned}-\dfrac{2}{3} - 3\left(\dfrac{3}{4}\right)^2 &= -\dfrac{2}{3} - 3\left(\dfrac{9}{16}\right) \\ &= -\dfrac{2}{3} - \dfrac{27}{16} \\ &= -\dfrac{32}{48} - \dfrac{81}{48} \\ &= -\dfrac{113}{48} \text{ or } -2\dfrac{17}{48}\end{aligned}$

65. $\begin{aligned}-4 + 3\left[-1 + (12 \div 2^2)\right] &= -4 + 3\left[-1 + (12 \div 4)\right] \\ &= -4 + 3[-1 + 3] \\ &= -4 + 3[2] \\ &= -4 + 6 \\ &= 2\end{aligned}$

66. $\begin{aligned}-2 + 4\left[-3 + (48 \div 4^2)\right] &= -2 + 4\left[-3 + (48 \div 16)\right] \\ &= -2 + 4[-3 + 3] \\ &= -2 + 4[0] \\ &= -2 + 0 \\ &= -2\end{aligned}$

67. $\begin{aligned}(6 \div 3)^3 + 4^2 \div 8 &= (2)^3 + 4^2 \div 8 \\ &= 8 + 16 \div 8 \\ &= 8 + 2 \\ &= 10\end{aligned}$

68. $4 + \left(4^2 - 13\right)^4 - 3 = 4 + \left(16 - 13\right)^4 - 3$
$$= 4 + 3^4 - 3$$
$$= 4 + 81 - 3$$
$$= 85 - 3$$
$$= 82$$

69. $-7 - 48 \div 6 \cdot 2^2 + 5 = -7 - 48 \div 6 \cdot 4 + 5$
$$= -7 - 8 \cdot 4 + 5$$
$$= -7 - 32 + 5$$
$$= -39 + 5$$
$$= -34$$

70. $-7 - 56 \div 7 \cdot 2^2 + 4 = -7 - 56 \div 7 \cdot 4 + 4$
$$= -7 - 8 \cdot 4 + 4$$
$$= -7 - 32 + 4$$
$$= -39 + 4$$
$$= -35$$

71. $\left(9 \div 3\right) + 4\left(7 - 2\right)^2 = \left(9 \div 3\right) + 4\left(5\right)^2$
$$= \left(9 \div 3\right) + 4\left(25\right)$$
$$= 3 + 100$$
$$= 103$$

72. $\left(12 \div 4\right) + 5\left(6 - 4\right)^2 = \left(12 \div 4\right) + 5\left(2\right)^2$
$$= \left(12 \div 4\right) + 5\left(4\right)$$
$$= 3 + 20$$
$$= 23$$

73. $\left[4 + \left(\left(5 - 2\right)^2 \div 3\right)^2\right]^2 = \left[4 + \left(\left(3\right)^2 \div 3\right)^2\right]^2$
$$= \left[4 + \left(9 \div 3\right)^2\right]^2$$
$$= \left[4 + \left(3\right)^2\right]^2$$
$$= \left[4 + 9\right]^2$$
$$= \left(13\right)^2$$
$$= 169$$

74. $\left(20 \div 5 \cdot 5 \div 5 - 5\right)^2 = \left(4 \cdot 5 \div 5 - 5\right)^2$
$$= \left(20 \div 5 - 5\right)^2$$
$$= \left(4 - 5\right)^2$$
$$= \left(-1\right)^2$$
$$= 1$$

75. $\left(-3\right)^3 + 8 \div 2 = -27 + 8 \div 2$
$$= -27 + 4$$
$$= -23$$

76. $-3^2 + 8 \div 2 = -27 + 8 \div 2$
$$= -27 + 4$$
$$= -23$$

77. $2\left[1.55 + 5\left(3.7\right)\right] - 3.35 = 2\left[1.55 + 18.5\right] - 3.35$
$$= 2\left(20.05\right) - 3.35$$
$$= 40.1 - 3.35$$
$$= 36.75$$

78. $\left(8.4 + 3.1\right)^2 - \left(3.64 - 1.2\right) = \left(11.5\right)^2 - \left(2.44\right)$
$$= 132.25 - 2.44$$
$$= 129.81$$

79. $\left(\dfrac{2}{5} + \dfrac{3}{8}\right) - \dfrac{3}{20} = \left(\dfrac{16}{40} + \dfrac{15}{40}\right) - \dfrac{3}{20}$
$$= \dfrac{31}{40} - \dfrac{3}{20}$$
$$= \dfrac{31}{40} - \dfrac{6}{40}$$
$$= \dfrac{25}{40} = \dfrac{5}{8}$$

80. $\left(\dfrac{5}{6} \cdot \dfrac{4}{5}\right) + \left(\dfrac{2}{3} \cdot \dfrac{5}{8}\right) = \left(\dfrac{1}{3} \cdot \dfrac{2}{1}\right) + \left(\dfrac{1}{3} \cdot \dfrac{5}{4}\right)$
$$= \dfrac{2}{3} + \dfrac{5}{12}$$
$$= \dfrac{8}{12} + \dfrac{5}{12}$$
$$= \dfrac{13}{12} \text{ or } 1\dfrac{1}{12}$$

81. $\dfrac{3}{4} - 4 \cdot \dfrac{5}{40} = \dfrac{3}{4} - \dfrac{4}{1} \cdot \dfrac{5}{40} = \dfrac{3}{4} - \dfrac{4}{8} = \dfrac{3}{4} - \dfrac{2}{4} = \dfrac{1}{4}$

82. $\dfrac{1}{8} - \dfrac{1}{4} \cdot \dfrac{3}{2} + \dfrac{3}{5} = \dfrac{1}{8} - \dfrac{3}{8} + \dfrac{3}{5}$
$$= -\dfrac{2}{8} + \dfrac{3}{5}$$
$$= -\dfrac{10}{40} + \dfrac{24}{40}$$
$$= \dfrac{14}{40} = \dfrac{7}{20}$$

83.
$$\frac{4}{5}+\frac{3}{4}\div\frac{1}{2}-\frac{2}{3}=\frac{4}{5}+\frac{3}{4}\cdot\frac{2}{1}-\frac{2}{3}$$
$$=\frac{4}{5}+\frac{3}{2}-\frac{2}{3}$$
$$=\frac{24}{30}+\frac{45}{30}-\frac{20}{30}$$
$$=\frac{49}{30}\text{ or }1\frac{19}{30}$$

84.
$$\frac{12-(4-6)^2}{6+4^2\div2^2}=\frac{12-(-2)^2}{6+4^2\div2^2}$$
$$=\frac{12-4}{6+16\div4}$$
$$=\frac{12-4}{6+4}$$
$$=\frac{8}{10}$$
$$=\frac{4}{5}$$

85.
$$\frac{-4-\left[2(9\div3)-5\right]}{6^2-3^2\cdot7}=\frac{-4-\left[2(3)-5\right]}{36-9\cdot7}$$
$$=\frac{-4-[6-5]}{36-63}$$
$$=\frac{-4-1}{-27}$$
$$=\frac{-5}{-27}=\frac{5}{27}$$

86.
$$\frac{[(7-3)^2-4]^2}{9-16\div8-4}=\frac{[4^2-4]^2}{9-16\div8-4}$$
$$=\frac{[16-4]^2}{9-2-4}$$
$$=\frac{(12)^2}{7-4}$$
$$=\frac{144}{3}$$
$$=48$$

87.
$$\frac{-[4-(6-12)^2]}{\left[(9\div3)+4\right]^2+2^2}=\frac{-[4-(-6)^2]}{(3+4)^2+4}$$
$$=\frac{-[4-36]}{7^2+4}$$
$$=\frac{-(-32)}{49+4}$$
$$=\frac{32}{53}$$

88.
$$\frac{[5-(3-7)-2]^2}{2\left[\left(16\div2^2\right)-(8\cdot4)\right]}=\frac{[5-(-4)-2]^2}{2\left[(16\div4)-32\right]}$$
$$=\frac{[5+4-2]^2}{2[4-32]}$$
$$=\frac{(7)^2}{2(-28)}$$
$$=\frac{49}{-56}=-\frac{7}{8}$$

89.
$$\left\{5-2\left[4-(6\div2)\right]^2\right\}^2=\left\{5-2\left[4-3\right]^2\right\}^2$$
$$=\left\{5-2(1)^2\right\}^2$$
$$=\left\{5-2(1)\right\}^2$$
$$=\left\{5-2\right\}^2$$
$$=(3)^2$$
$$=9$$

90.
$$\left\{-6-\left[3\left(16\div4^2\right)^2\right]\right\}^2=\left\{-6-\left[3(16\div16)^2\right]\right\}^2$$
$$=\left\{-6-\left[3(1)^2\right]\right\}^2$$
$$=\left\{-6-\left[3(1)\right]\right\}^2$$
$$=\left\{-6-3\right\}^2$$
$$=(-9)^2$$
$$=81$$

91.
$$-\left\{4-\left[-3-(2-5)\right]^2\right\}=-\left\{4-\left[-3-(-3)\right]^2\right\}$$
$$=-\left\{4-\left[-3+3\right]^2\right\}$$
$$=-\left\{4-\left[0\right]^2\right\}$$
$$=-\left\{4-0\right\}$$
$$=-(4)$$
$$=-4$$

92. $3\{4[(3-4)^2-3]^3-1\}=3\{4[(-1)^2-3]^3-1\}$

$$=3\{4[1-3]^3-1\}$$
$$=3\{4[-2]^3-1\}$$
$$=3\{4(-8)-1\}$$
$$=3\{-32-1\}$$
$$=3(-33)$$
$$=-99$$

93. $\{4-3[2-(9\div 3)]^2\}^2=\{4-3[2-3]^2\}^2$

$$=\{4-3[-1]^2\}^2$$
$$=\{4-3[1]\}^2$$
$$=\{4-3\}^2$$
$$=1^2$$
$$=1$$

94. $2\{5[(4-6)^3-1]^2-3\}=2\{5[(-2)^3-1]^2-3\}$

$$=2\{5[-8-1]^2-3\}$$
$$=2\{5[-9]^2-3\}$$
$$=2\{5[81]-3\}$$
$$=2\{405-3\}$$
$$=2\{402\}$$
$$=804$$

95. Substitute 5 for x

   a. $x^2=5^2=5\cdot 5=25$

   b. $-x^2=-5^2=-(5)(5)=-25$

   c. $(-x)^2=(-5)^2=(-5)^2=(-5)(-5)=25$

96. Substitute 8 for x

   a. $x^2=8^2=8\cdot 8=64$

   b. $-x^2=-8^2=-(8)(8)=-64$

   c. $(-x)^2=(-8)^2=(-8)(-8)=64$

97. Substitute –2 for x

   a. $x^2=(-2)^2=(-2)(-2)=4$

   b. $-x^2=-(-2)^2=-(-2)(-2)=-(4)=-4$

   c. $(-x)^2=2^2=2\cdot 2=4$

98. Substitute –5 for x

   a. $x^2=(-5)^2=(-5)(-5)=25$

   b. $-x^2=-(-5)^2=-(-5)(-5)=-25$

   c. $(-x)^2=5^2=5\cdot 5=25$

99. Substitute 6 for x

   a. $x^2=6^2=6\cdot 6=36$

   b. $-x^2=-6^2=-(6\cdot 6)=-36$

   c. $(-x)^2=(-6)^2=(-6)(-6)=36$

100. Substitute 7 for x

   a. $x^2=7^2=7\cdot 7=49$

   b. $-x^2=-7^2=-(7)(7)=-49$

   c. $(-x)^2=(-7)^2=(-7)(-7)=49$

101. Substitute $-\dfrac{1}{3}$ for x.

   a. $x^2=\left(-\dfrac{1}{3}\right)^2=\left(-\dfrac{1}{3}\right)\left(-\dfrac{1}{3}\right)=\dfrac{1}{9}$

   b. $-x^2=-\left(-\dfrac{1}{3}\right)^2=-\left(-\dfrac{1}{3}\right)\left(-\dfrac{1}{3}\right)=-\dfrac{1}{9}$

   c. $(-x)^2=\left(\dfrac{1}{3}\right)^2=\left(\dfrac{1}{3}\right)\left(\dfrac{1}{3}\right)=\dfrac{1}{9}$

102. Substitute $\dfrac{3}{4}$ for x.

   a. $x^2=\left(\dfrac{3}{4}\right)^2=\left(\dfrac{3}{4}\right)\left(\dfrac{3}{4}\right)=\dfrac{9}{16}$

   b. $-x^2=-\left(\dfrac{3}{4}\right)^2=-\left(\dfrac{3}{4}\right)\left(\dfrac{3}{4}\right)=-\dfrac{9}{16}$

   c. $(-x)^2=\left(-\dfrac{3}{4}\right)^2=\left(-\dfrac{3}{4}\right)\left(-\dfrac{3}{4}\right)=\dfrac{9}{16}$

103. Substitute –2 for x in the expression.
$x+6=-2+6=4$

104. Substitute 3 for each x in the expression.
$$2x - 4x + 5 = 2(3) - 4(3) + 5$$
$$= 6 - 12 + 5$$
$$= -6 + 5$$
$$= -1$$

105. Substitute 6 for z in the expression.
$$-7z - 3 = -7(6) - 3 = -42 - 3 = -45$$

106. Substitute 5 for x in the expression.
$$3(x - 2) = 3(5 - 2) = 3(3) = 9$$

107. Substitute −3 for a in the expression.
$$a^2 - 6 = (-3)^2 - 6 = 9 - 6 = 3$$

108. Substitute 5 for b in the expression.
$$b^2 - 8 = (5)^2 - 8 = 25 - 8 = 17$$

109. Substitute 2 for each p in the expression.
$$3p^2 - 6p - 4 = 3(2)^2 - 6(2) - 4$$
$$= 3(4) - 12 - 4$$
$$= 12 - 12 - 4$$
$$= 0 - 4$$
$$= -4$$

110. Substitute 1 for each r in the expression.
$$2r^2 - 5r + 3 = 2(1)^2 - 5(1) + 3$$
$$= 2(1) - 5 + 3$$
$$= 2 - 5 + 3$$
$$= -3 + 3$$
$$= 0$$

111. Substitute −1 for each x in the expression.
$$-4x^2 - 2x + 1 = -4(-1)^2 - 2(-1) + 1$$
$$= -4(1) - 2(-1) + 1$$
$$= -4 + 2 + 1$$
$$= -2 + 1$$
$$= -1$$

112. Substitute −4 for t in the expression.
$$-t^2 - 4t + 5 = -(-4)^2 - 4(-4) + 5$$
$$= -16 + 16 + 5$$
$$= 0 + 5$$
$$= 5$$

113. Substitute $\dfrac{1}{2}$ for each x in the expression.
$$-x^2 - 2x + 5 = -\left(\frac{1}{2}\right)^2 - 2\left(\frac{1}{2}\right) + 5$$
$$= -\frac{1}{4} - 1 + 5$$
$$= -\frac{1}{4} - \frac{4}{4} + \frac{20}{4}$$
$$= -\frac{5}{4} + \frac{20}{4}$$
$$= \frac{15}{4} \text{ or } 3\frac{3}{4}$$

114. Substitute $\dfrac{3}{4}$ for each x in the expression.
$$2x^2 - 4x - 10 = 2\left(\frac{3}{4}\right)^2 - 4\left(\frac{3}{4}\right) - 10$$
$$= 2\left(\frac{9}{16}\right) - 3 - 10$$
$$= \frac{18}{16} - 3 - 10$$
$$= \frac{9}{8} - \frac{24}{8} - \frac{80}{8}$$
$$= -\frac{15}{8} - \frac{80}{8}$$
$$= -\frac{95}{8} \text{ or } -11\frac{7}{8}$$

115. Substitute 5 for each x in the expression.
$$4(3x + 1)^2 - 6x = 4(3(5) + 1)^2 - 6(5)$$
$$= 4(15 + 1)^2 - 30$$
$$= 4(16)^2 - 30$$
$$= 4(256) - 30$$
$$= 1024 - 30$$
$$= 994$$

116. Substitute −4 for each n in the expression.
$$3n^2(2n - 1) + 5 = 3(-4)^2(2(-4) - 1) + 5$$
$$= 3(-4)^2(-8 - 1) + 5$$
$$= 3(16)(-9) + 5$$
$$= (48)(-9) + 5$$
$$= -432 + 5$$
$$= -427$$

117. Substitute –2 for *r* and –3 for *s* in the expression.
$$r^2 - s^2 = (-2)^2 - (-3)^2 = 4 - 9 = -5$$

118. Substitute 5 for *p* and –3 for *q* in the expression.
$$p^2 - p^2 = (5)^2 - (-3)^2 = 25 - 9 = 16$$

119. Substitute 1 for *x* and –5 for *y* in the expression.
$$\begin{aligned}
5(x - 6y) + 3x - 7y &= 5(1 - 6(-5)) + 3(1) - 7(-5) \\
&= 5(1 - (-30)) + 3 + 35 \\
&= 5(31) + 3 + 35 \\
&= 155 + 3 + 35 \\
&= 158 + 35 \\
&= 193
\end{aligned}$$

120. Substitute 2 for *x* and 4 for *y* in the expression.
$$\begin{aligned}
&4(x + y)^2 + 2(x + y) + 3 \\
&= 4(2 + 4)^2 + 2(2 + 4) + 3 \\
&= 4(6)^2 + 2(6) + 3 \\
&= 4(36) + 2(6) + 3 \\
&= 144 + 12 + 3 \\
&= 156 + 3 \\
&= 159
\end{aligned}$$

121. Substitute –1 for *x* and –2 for *y* in the expression.
$$\begin{aligned}
3(x - 4)^2 - (3y - 4)^2 &= 3(-1 - 4)^2 - [3(-2) - 4]^2 \\
&= 3(-5)^2 - (-6 - 4)^2 \\
&= 3(-5)^2 - (-10)^2 \\
&= 3(25) - 100 \\
&= 75 - 100 \\
&= -25
\end{aligned}$$

122. Substitute 2 for *x* and –3 for *y* in the expression.
$$\begin{aligned}
6x^2 + 3xy - y^2 &= 6(2)^2 + 3(2)(-3) - (-3)^2 \\
&= 6(4) + 3(2)(-3) - 9 \\
&= 24 + (-18) - 9 \\
&= 6 - 9 \\
&= -3
\end{aligned}$$

123.
$$6 \cdot 3 \qquad\qquad \text{Multiply 6 by 3}$$
$$(6 \cdot 3) - 4 \qquad\qquad \text{Subtract 4 from the product}$$
$$\left[(6 \cdot 3) - 4\right] - 2 \quad \text{Subtract 2 from the difference}$$
Evaluate:
$$\left[(6 \cdot 3) - 4\right] - 2 = [18 - 4] - 2 = 14 - 2 = 12$$

124.
$$9 + 4 \qquad\qquad\qquad \text{Add 4 to 9}$$
$$(9 + 4) \div 2 \qquad\qquad \text{Divide by 2}$$
$$\left[(9 + 4) \div 2\right] + 10 \qquad \text{Add 10 to the quotient}$$
Evaluate:
$$\begin{aligned}
[(9 + 4) \div 2] + 10 &= [13 \div 2] + 10 \\
&= \frac{13}{2} + 10 \\
&= \frac{13}{2} + \frac{20}{2} \\
&= \frac{33}{2} \text{ or } 16\frac{1}{2}
\end{aligned}$$

125.
$$10 \cdot 4 \qquad\qquad\qquad\qquad \text{Multiply 10 by 4}$$
$$(10 \cdot 4) + 9 \qquad\qquad\qquad \text{Add 9 to the product}$$
$$\left[(10 \cdot 4) + 9\right] - 6 \qquad\qquad \text{Subtract 6 from the sum}$$
$$\left\{[(10 \cdot 4) + 9] - 6\right\} \div 7 \quad \text{Divide the difference}$$
$$\phantom{\left\{[(10 \cdot 4) + 9] - 6\right\} \div 7 \quad} \text{by 7}$$
Evaluate:
$$\begin{aligned}
\left\{[(10 \cdot 4) + 9] - 6\right\} \div 7 &= \left\{[40 + 9] - 6\right\} \div 7 \\
&= \left\{49 - 6\right\} \div 7 \\
&= 43 \div 7 \\
&= \frac{43}{7} \text{ or } 6\frac{1}{7}
\end{aligned}$$

126.
$$6 \cdot 3 \qquad\qquad\qquad\qquad \text{Multiply 6 by 3}$$
$$(6 \cdot 3) + 27 \qquad\qquad\qquad \text{Add 27}$$
$$\left[(6 \cdot 3) + 27\right] \div 8 \qquad\qquad \text{Divide by 8}$$
$$10\left\{[(6 \cdot 3) + 27] \div 8\right\} \qquad \text{Multiply quotient by 10}$$
Evaluate:
$$\begin{aligned}
10\left\{[(6 \cdot 3) + 27] \div 8\right\} &= 10\left\{[18 + 27] \div 8\right\} \\
&= 10[45 \div 8] \\
&= 10\left(\frac{45}{8}\right) \\
&= \frac{10}{1} \cdot \frac{45}{8} \\
&= \frac{5}{1} \cdot \frac{45}{4} \\
&= \frac{225}{4} \text{ or } 56\frac{1}{4}
\end{aligned}$$

127. $\dfrac{4}{5} + \dfrac{3}{7}$ Add $\dfrac{4}{5}$ to $\dfrac{3}{7}$

$\left(\dfrac{4}{5} + \dfrac{3}{7}\right) \cdot \dfrac{2}{3}$ Multiply the sum by $\dfrac{2}{3}$

Evaluate:

$\left(\dfrac{4}{5} + \dfrac{3}{7}\right) \cdot \dfrac{2}{3} = \left(\dfrac{28}{35} + \dfrac{15}{35}\right) \cdot \dfrac{2}{3}$

$= \left(\dfrac{43}{35}\right) \cdot \left(\dfrac{2}{3}\right)$

$= \dfrac{86}{105}$

128. $\dfrac{3}{8} \cdot \dfrac{4}{5}$ Multiply $\dfrac{3}{8}$ by $\dfrac{4}{5}$

$\left(\dfrac{3}{8} \cdot \dfrac{4}{5}\right) + \dfrac{7}{120}$ Add $\dfrac{7}{120}$

$\left[\left(\dfrac{3}{8} \cdot \dfrac{4}{5}\right) + \dfrac{7}{120}\right] - \dfrac{1}{60}$ Subtract $\dfrac{1}{60}$ from the

sum

Evaluate:

$\left[\left(\dfrac{3}{8} \cdot \dfrac{4}{5}\right) + \dfrac{7}{120}\right] - \dfrac{1}{60} = \left[\left(\dfrac{3}{2} \cdot \dfrac{1}{5}\right) + \dfrac{7}{120}\right] - \dfrac{1}{60}$

$= \left[\dfrac{3}{10} + \dfrac{7}{120}\right] - \dfrac{1}{60}$

$= \left[\dfrac{36}{120} + \dfrac{7}{120}\right] - \dfrac{1}{60}$

$= \dfrac{43}{120} - \dfrac{1}{60}$

$= \dfrac{43}{120} - \dfrac{2}{120}$

$= \dfrac{41}{120}$

129. $-\left(x^2\right) = -x^2$ is true for all real numbers.

130. When $x = 0$ or 1, $x = x^2$.

131. When $t = 2.5$, $65t = 65(2.5) = 162.5$

The car travels 162.5 miles.

132. When $d = 19.99$, $0.08d = 0.08(19.99) \approx 1.60$.

The sales tax is $1.60.

133. When $t = 1$,

$-16t^2 + 57t + 6 = -16(1)^2 + 57(1) + 6$

$= -16 + 57 + 6$

$= 41 + 6$

$= 47$

After 1 second the height will be 47 feet.

134. When $t = 2$,

$-16t^2 + 48t + 70 = -16(2)^2 + 48(2) + 70$

$= -16(4) + 48(2) + 70$

$= -64 + 96 + 70$

$= 32 + 70$

$= 102$

After 2 seconds the height will be 102 feet.

135. When $c = 21{,}000$,

$c + 0.07c = 21{,}000 + 0.07(21{,}000)$

$= 21{,}000 + 1470$

$= 22{,}470$

The total cost is $22,470.

136. When $c = 13{,}000$,

$c + 0.06c = 13{,}000 + 0.06(13{,}000)$

$= 13{,}000 + 780$

$= 13{,}780$

The total cost is $13,780.

137. When $R = 2$ and $T = 70$,

$0.2R^2 + 0.003RT + 0.0001T^2$

$= 0.02(2)^2 + 0.003(2)(70) + 0.0001(70)^2$

$= 0.2(4) + 0.003(2)(70) + 0.0001(4900)$

$= 0.8 + 0.42 + 0.49 = 1.71$

The growth is 1.71 inches.

138. $12 - (4 - 6) + 10 = 24$

139. $(14 + 6) \div 2 \times 4 = 40$

140. **a.** $2^2 \cdot 2^3 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 2^5$

b. $3^2 \cdot 3^3 = 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 = 3^5$

c. $2^3 \cdot 2^4 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 2^7$

d. $x^m \cdot x^n = x^{m+n}$

141. a. $\dfrac{2^3}{2^2} = \dfrac{\cancel{2} \cdot \cancel{2} \cdot 2}{\cancel{2} \cdot \cancel{2}} = 2^1 = 2$

    b. $\dfrac{3^4}{3^2} = \dfrac{\cancel{3} \cdot \cancel{3} \cdot 3 \cdot 3}{\cancel{3} \cdot \cancel{3}} = 3^2$

    c. $\dfrac{4^5}{4^3} = \dfrac{\cancel{4} \cdot \cancel{4} \cdot \cancel{4} \cdot 4 \cdot 4}{\cancel{4} \cdot \cancel{4} \cdot \cancel{4}} = 4^2$

    d. $\dfrac{x^m}{x^n} = x^{m-n}$

142. a. $\left(2^3\right)^2 = 2^3 \cdot 2^3 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 2^6$

    b. $\left(3^3\right)^2 = 3^3 \cdot 3^3 = 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 = 3^6$

    c. $\left(4^2\right)^2 = 4^2 \cdot 4^2 = 4 \cdot 4 \cdot 4 \cdot 4 = 4^4$

    d. $\left(x^m\right)^n = x^{mn}$

143. a. $\left(2x\right)^2 = \left(2x\right) \cdot \left(2x\right) = 2 \cdot 2 \cdot x \cdot x = 2^2 x^2$

    b. $\left(3x\right)^2 = \left(3x\right) \cdot \left(3x\right) = 3 \cdot 3 \cdot x \cdot x = 3^2 x^2$

    c. $\left(4x\right)^3 = \left(4x\right) \cdot \left(4x\right) \cdot \left(4x\right)$
$= 4 \cdot 4 \cdot 4 \cdot x \cdot x \cdot x$
$= 4^3 x^3$

    d. $\left(ax\right)^m = a^m x^m$

144. a. There are 3 houses with 2 dogs.

    b.

Dogs	Number of Houses
0	4
1	5
2	3
3	1
4	1

    c. $4(1) + 3(1) + 2(3) + 1(5) + 0(4)$
$= 4 + 3 + 6 + 5 + 0$
$= 7 + 6 + 5$
$= 13 + 5$
$= 18$
There are 18 dogs in all.

    d. Number of dogs = 18
$\text{mean} = \dfrac{\text{number of dogs}}{\text{number of houses}} = \dfrac{18}{14} \approx 1.29$
There is a mean of 1.29 dogs per house.

145. $3 = \dfrac{6}{2} = \dfrac{1}{2} + \dfrac{5}{2} = \dfrac{1}{2} + \dfrac{20}{8}$
$\text{Cost } = \$2.40 + 20\left(0.20\right) = \$2.40 + \$4.00 = \$6.40$

146. $-\dfrac{7}{12} + \dfrac{4}{9} = \dfrac{-21}{36} + \dfrac{16}{36} = \dfrac{-21+16}{36} = -\dfrac{5}{36}$

147. $\left(\dfrac{-5}{7}\right) \div \left(\dfrac{-3}{14}\right) = \left(\dfrac{-5}{\cancel{7}_1}\right) \cdot \left(\dfrac{\cancel{14}^2}{-3}\right)$
$= \dfrac{-5}{1} \cdot \dfrac{2}{-3}$
$= \dfrac{(-5)(2)}{(1)(-3)}$
$= \dfrac{10}{3} \text{ or } 3\dfrac{1}{3}$

Exercise Set 1.10

1. (5 + 4) + 6 = 5 + (4 + 6) illustrates the <u>associative</u> property of addition.

2. (14)(–3) = –3(14) illustrates the <u>commutative</u> property of multiplication.

3. The number <u>0</u> does not have a multiplicative inverse.

4. 4 · (25 · 3) = (4 · 25) · 3 illustrates the associative property of <u>multiplication</u>.

5. 5 is the additive inverse of <u>–5</u>.

6. $\dfrac{1}{5}$ is the multiplicative inverse of <u>5</u>.

7. $-5(x-3) = -5x + 15$ illustrates the <u>distributive</u> property of multiplication over addition.

8. $x + y = y + x$ illustrates the commutative property of <u>addition</u>.

9. When any real number is multiplied by the number 1, the real number is unchanged. For this reason we call 1 the multiplicative <u>identity</u>.

10. When any real number is added to the number 0, the real number is unchanged. For this reason we call 0 the <u>additive</u> identity.

11. a. –6   **b.** $\dfrac{1}{6}$

12. a. -5 **b.** $\dfrac{1}{5}$

13. a. 3 **b.** $-\dfrac{1}{3}$

14. a. 7 **b.** $-\dfrac{1}{7}$

15. a. $-x$ **b.** $\dfrac{1}{x}$

16. a. $-z$ **b.** $\dfrac{1}{z}$

17. a. 0 **b.** does not exist

18. a. -1 **b.** 1

19. a. $-\dfrac{1}{5}$ **b.** 5

20. a. $-\dfrac{1}{8}$ **b.** 8

21. a. $\dfrac{5}{6}$ **b.** $-\dfrac{6}{5}$

22. a. $\dfrac{2}{9}$ **b.** $-\dfrac{9}{2}$

23. distributive property

24. commutative property of addition

25. associative property of addition

26. distributive property

27. commutative property of multiplication

28. inverse property for addition

29. associative property of multiplication

30. identity property of multiplication

31. inverse property of addition

32. associative property of addition

33. identity property for multiplication

34. identity property for addition

35. inverse property for multiplication

36. commutative property of multiplication

37. commutative, addition

38. associative, multiplication

39. identity property of addition

40. inverse property of multiplication

41. $(-6 \cdot 4) \cdot 2$

42. $-\dfrac{1}{3}b$

43. $y \cdot x$

44. $4x + 12$

45. $3y + 4x$

46. $(-9 \cdot 3) \cdot 8$

47. 1

48. $3(x + 2)$

49. $3x + (4 + 6)$

50. $3(y + x)$

51. $-5x$

52. $(-5 + 6) + 8$

53. $4x + 4y + 12$

54. 0

55. 0

56. $2x$

57. $\dfrac{5}{2}n$

58. 1

59. Yes; the order does not affect the outcome so the process is commutative.

60. No; the order affects the outcome, so the process is not commutative.

61. Yes; the order does not affect the outcome so the process is commutative.

62. No; the order affects the outcome, so the process is not commutative.

63. No; the order affects the outcome, so the process is not commutative.

64. No; the order affects the outcome, so the process is not commutative.

65. Yes; the outcome is not affected by whether you do the first two items first or the last two first, so the process is associative.

66. Yes; the outcome is not affected by whether you do the first two items first or the last two first, so the process is associative.

67. No; the outcome is affected by whether you do the first two items first or the last two first, so the process is not associative.

68. No; the outcome is affected by whether you do the first two items first or the last two first, so the process is not associative.

69. No; the outcome is affected by whether you do the first two items first or the last two first, so the process is not associative.

70. Yes; the outcome is not affected by whether you do the first two items first or the last two first, so the process is associative.

71. In $(3+4)+x = x+(3+4)$ the $(3+4)$ is treated as one value.

72. In $(3+4)\cdot x = x\cdot(3+4)$, the $(3+4)$ is treated as one value.

73. This illustrates the commutative property of addition because the change is 3 + 5 = 5 + 3.

74. This illustrates the commutative property of addition. The (3 + 5) is treated as one value and x is the other value.

75. No; it illustrates the associative property of addition since the grouping is changed.

76. In $(3+4)\cdot(5+6) = (5+6)\cdot(3+4)$, the $(3+4)$ is treated as one value and the $(5+6)$ is treated as one value.

77. $2\dfrac{3}{5}+\dfrac{2}{3}$

$2\dfrac{3}{5} = \dfrac{13}{5} = \dfrac{3}{3}\cdot\dfrac{13}{5} = \dfrac{39}{15}$

$\dfrac{2}{3} = \dfrac{2}{3}\cdot\dfrac{5}{5} = \dfrac{10}{15}$

$2\dfrac{3}{5}+\dfrac{2}{3} = \dfrac{39}{15}+\dfrac{10}{15} = \dfrac{49}{15}$ or $3\dfrac{4}{15}$

78. $3\dfrac{5}{8}-2\dfrac{3}{16}$

$3\dfrac{5}{8} = \dfrac{29}{8} = \dfrac{2}{2}\cdot\dfrac{29}{8} = \dfrac{58}{16}$

$2\dfrac{3}{16} = \dfrac{35}{16}$

$3\dfrac{5}{8}-2\dfrac{3}{16} = \dfrac{58}{16}-\dfrac{35}{16} = \dfrac{23}{16}$ or $1\dfrac{7}{16}$

79. $102.7+(-113.9) = -11.2$

80. $-\dfrac{7}{8}$

Review Exercises

1. $8(30)-(24+31+17+49+53) = 240-174$
$$= 66$$
66 hot dogs are left.

2. $1.07\big[1.07(500.00)\big] = 1.07\big[535\big] = 572.45$
In 2 years tuition for a course will cost $572.45.

3. a. $899.99(.0825) = 74.25$
The sales tax is $74.25.

   b. total cost = cost of laptop + sales tax
total cost $= 899.99 + 74.25$
$$= 974.24$$
The total cost of the laptop is $974.24.

4. $\big[400+12(225)\big]-3000 = \big[400+2700\big]-3000$
$$= 3100-3000$$
$$= 100$$
Dan can save $100.

5. a. mean $= \dfrac{75+79+86+88+64}{5}$
$$= \dfrac{392}{5}$$
$$= 78.4$$
The mean grade is 78.4.   `

   b. 64, 75, 79, 86, 88
The middle number is 79. The median grade is 79.

6. a. mean $= \dfrac{21+3+17+10+9+6}{6} = \dfrac{66}{6} = 11$
The mean is 11.

   b. 3, 6, 9, 10, 17, 21
The middle numbers are 9 and 10. Their average is $\dfrac{9+10}{2} = \dfrac{19}{2} = 9.5$. The median is 9.5.

7. a. 29 minutes

   b. 34 minutes

8. a. 900(0.25) = 225
In 2006, there were 225 Information Technology majors.

b. $1100(0.15) = 165$
In 2009, there were 165 Sports Administration majors.

9. $\dfrac{3}{5} \cdot \dfrac{5}{6} = \dfrac{\overset{1}{\cancel{3}}}{\underset{1}{\cancel{5}}} \cdot \dfrac{\overset{1}{\cancel{5}}}{\underset{2}{\cancel{6}}} = \dfrac{1 \cdot 1}{1 \cdot 2} = \dfrac{1}{2}$

10. $3\dfrac{5}{7} + 2\dfrac{1}{3} = \dfrac{26}{7} + \dfrac{7}{3}$

$\qquad = \dfrac{26}{7} \cdot \dfrac{3}{3} + \dfrac{7}{3} \cdot \dfrac{7}{7}$

$\qquad = \dfrac{78}{21} + \dfrac{49}{21}$

$\qquad = \dfrac{78 + 49}{21}$

$\qquad = \dfrac{127}{21}$ or $6\dfrac{1}{21}$

11. $\dfrac{5}{12} \div \dfrac{3}{5} = \dfrac{5}{12} \cdot \dfrac{5}{3} = \dfrac{5 \cdot 5}{12 \cdot 3} = \dfrac{25}{36}$

12. $\dfrac{5}{6} + \dfrac{1}{3} = \dfrac{5}{6} + \dfrac{1}{3} \cdot \dfrac{2}{2} = \dfrac{5}{6} + \dfrac{2}{6} = \dfrac{7}{6}$ or $1\dfrac{1}{6}$

13. $3\dfrac{1}{6} - 1\dfrac{1}{4} = \dfrac{19}{6} - \dfrac{5}{4}$

$\qquad = \dfrac{19}{6} \cdot \dfrac{2}{2} - \dfrac{5}{4} \cdot \dfrac{3}{3}$

$\qquad = \dfrac{38}{12} - \dfrac{15}{12}$

$\qquad = \dfrac{38 - 15}{12}$

$\qquad = \dfrac{23}{12}$ or $1\dfrac{11}{12}$

14. $7\dfrac{3}{8} \div \dfrac{5}{12} = 7\dfrac{3}{8} \cdot \dfrac{12}{5}$

$\qquad = \dfrac{59}{\underset{2}{\cancel{8}}} \cdot \dfrac{\overset{3}{\cancel{12}}}{5}$

$\qquad = \dfrac{59 \cdot 3}{2 \cdot 5}$

$\qquad = \dfrac{177}{10}$ or $17\dfrac{7}{10}$

15. The natural numbers are $\{1, 2, 3, \ldots\}$.

16. The whole numbers are $\{0, 1, 2, 3, \ldots\}$.

17. The integers are $\{\ldots, -3, -2, -1, 0, 1, 2, 3, \ldots\}$.

18. The set of rational numbers is the set of all numbers which can be expressed as the quotient of two integers, denominator not zero.

19. a. 3 and 426 are positive integers.

   b. 3, 0, and 426 are whole numbers.

   c. 3, –5, –12, 0, and 426 are integers.

   d. 3, –5, –12, 0, $\dfrac{1}{2}$, –0.62, 426, and $-3\dfrac{1}{4}$ are rational numbers.

   e. $\sqrt{7}$ is an irrational number.

   f. 3, –5, –12, 0, $\dfrac{1}{2}$, –0.62, $\sqrt{7}$, 426, and $-3\dfrac{1}{4}$ are real numbers.

20. a. 1 is a natural number.

   b. 1 is a whole number.

   c. –8 and –9 are negative numbers.

   d. –8, –9, and 1 are integers.

   e. –2.3, –8, –9, $1\dfrac{1}{2}$, 1, and $-\dfrac{3}{17}$ are rational numbers.

   f. $\sqrt{2}, -\sqrt{2}$ are irrational numbers.

   g. –2.3, –8, –9, $1\dfrac{1}{2}$, $\sqrt{2}$, $-\sqrt{2}$, 1, and $-\dfrac{3}{17}$ are real numbers.

21. $-7 < -5$; –7 is to the left of –5 on a number line.

22. $-2.6 > -3.6$; –2.6 is to the right of –3.6 on a number line.

23. $0.50 < 0.509$; 0.50 is to the left 0.509 on a number line.

24. $-\dfrac{5}{6} < -\dfrac{11}{15}$; $-\dfrac{5}{6}$ is to the left of $-\dfrac{11}{15}$ on a number line.

25. $-6.3 < -6.03$; –6.3 is to the left of –6.03 on a number line.

26. $5 > |-3|$ since $|-3|$ equals 3.

27. $\left|-\dfrac{9}{2}\right| = |-4.5|$ since $\left|-\dfrac{9}{2}\right| = |-4.5| = 4.5$.

28. $-\lvert-3\rvert < -(-3)$ since $-\lvert-3\rvert$ equals -3 and $-(-3)$ equals 3.

29. $-9 + (5) = -14$

30. $-6 + 6 = 0$

31. $0 + (-3) = -3$

32. $-10 + 4 = -6$

33. $-8 - (-2) = -8 + 2 = -6$

34. $-2 - (-4) = -2 + 4 = 2$

35. $4 - (-4) = 4 + 4 = 8$

36. $12 - 12 = 12 + (-12) = 0$

37. $2 - 7 = 2 + (-7) = -5$

38. $7 - (-7) = 7 + 7 = 14$

39. $0 - (-4) = 0 + 4 = 4$

40. $-7 - 5 = -7 + (-5) = -12$

41. $\dfrac{4}{3} - \dfrac{3}{4} = \dfrac{16}{12} - \dfrac{9}{12} = \dfrac{16 - 9}{12} = \dfrac{7}{12}$

42. $\dfrac{1}{2} + \dfrac{3}{5} = \dfrac{5}{10} + \dfrac{6}{10} = \dfrac{5 + 6}{10} = \dfrac{11}{10}$ or $1\dfrac{1}{10}$

43. $\dfrac{5}{9} - \dfrac{3}{4} = \dfrac{20}{36} - \dfrac{27}{36} = \dfrac{20 - 27}{36} = -\dfrac{7}{36}$

44. $-\dfrac{5}{7} + \dfrac{3}{8} = -\dfrac{40}{56} + \dfrac{21}{56} = \dfrac{-40 + 21}{56} = -\dfrac{19}{56}$

45. $-\dfrac{5}{12} - \dfrac{5}{6} = -\dfrac{5}{12} - \dfrac{10}{12} = \dfrac{-5 - 10}{12}$
$= -\dfrac{15}{12} = -\dfrac{5}{4}$ or $-1\dfrac{1}{4}$

46. $-\dfrac{6}{7} + \dfrac{5}{12} = -\dfrac{72}{84} + \dfrac{35}{84} = \dfrac{-72 + 35}{84} = -\dfrac{37}{84}$

47. $\dfrac{2}{9} - \dfrac{3}{10} = \dfrac{20}{90} - \dfrac{27}{90} = \dfrac{20 - 27}{90} = -\dfrac{7}{90}$

48. $\dfrac{5}{12} - \left(-\dfrac{3}{5}\right) = \dfrac{25}{60} + \dfrac{36}{60} = \dfrac{25 + 36}{60} = \dfrac{61}{60}$ or $1\dfrac{1}{60}$

49. $9 - 4 + 9 = 5 + 9 = 14$

50. $-8 - 9 + 14 = -17 + 14 = -3$

51. $-5 - 4 - 3 = -9 - 3 = -12$

52. $-2 + (-3) - 2 = -5 - 2 = -7$

53. $17 - (+4) - (-3) = 17 - 4 + 3 = 13 + 3 = 16$

54. $6 - (-2) + 3 = 6 + 2 + 3 = 8 + 3 = 11$

55. Since the numbers have unlike signs, the product is negative; $7(-9) = -63$

56. Since the numbers have like signs, the product is positive; $(-8.2)(-3.1) = 25.42$

57. Since there are an odd number (3) of negatives the product is negative;
$(-4)(-5)(-6) = (20)(-6) = -120$

58. $\left(\dfrac{3}{5}\right)\left(\dfrac{-2}{7}\right) = \dfrac{3(-2)}{5 \cdot 7} = \dfrac{-6}{35} = -\dfrac{6}{35}$

59. $\left(\dfrac{10}{11}\right)\left(\dfrac{3}{-5}\right) = \dfrac{2}{11} \cdot \dfrac{3}{-1} = \dfrac{2 \cdot 3}{(11)(-1)} = \dfrac{6}{-11} = -\dfrac{6}{11}$

60. $\left(\dfrac{-5}{8}\right)\left(\dfrac{-3}{7}\right) = \dfrac{(-5)(-3)}{8 \cdot 7} = \dfrac{15}{56}$

61. Zero multiplied by any real number is zero.
$0 \cdot \dfrac{4}{9} = 0$

62. Since there are four negative numbers (an even number), the product is positive.
$(-4)(-6)(-2)(-3) = (24)(-2)(-3)$
$\qquad = (-48)(-3) = 144$

63. Since the numbers have unlike signs, the quotient is negative. $45 \div (-3) = \dfrac{45}{-3} = -15$

64. Since the numbers have unlike signs, the quotient is negative.
$12 \div (-2) = \dfrac{12}{-2} = -6$

65. Since the numbers have unlike signs, the quotient is negative;
$-14.72 \div 4.6 = \dfrac{-14.72}{4.6} = -3.2$

66. Since the numbers have like signs, the quotient is positive: $-37.41 \div (-8.7) = 4.3$

67. Since the numbers have like signs, the quotient is positive: $-88 \div (-11) = 8$

68. $-4 \div \left(\dfrac{-4}{9}\right) = \dfrac{-4}{1} \cdot \dfrac{9}{-4} = \dfrac{-1}{1} \cdot \dfrac{9}{-1} = \dfrac{-9}{-1} = 9$

69. $\dfrac{28}{-3} \div \left(\dfrac{9}{-2}\right) = \left(\dfrac{28}{-3}\right) \cdot \left(\dfrac{-2}{9}\right) = \dfrac{-56}{-27} = \dfrac{56}{27}$ or $2\dfrac{2}{27}$

70. $\dfrac{14}{3} \div \left(\dfrac{-6}{5}\right) = \dfrac{{}^{7}\cancel{14}}{3} \cdot \left(\dfrac{5}{\cancel{-6}_{3}}\right)$

$\qquad = \dfrac{7(5)}{3(-3)}$

$\qquad = \dfrac{35}{-9} = -\dfrac{35}{9}$ or $-3\dfrac{8}{9}$

71. Zero divided by any nonzero number is zero;

$0 \div 5 = \dfrac{0}{5} = 0$

72. Zero divided by any nonzero number is zero;

$0 \div (-6) = \dfrac{0}{-6} = 0$

73. Any real number divided by zero is undefined;

$-12 \div 0 = \dfrac{-12}{0}$ is undefined.

74. Any real number divided by zero is undefined;

$-4 \div 0 = \dfrac{-4}{0}$ is undefined.

75. Any real number divided by zero is undefined;

$\dfrac{8.3}{0}$ is undefined

76. Zero divided by any nonzero number is zero;

$\dfrac{0}{-9.8} = 0$

77. $-5(3 - 8) = -5(-5) = 25$

78. $2(4 - 8) = 2(-4) = -8$

79. $(3 - 6) + 4 = -3 + 4 = 1$

80. $(-4 + 3) - (2 - 6) = (-1) - (-4) = -1 + 4 = 3$

81. $\left[6 + 3(-2)\right] - 6 = \left[6 + (-6)\right] - 6 = 0 - 6 = -6$

82. $(-5 - 3)(4) = (-5 + (-3))(4) = (-8)(4) = -32$

83. $\left[12 + (-4)\right] + (6 - 8) = 8 + (-2) = 6$

84. $9\left[3 + (-4)\right] + 5 = 9(-1) + 5 = -9 + 5 = -4$

85. $-4(-3) + \left[4 \div (-2)\right] = (12) + (-2) = 10$

86. $(-3 \cdot 4) \div (-2 \cdot 6) = -12 \div (-12) = 1$

87. $(-3)(-4) + 6 - 3 = 12 + 6 - 3 = 18 - 3 = 15$

88. $\left[-2(3) + 6\right] - 4 = \left[-6 + 6\right] - 4 = 0 - 4 = -4$

89. $-6^2 = -(6)(6) = -36$

90. $(-6)^2 = (-6)(-6) = 36$

91. $2^4 = (2)(2)(2)(2) = 16$

92. $(-3)^3 = (-3)(-3)(-3) = -27$

93. $(-1)^9 = (-1)(-1)(-1)(-1)(-1)(-1)(-1)(-1)(-1)$
$\qquad = -1$

94. $(-2)^5 = (-2)(-2)(-2)(-2)(-2) = -32$

95. $\left(\dfrac{-4}{5}\right)^2 = \left(\dfrac{-4}{5}\right)\left(\dfrac{-4}{5}\right) = \dfrac{16}{25}$

96. $\left(\dfrac{2}{5}\right)^3 = \left(\dfrac{2}{5}\right)\left(\dfrac{2}{5}\right)\left(\dfrac{2}{5}\right) = \dfrac{8}{125}$

97. $5^3 \cdot (-2)^2 = (5)(5)(5)(-2)(-2) = 500$

98. $(-2)^4 \left(\dfrac{1}{2}\right)^2 = (-2)(-2)(-2)(-2)\left(\dfrac{1}{2}\right)\left(\dfrac{1}{2}\right) = 4$

99. $\left(-\dfrac{2}{3}\right)^2 \cdot 3^3 = \left(-\dfrac{2}{3}\right)\left(-\dfrac{2}{3}\right)(3)(3)(3) = 12$

100. $(-4)^3 (-2)^2 = (-4)(-4)(-4)(-2)(-2) = -256$

101. $45 \div 15 \cdot 3 = 3 \cdot 3 = 9$

102. $-5 + 7 \cdot 3 = -5 + 21 = 16$

103. $(3.7 - 4.1)^2 + 6.2 = (-0.4)^2 + 6.2$
$\qquad\qquad\qquad\quad = 0.16 + 6.2$
$\qquad\qquad\qquad\quad = 6.36$

104. $10 - 36 \div 4 \cdot 3 = 10 - 9 \cdot 3 = 10 - 27 = -17$

105. $6 - 3^2 \cdot 5 = 6 - 9 \cdot 5 = 6 - 45 = -39$

106. $\left[6.9 - (3 \cdot 5)\right] + 5.8 = \left[6.9 - 15\right] + 5.8$
$$= -8.1 + 5.8$$
$$= -2.3$$

107. $\dfrac{6^2 - 4 \cdot 3^2}{-\left[6 - (3-4)\right]} = \dfrac{36 - 4 \cdot 9}{-\left[6 - (-1)\right]}$
$$= \dfrac{36 - 36}{-7}$$
$$= \dfrac{0}{-7} = 0$$

108. $\dfrac{4 + 5^2 \div 5}{6 - (-3 + 2)} = \dfrac{4 + 25 \div 5}{6 - (-1)} = \dfrac{4 + 5}{7} = \dfrac{9}{7}$ or $1\dfrac{2}{7}$

109. $3[9(4^2 + 3)] \cdot 2 = 3[9 - (16 + 3)] \cdot 2$
$$= 3[9 - 19] \cdot 2$$
$$= 3 \cdot (-10) \cdot 2$$
$$= -30 \cdot 2$$
$$= -60$$

110. $(-3^2 + 4^2) + (3^2 \div 3) = (-9 + 16) + (9 \div 3)$
$$= (7) + (3)$$
$$= 10$$

111. $2^3 \div 4 + 6 \cdot 3 = 8 \div 4 + 6 \cdot 3 = 2 + 18 = 20$

112. $(4 \div 2)^4 + 4^2 \div 2^2 = (2)^4 + 16 \div 4$
$$= 16 + 16 \div 4$$
$$= 16 + 4$$
$$= 20$$

113. $\left(8 - 2^2\right)^2 - 4 \cdot 3 + 10 = (8 - 4)^2 - 4 \cdot 3 + 10$
$$= (4)^2 - 4 \cdot 3 + 10$$
$$= 16 - 4 \cdot 3 + 10$$
$$= 16 - 12 + 10$$
$$= 4 + 10$$
$$= 14$$

114. $4^3 \div 4^2 - 5(2 - 7) \div 5 = 64 \div 16 - 5(-5) \div 5$
$$= 4 - (-25) \div 5$$
$$= 4 - (-5)$$
$$= 4 + 5$$
$$= 9$$

115. $-\left\{-4\left[27 \div 3^2 - 2(4 - 2)\right]\right\}$
$$= -\left\{-4\left[27 \div 9 - 2(2)\right]\right\}$$
$$= -\left\{-4\left[3 - 4\right]\right\}$$
$$= -\left\{-4\left[-1\right]\right\}$$
$$= -\left\{4\right\}$$
$$-4$$

116. $2\left\{4^3 - 6\left[4 - (2 - 4)\right] - 3\right\}$
$$= 2\left\{64 - 6\left[4 - (2 - 4)\right] - 3\right\}$$
$$= 2\left\{64 - 6\left[4 - (-2)\right] - 3\right\}$$
$$= 2\left\{64 - 6[6] - 3\right\}$$
$$= 2\left\{64 - 36 - 3\right\}$$
$$= 2\left\{25\right\}$$
$$= 50$$

117. Substitute 4 for *x*;
$$3x - 7 = 3(4) - 7 = 12 - 7 = 5$$

118. Substitute –5 for *x*;
$$6 - 4x = 6 - 4(-5) = 6 - (-20) = 6 + 20 = 26$$

119. Substitute 6 for *x*;
$$2x^2 - 5x + 3 = 2(6)^2 - 5(6) + 3$$
$$= 2(36) - 30 + 3$$
$$= 72 - 30 + 3$$
$$= 42 + 3$$
$$= 45$$

120. Substitute –1 for y;

$$5y^2 + 3y - 2 = 5(-1)^2 + 3(-1) - 2$$
$$= 5(1) - 3 - 2$$
$$= 5 - 3 - 2$$
$$= 2 - 2$$
$$= 0$$

121. Substitute –2 for x;

$$-x^2 + 2x - 3 = -(-2)^2 + 2(-2) - 3$$
$$= -4 + (-4) - 3$$
$$= -8 - 3$$
$$= -11$$

122. Substitute 2 for x;

$$-x^2 + 2x - 3 = -2^2 + 2(2) - 3$$
$$= -4 + 4 - 3$$
$$= 0 - 3$$
$$= -3$$

123. Substitute 1 for x;

$$-3x^2 - 5x + 5 = -3(1)^2 - 5(1) + 5$$
$$= -3(1) - 5 + 5$$
$$= -3 - 5 + 5$$
$$= -8 + 5$$
$$= -3$$

124. Substitute –3 for x and –2 for y;

$$-x^2 - 8x - 12y = -(-3)^2 - 8(-3) - 12(-2)$$
$$= -9 - (-24) + 24$$
$$= -9 + 24 + 24$$
$$= 15 + 24$$
$$= 39$$

125. a. $278 + (-493) = -215$

b. $|-493|$ is greater than $|278|$ so the sum should be (and is) negative.

126. a. $324 - (-29.6) = 324 + 29.6 = 353.6$

b. The sum of two positive numbers is always positive. As expected, the answer is positive.

127. a. $\dfrac{-17.28}{6} = -2.88$

b. Since the numbers have unlike signs, the quotient is negative, as expected.

128. a. $(-62)(-1.9) = 117.8$

b. Since the numbers have like signs, the product is positive, as expected.

129. a. $(-4)^8 = 65,536$

b. A negative number raised to an even power is positive. As expected, the answer is positive.

130. a. $-(4.2)^3 = -74.088$

b. Since $(4.2)^3$ is positive, $-(4.2)^3$ should be (and is) negative.

131. associative property of addition

132. distributive property

133. commutative property of addition

134. commutative property of multiplication

135. associative property of multiplication

136. inverse property of multiplication

137. identity property of multiplication

138. inverse property of addition

139. identity property of addition

140. associative property of addition

Practice Test

1. a. $2(1.30) + 4.75 + 3(1.10)$
$= 2.60 + 4.75 + 3.30$
$= 7.35 + 3.30$
$= 10.65$
The bill is $10.65 before tax.

b. $0.07(3.30) \bullet 0.23$
The tax on the soda is $0.23.

c. $10.65 + 0.23 = 10.88$
The total bill is $10.88.

d. $50 - 10.88 = 39.12$
Her change will be $39.12.

2. $\dfrac{1,600,000}{643,500} \approx 2.49$
The price was about 2.49 times greater in the twelfth year compared to the first year.

3. a. About 13 thousand people listened to WRAB at this time.

b. During this specific time, half the time KFUN had more than 8.8 thousand listeners and half the time KFUN had less than 8.8 thousand listeners.

4. a. 42 is a natural number.

b. 42 and 0 are whole numbers.

c. –6, 42, 0, –7, and –1 are integers.

d. $-6, 42, -3\frac{1}{2}, 0, 6.52, \frac{5}{9}, -7,$ and –1 are rational numbers.

e. $\sqrt{5}$ is an irrational number.

f. $-6, 42, -3\frac{1}{2}, 0, 6.52, \sqrt{5}, \frac{5}{9}, -7,$ and –1 are real numbers.

5. –9.9 < –9.09; –9.9 is to the left of –9.09 on a number line.

6. $|-3| > |-2|$ since $|-3| = 3$ and $|-2| = 2$.

7. $-7 + (-8) = -15$

8. $-6 - 5 = -6 + (-5) = -11$

9. $15 - 12 - 17 = 3 - 17 = -14$

10. $(-4 + 6) - 3(-2) = (2) - (-6) = 2 + 6 = 8$

11. $(-4)(-3)(2)(-1) = (12)(2)(-1)$
$$= (24)(-1)$$
$$= -24$$

12. $\left(\dfrac{-2}{9}\right) \div \left(\dfrac{-7}{8}\right) = \dfrac{-2}{9} \cdot \dfrac{8}{-7} = \dfrac{-16}{-63} = \dfrac{16}{63}$

13. $\left(-18 \cdot \dfrac{1}{2}\right) \div 3 = \left(\dfrac{-\overset{9}{\cancel{18}}}{1} \cdot \dfrac{1}{\underset{1}{\cancel{2}}}\right) \div 3$
$$= \left(\dfrac{-9 \cdot 1}{1 \cdot 1}\right) \div 3$$
$$= -9 \div 3$$
$$= -3$$

14. $-\dfrac{3}{8} - \dfrac{4}{7} = -\dfrac{21}{56} - \dfrac{32}{56} = \dfrac{-21 - 32}{56} = -\dfrac{53}{56}$

15. $-6(-2 - 3) \div 5 \cdot 2 = -6(-5) \div 5 \cdot 2$
$$= 30 \div 5 \cdot 2$$
$$= 6 \cdot 2$$
$$= 12$$

16. $\left(-\dfrac{2}{3}\right)^5 = \left(-\dfrac{2}{3}\right)\left(-\dfrac{2}{3}\right)\left(-\dfrac{2}{3}\right)\left(-\dfrac{2}{3}\right)\left(-\dfrac{2}{3}\right)$
$$= -\dfrac{32}{243}$$

17. $\left[6 + \left((9 - 3)^2 \div 18\right)^2\right]^2 = \left[6 + \left(6^2 \div 18\right)^2\right]^2$
$$= \left[6 + (36 \div 18)^2\right]^2$$
$$= \left[6 + 2^2\right]^2$$
$$= [6 + 4]^2$$
$$= 10^2$$
$$= 100$$

18. Because x^2 will be positive for any real nonzero number, $-\left(x^2\right)$ or $-x^2$ will be negative.

19. Substitute –3 for x;
$$5x^2 - 8 = 5(-3)^2 - 8 = 5(9) - 8 = 45 - 8 = 37$$

20. Substitute –2 for each x;
$$-x^2 - 6x + 3 = -(-2)^2 - 6(-2) + 3$$
$$= -4 - (-12) + 3$$
$$= -4 + 12 + 3$$
$$= 8 + 3$$
$$= 11$$

21. Substitute 3 for x and –2 for y;
$$6x - 3y^2 + 4 = 6(3) - 3(-2)^2 + 4$$
$$= 6(3) - 3(4) + 4$$
$$= 18 - 12 + 4$$
$$= 6 + 4$$
$$= 10$$

22. Substitute 1 for x and –2 for y;
$$-x^2 + xy + y^2 = -(1)^2 + (1)(-2) + (-2)^2$$
$$= -1 + (-2) + 4$$
$$= -3 + 4$$
$$= 1$$

23. commutative property of addition

24. distributive property

25. associative property of addition

Chapter 2

Exercise Set 2.1

1. In the expression $5x - 3y + 17 - 2x$, 17 is called a <u>constant</u> term.

2. When we apply the distributive property to $-2(2x - 3y - 9)$, we obtain <u>$-4x + 6y + 18$</u>.

3. In the expression $5x - 3y + 17 - 2x$, $5x$ and $-2x$ are called <u>like</u> terms.

4. In the expression $5x - 3y + 17 - 2x$, -3 is called the <u>coefficient</u> of the second term.

5. In the expression $5x - 3y + 17 - 2x$, $5x$ and $-3y$ are called <u>unlike</u> terms.

6. In the expression $12x + 17$, 12 and x are <u>factors</u> of the first term.

7. In the expression $4x^2 + 17x - 90$, the parts $-4x^2$, $17x$, and -90 are called <u>terms</u>.

8. In the expression $17x$, x is called a <u>variable</u>.

9. $6x + 8x = 14x$

10. $4x - 5x = -x$

11. There are no like terms.
    $3x + 6$

12. There are no like terms.
    $4x + 3y$

13. $y + 3 + 4y = y + 4y + 3$
    $\qquad = 5y + 3$

14. $4x - 7x + 4 = -3x + 4$

15. $\dfrac{3}{4} - \dfrac{6}{11} = \dfrac{33}{44} - \dfrac{24}{44} = \dfrac{9}{44}$

    $\dfrac{3}{4}a - \dfrac{6}{11}a = \dfrac{9}{44}a$

16. $\dfrac{3}{4} - \dfrac{2}{7} = \dfrac{21}{28} - \dfrac{8}{28} = \dfrac{13}{28}$

    $\dfrac{3}{4}p - \dfrac{2}{7}p = \dfrac{13}{28}p$

17. $2t - 6x + 5t = -6x + 2t + 5t$
    $\qquad\qquad = -6x + 7t$

18. $-7 - 4m - 66 = -4m - 7 - 66$
    $\qquad\qquad = -4m - 73$

19. $-2w - 3w + 5 = -5w + 5$

20. $-8y - 4y - 7 = -12y - 7$

21. $-x + 2 - x - 2 = -x - x + 2 - 2$
    $\qquad\qquad = -2x$

22. $-3a + 4 + 3a - 13 = -3a + 3a + 4 - 13$
    $\qquad\qquad = -9$

23. $3 + 6x - 3 - 6x = 6x - 6x + 3 - 3 = 0$

24. $-5y + 7 - 7 + 5y = -5y + 5y + 7 - 7$
    $\qquad\qquad = 0$

25. $5 + 2t - 4t + 16 = 2t - 4t + 5 + 16$
    $\qquad\qquad = -2t + 21$

26. $7 + d - 13 - 5d = d - 5d + 7 - 13$
    $\qquad\qquad = -4d - 6$

27. $4p - 6 - 16p - 2 = 4p - 16p - 6 - 2$
    $\qquad\qquad = -12p - 8$

28. $-6t + 5 + 2t - 9 = -6t + 2t + 5 - 9$
    $\qquad\qquad = -4t - 4$

29. $3x^2 - 9y^2 + 7x^2 - 5 - y^2 - 2$
    $= 3x^2 + 7x^2 - 9y^2 - y^2 - 5 - 2$
    $= 10y^2 - 10y^2 - 7$

30. $-4x^2 - 6y - 3x^2 + 6 - y - 1$
    $= -4x^2 - 3x^2 - 6y - y + 6 - 1$
    $= -7x^2 - 7y + 5$

31. $-2x + 4x - 8 = 2x - 8$

32. $4 - x + 4x - 8 = -x + 4x + 4 - 8$
    $\qquad\qquad = 3x - 4$

33. $b + 4 + \dfrac{3}{5} = b + \dfrac{20}{5} + \dfrac{3}{5}$
    $\qquad\quad = b + \dfrac{23}{5}$

34. $\dfrac{3}{4}y + 2 + y = \dfrac{3}{4}y + y + 2$
    $\qquad\quad = \dfrac{3}{4}y + \dfrac{4}{4}y + 2$
    $\qquad\quad = \dfrac{7}{4}y + 2$

35. $5.1n + 6.42 - 4.3n = 5.1n - 4.3n + 6.42$
$$= 0.8n + 6.42$$

36. $-2.53c + 8.1 - 9.1c = -2.53c - 9.1c + 8.1$
$$= -11.63c + 8.1$$

37. There are no like terms.
$$-\frac{2}{3}x + \frac{5}{9}y + \frac{1}{9}$$

38. There are no like terms.
$$\frac{3}{4}p + \frac{1}{7}q + \frac{1}{4}$$

39. $13.4x + 1.2x + 8.3 = 14.6x + 8.3$

40. $-4x^2 - 3.1 - 5.2 = -4x^2 - 8.3$

41. $-x^2 + 2x^2 + y = x^2 + y$

42. $1 + x^2 + 6 - 3x^2 = x^2 - 3x^2 + 1 + 6$
$$= -2x^2 + 7$$

43. $2x - 7y - 5x + 2y = 2x - 5x - 7y + 2y$
$$= -3x - 5y$$

44. $3x - 7 - 9 + 4x = 3x + 4x - 7 - 9$
$$= 7x - 16$$

45. $4 - 3n^2 + 9 - 2n = -3n^2 - 2n + 4 + 9$
$$= -3n^2 - 2n + 13$$

46. $-5x^2 + 1 - 3x^2 + x = -5x^2 - 3x^2 + x + 1$
$$= -8x^2 + x + 1$$

47. $-19.36 + 40.02x + 12.25 - 18.3x$
$$= 40.02x - 18.3x - 19.36 + 12.25$$
$$= 21.72x - 7.11$$

48. $-3.4k + 13.01 - 1.09k - 17.3$
$$= -3.4k - 1.09k + 13.01 - 17.3$$
$$= -4.49k - 4.29$$

49. $\frac{3}{5}x - 3 - \frac{7}{4}x - 2 = \frac{3}{5}x - \frac{7}{4}x - 3 - 2$
$$= \frac{12}{20}x - \frac{35}{20}x - 5$$
$$= -\frac{23}{20}x - 5$$

50. $\frac{1}{2}y - 4 + \frac{3}{4}x - \frac{1}{5}y = \frac{3}{4}x + \frac{1}{2}y - \frac{1}{5}y - 4$
$$= \frac{3}{4}x + \frac{5}{10}y - \frac{2}{10}y - 4$$
$$= \frac{3}{4}x + \frac{3}{10}y - 4$$

51. There are no like terms.
$$5w^3 + 2w^2 + w + 3$$

52. There are no like terms.
$$3m^3 - 7m^2 + 7m - 2$$

53. $2z - 5z^3 - 2z^3 - z^2 = -5z^3 - 2z^3 - z^2 + 2z$
$$= -7z^3 - z^2 + 2z$$

54. $c^3 - 7 + 4c^2 - 2c^2 - 5c^3 = c^3 - 5c^3 + 4c^2 - 2c^2 - 7$
$$= -4c^3 + 2c^2 - 7$$

55. $2x^2 + 2x - 5x - 5 = 2x^2 - 3x - 5$

56. $x^2 - 3xy - 2xy + 6 = x^2 - 5xy + 6$

57. $2a^3 - 6a^2 + 2a + a^2 - 3a + 1$
$$= 2a^3 - 6a^2 + a^2 + 2a - 3a + 1$$
$$= 2a^3 - 5a^2 - a + 1$$

58. $3b^3 - 3b^2 + 6b + 2b^2 - 2b + 4$
$$= 3b^3 - 3b^2 + 2b^2 + 6b - 2b + 4$$
$$= 3b^3 - b^2 + 4b + 4$$

59. $5(x + 2) = 5x + 5(2)$
$$= 5x + 10$$

60. $2(-y + 5) = 2(-y) + 2(5)$
$$= -2y + 10$$

61. $5(x + 4) = 5x + 5(4)$
$$= 5x + 20$$

62. $-2(y + 8) = -2y + (-2)(8)$
$$= -2y + (-16)$$
$$= -2y - 16$$

63. $3(x - 6) = 3x + 3(-6) = 3x - 18$

64. $-2(x - 4) = -2[x + (-4)]$
$$= -2x + (-2)(-4)$$
$$= -2x + 8$$

65.
$$-\frac{1}{2}(2x-4) = -\frac{1}{2}\left[2x+(-4)\right]$$
$$= -\frac{1}{2}(2x)+\left(-\frac{1}{2}\right)(-4)$$
$$= -x+2$$

66.
$$-\frac{1}{3}(-6x+9) = -\frac{1}{3}(-6x)+\left(-\frac{1}{3}\right)(9)$$
$$= 2x+(-3)$$
$$= 2x-3$$

67.
$$1(-4+x) = 1(-4)+1(x)$$
$$= -4+x$$
$$= x-4$$

68.
$$-1(5-x) = -1\left[5+(-x)\right]$$
$$= -1(5)+(-1)(-x)$$
$$= -5+x$$

69.
$$\frac{4}{5}(s-5) = \frac{4}{5}s-\frac{4}{5}(5)$$
$$= \frac{4}{5}s-4$$

70.
$$-\frac{2}{3}(x-6) = -\frac{2}{3}\left[x+(-6)\right]$$
$$= -\frac{2}{3}x+\left(-\frac{2}{3}\right)(-6)$$
$$= -\frac{2}{3}x+4$$

71.
$$-0.3(3x^2+5) = -0.3(3x^2)+(-0.3)(5)$$
$$= -0.9x^2+(-1.5)$$
$$= -0.9x^2-1.5$$

72.
$$0.4(-3x+2) = 0.4(-3x)+0.4(2)$$
$$= -1.2x+0.8$$

73.
$$-\frac{1}{3}(3r-12) = -\frac{1}{3}(3r)+\left(-\frac{1}{3}\right)(-12)$$
$$= -r+4$$

74.
$$-\frac{5}{6}(12x-18) = -\frac{5}{6}\left[12x+(-18)\right]$$
$$= -\frac{5}{6}(12x)+\left(-\frac{5}{6}\right)(-18)$$
$$= -10x+15$$

75.
$$0.7(2x+0.5) = 0.7(2x)+0.7(0.5)$$
$$= 1.4x+0.35$$

76.
$$-0.3(5x-0.9) = -0.3\left[5x+(-0.9)\right]$$
$$= -1.5x+(-0.3)(-0.9)$$
$$= -1.5x+2.7$$

77.
$$-(-x+y) = -1(-x+y)$$
$$= -1(-x)+(-1)(y)$$
$$= x+(-y)$$
$$= x-y$$

78.
$$-(-p-q) = -1\left[(-p)+(-q)\right]$$
$$= -1(-p)+(-1)(-q)$$
$$= p+q$$

79.
$$-(2x+4y-8) = -1\left[2x+4y+(-8)\right]$$
$$= -1(2x)+(-1)(4y)+(-1)(-8)$$
$$= -2x-4y+8$$
$$= -2x-4y+8$$

80.
$$-3(2a+3b-7) = -3[(2a)+(3b)+(-7)]$$
$$= -3(2a)+(-3)(3b)+(-3)(-7)$$
$$= -6a-9b+21$$

81.
$$1.1(3.1x-5.2y+2.8)$$
$$= 1.1[3.1x+(-5.2y)+2.8]$$
$$= (1.1)(3.1x)+(1.1)(-5.2y)+(1.1)(2.8)$$
$$= 3.41x+(-5.72y)+3.08$$
$$= 3.41x-5.72y+3.08$$

82.
$$-4(-2m-3n+8) = -4[(-2m)+(-3n)+8]$$
$$= -4(2m)+(-4)(-3n)+(-4)(8)$$
$$= 8m+12n-32$$

83.
$$(2x-9y)5 = (2x)5+(-9y)5$$
$$= 10x-45y$$

84.
$$(8b-1)7 = (8b)7+(-1)7$$
$$= 56b-7$$

85.
$$(r+3s-19) = 1\left[r+3s+(-19)\right]$$
$$= 1(r)+1(3s)+(1)(-19)$$
$$= r+3s+(-19) = r+3s-19$$

86. There are no like terms.
$$-p+2q-3$$