Chapter 2

Section 2.1 Practice Exercises

1.
$$\begin{aligned} 3x+7&=22\\ 3x+7-7&=22-7\\ 3x&=15\\ \frac{3x}{3}&=\frac{15}{3}\\ x&=5 \end{aligned}$$

2.
$$\begin{aligned} 2.5&=3-2.5t\\ 2.5-3&=3-2.5t-3\\ -0.5&=-2.5t\\ \frac{-0.5}{-2.5}&=\frac{-2.5t}{-2.5}\\ 0.2&=t \end{aligned}$$

3.
$$\begin{aligned} -8x-4+6x&=5x+11-4x\\ -2x-4&=x+11\\ -2x-4-x&=x+11-x\\ -3x-4&=11\\ -3x-4+4&=11+4\\ -3x&=15\\ \frac{-3x}{-3}&=\frac{15}{-3}\\ x&=-5 \end{aligned}$$

4.
$$\begin{aligned} 3(x-5)&=6x-3\\ 3x-15&=6x-3\\ 3x-15-6x&=6x-3-6x\\ -3x-15&=-3\\ -3x-15+15&=-3+15\\ -3x&=12\\ \frac{-3x}{-3}&=\frac{12}{-3}\\ x&=-4 \end{aligned}$$

5.
$$\begin{aligned} \frac{y}{2}-\frac{y}{5}&=\frac{1}{4}\\ 20\left(\frac{y}{2}-\frac{y}{5}\right)&=20\left(\frac{1}{4}\right)\\ 20\left(\frac{y}{2}\right)-20\left(\frac{y}{5}\right)&=5\\ 10y-4y&=5\\ 6y&=5\\ \frac{6y}{6}&=\frac{5}{6}\\ y&=\frac{5}{6} \end{aligned}$$

6.
$$\begin{aligned} x-\frac{x-2}{12}&=\frac{x+3}{4}+\frac{1}{4}\\ 12\left(x-\frac{x-2}{12}\right)&=12\left(\frac{x+3}{4}+\frac{1}{4}\right)\\ 12\cdot x-12\left(\frac{x-2}{12}\right)&=12\left(\frac{x+3}{4}\right)+12\cdot\frac{1}{4}\\ 12x-(x-2)&=3(x+3)+3\\ 12x-x+2&=3x+9+3\\ 11x+2&=3x+12\\ 11x+2-3x&=3x+12-3x\\ 8x+2&=12\\ 8x+2-2&=12-2\\ 8x&=10\\ \frac{8x}{8}&=\frac{10}{8}\\ x&=\frac{5}{4} \end{aligned}$$

7.
$$\begin{aligned} 0.15x-0.03&=0.2x+0.12\\ 100(0.15x-0.03)&=100(0.2x+0.12)\\ 100(0.15x)-100(0.03)&=100(0.2x)+100(0.12)\\ 15x-3&=20x+12\\ 15x-20x&=12+3\\ -5x&=15\\ \frac{-5x}{-5}&=\frac{15}{-5}\\ x&=-3 \end{aligned}$$

8.
$$\begin{aligned} 4x-3&=4(x+5)\\ 4x-3&=4x+20\\ 4x-3-4x&=4x+20-4x\\ -3&=20 \end{aligned}$$
This equation is false no matter what value the variable x might have. Thus, there is no solution. The solution set is $\{\ \}$ or $\varnothing$.

9.
$$\begin{aligned} 5x-2&=3+5(x-1)\\ 5x-2&=3+5x-5\\ 5x-2&=-2+5x\\ 5x-2+2&=-2+5x+2\\ 5x&=5x\\ 5x-5x&=5x-5x\\ 0&=0 \end{aligned}$$
Since $0 = 0$ is a true statement for every value of x, all real numbers are solutions. The solution set is the set of all real numbers or $\{x|x \text{ is a real number}\}$.

Vocabulary, Readiness & Video Check 2.1

1. Equations with the same solution set are called equivalent equations.

2. A value for the variable in an equation that makes the equation a true statement is called a solution of the equation.

3. By the addition property of equality, $y = -3$ and $y - 7 = -3 - 7$ are equivalent equations.

4. By the multiplication property of equality, $2y = -3$ and $\frac{2y}{2} = \frac{-3}{2}$ are equivalent equations.

5. $\frac{1}{3}x - 5$ expression

6. $2(x - 3) = 7$ equation

7. $\frac{5}{9}x + \frac{1}{3} = \frac{2}{9} - x$ equation

8. $\frac{5}{9}x + \frac{1}{3} - \frac{2}{9} - x$ expression

9. The addition property of equality allows us to add the same number to (or subtract the same number from) both sides of an equation and have an equivalent equation. The multiplication property of equality allows us to multiply (or divide) both sides of an equation by the same nonzero number and have an equivalent equation.

10. distributive property

11. to make the calculations less tedious

12. When solving a linear equation and all variable terms subtract out and:

a. you have a true statement, then the equation has all real numbers for which the equation is defined as solutions.

b. you have a false statement, then the equation has no solution.

Exercise Set 2.1

2.
$$-2x = 18$$
$$\frac{-2x}{-2} = \frac{18}{-2}$$
$$x = -9$$
Check: $-2x = 18$
$-2(-9) \stackrel{?}{=} 18$
$18 = 18$ True
The solution is -9.

4.
$$-25 = y + 30$$
$$-25 - 30 = y + 30 - 30$$
$$-55 = y$$
Check: $-25 = y + 30$
$-25 \stackrel{?}{=} -55 + 30$
$-25 = -25$ True
The solution is -55.

6.
$$y - 8.6 = -6.3$$
$$y - 8.6 + 8.6 = -6.3 + 8.6$$
$$y = 2.3$$
Check: $y - 8.6 = -6.3$
$2.3 - 8.6 \stackrel{?}{=} -6.3$
$-6.3 = -6.3$ True
The solution is 2.3.

8.
$$5y - 3 = 11 + 3y$$
$$5y - 3y = 11 + 3$$
$$2y = 14$$
$$\frac{2y}{2} = \frac{14}{2}$$
$$y = 7$$
Check: $5y - 3 = 11 + 3y$
$5(7) - 3 \stackrel{?}{=} 11 + 3(7)$
$35 - 3 \stackrel{?}{=} 11 + 21$
$32 = 32$ True
The solution is 7.

10.
$$10.3 - 6x = -2.3$$
$$10.3 - 6x - 10.3 = -2.3 - 10.3$$
$$-6x = -12.6$$
$$\frac{-6x}{-6} = \frac{-12.6}{-6}$$
$$x = 2.1$$
Check: $10.3 - 6x = -2.3$
$10.3 - 6(2.1) \stackrel{?}{=} -2.3$
$10.3 - 12.6 \stackrel{?}{=} -2.3$
$-2.3 = -2.3$ True
The solution is 2.1.

12. $4x+14=6x+8$

$4x-6x=8-14$

$-2x=-6$

$\frac{-2x}{-2}=\frac{-6}{-2}$

$x=3$

Check: $4x+14=6x+8$

$4(3)+14 \stackrel{?}{=} 6(3)+8$

$12+14 \stackrel{?}{=} 18+8$

$26=26$ True

The solution is 3.

14. $13x-15x+8=4x+2-24$

$-2x+8=4x-22$

$-2x-4x=-22-8$

$-6x=-30$

$x=5$

Check: $13x-15x+8=4x+2-24$

$13(5)-15(5)+8 \stackrel{?}{=} 4(5)+2-24$

$65-75+8 \stackrel{?}{=} 20+2-24$

$-2=-2$ True

The solution is 5.

16. $6+3x+x=-x+8-26+24$

$6+4x=-x+6$

$5x=0$

$x=0$

Check: $6+3x+x=-x+8-26+24$

$6+3(0)+0 \stackrel{?}{=} -0+8-26+24$

$6=6$ True

The solution is 0.

18. $2(4x+3)=7x+5$

$8x+6=7x+5$

$x+6=5$

$x=-1$

Check: $2(4x+3)=7x+5$

$2(4(-1)+3) \stackrel{?}{=} 7(-1)+5$

$2(-1) \stackrel{?}{=} -7+5$

$-2=-2$ True

The solution is -1.

20. $6x=4(x-5)$

$6x=4x-20$

$2x=-20$

$x=-10$

Check: $6x=4(x-5)$

$6(-10) \stackrel{?}{=} 4(-10-5)$

$-60 \stackrel{?}{=} 4(-15)$

$-60=-60$ True

The solution is -10.

22. $-4(3n-2)-n=-11(n-1)$

$-12n+8-n=-11n+11$

$-13n+8=-11n+11$

$-13n+11n=11-8$

$-2n=3$

$n=-\frac{3}{2}$

Check:

$-4(3n-2)-n=-11(n-1)$

$-4\left(3\cdot\left(-\frac{3}{2}\right)-2\right)-\left(-\frac{3}{2}\right) \stackrel{?}{=} -11\left(-\frac{3}{2}-1\right)$

$-4\left(-\frac{13}{2}\right)+\frac{3}{2} \stackrel{?}{=} -11\left(-\frac{5}{2}\right)$

$\frac{55}{2}=\frac{55}{2}$ True

The solution is $-\frac{3}{2}$.

24. $\frac{x}{2}+\frac{x}{5}=\frac{5}{4}$

$20\left(\frac{x}{2}+\frac{x}{5}\right)=20\left(\frac{5}{4}\right)$

$10x+4x=25$

$14x=25$

$x=\frac{25}{14}$

Check: $\frac{x}{2}+\frac{x}{5}=\frac{5}{4}$

$\frac{25}{14}\cdot\frac{1}{2}+\frac{25}{14}\cdot\frac{1}{5} \stackrel{?}{=} \frac{5}{4}$

$\frac{25}{28}+\frac{5}{14} \stackrel{?}{=} \frac{5}{4}$

$\frac{5}{4}=\frac{5}{4}$ True

The solution is $\frac{25}{14}$.

26. $\frac{4r}{5}-\frac{r}{10}=7$

$10\left(\frac{4r}{5}-\frac{r}{10}\right)=10(7)$

$2(4r)-r=70$

$8r-r=70$

$7r=70$

$r=10$

Check: $\frac{4r}{5}-\frac{r}{10}=7$

$\frac{4(10)}{5}-\frac{10}{10}\stackrel{?}{=}7$

$8-1\stackrel{?}{=}7$

$7=7$ True

The solution is 10.

28. $\frac{2+h}{9}+\frac{h-1}{3}=\frac{1}{3}$

$9\left(\frac{2+h}{9}+\frac{h-1}{3}\right)=9\left(\frac{1}{3}\right)$

$2+h+3(h-1)=3$

$2+h+3h-3=3$

$4h-1=3$

$4h=4$

$h=1$

Check: $\frac{2+h}{9}+\frac{h-1}{3}=\frac{1}{3}$

$\frac{2+1}{9}+\frac{1-1}{3}\stackrel{?}{=}\frac{1}{3}$

$\frac{3}{9}+\frac{0}{3}\stackrel{?}{=}\frac{1}{3}$

$\frac{1}{3}=\frac{1}{3}$ True

The solution is 1.

30. $0.3x+2.4=0.1x+4$

$10(0.3x+2.4)=10(0.1x+4)$

$3x+24=1x+40$

$2x=16$

$x=8$

Check: $0.3x+2.4=0.1x+4$

$0.3(8)+2.4\stackrel{?}{=}0.1(8)+4$

$2.4+2.4\stackrel{?}{=}0.8+4$

$4.8=4.8$ True

The solution is 8.

32. $\frac{2z+7}{8}-2=z+\frac{z-1}{2}$

$8\left(\frac{2z+7}{8}-2\right)=8\left(z+\frac{z-1}{2}\right)$

$2z+7-16=8z+4(z-1)$

$2z+7-16=8z+4z-4$

$2z-9=12z-4$

$-10z=5$

$z=-\frac{1}{2}$

Check: $\frac{2z+7}{8}-2=z+\frac{z-1}{2}$

$\frac{2\left(-\frac{1}{2}\right)+7}{8}-2\stackrel{?}{=}-\frac{1}{2}+\frac{-\frac{1}{2}-1}{2}$

$\frac{6}{8}-2\stackrel{?}{=}-\frac{1}{2}-\frac{3}{4}$

$-\frac{5}{4}=-\frac{5}{4}$ True

The solution is $-\frac{1}{2}$.

34. $2.4(2x+3)=-0.1(2x+3)$

$10[2.4(2x+3)]=10[-0.1(2x+3)]$

$48x+72=-2x-3$

$50x=-75$

$x=-1.5$

Check: $2.4(2x+3)=-0.1(2x+3)$

$2.4(2(-1.5)+3)\stackrel{?}{=}-0.1(2(-1.5)+3)$

$2.4(-3+3)\stackrel{?}{=}-0.1(-3+3)$

$2.4(0)\stackrel{?}{=}-0.1(0)$

$0=0$ True

The solution is -1.5.

36. $6(4n+4)=8(3+3n)$

$24n+24=24+24n$

$24n+24-24n=24+24n-24n$

$24=24$

$0=0$

Therefore, all real numbers are solutions.

38. $4(x+2)+4=4x-8$

$4x+8+4=4x-8$

$4x+12=4x-8$

$12=-8$

This is false for any x. Therefore, no solution exists, $\varnothing$.

40. $5(x-4)+x=6(x-2)-8$

$5x-20+x=6x-12-8$

$6x-20=6x-20$

$-20=-20$

This is true for all x. Therefore, all real numbers are solutions.

42. $9(x-2)=8(x-3)+x$

$9x-18=8x-24+x$

$9x-18=9x-24$

$-18=-24$

This is false for any x. Therefore, no solution exists, $\varnothing$.

44. $\frac{a}{2}+\frac{7}{4}=5$

$4\left(\frac{a}{2}+\frac{7}{4}\right)=4\cdot 5$

$2a+7=20$

$2a=13$

$a=\frac{13}{2}$

46. $4x-7=2x-7$

$4x-2x=-7+7$

$2x=0$

$x=0$

48. $3x+2(x+4)=5(x+1)+3$

$3x+2x+8=5x+5+3$

$5x+8=5x+8$

$0=0$

Therefore, all real numbers are solutions.

50. $-(w+0.2)=0.3(4-w)$

$-w-0.2=1.2-0.3w$

$-w+0.3w=1.2+0.2$

$-0.7w=1.4$

$w=-2$

52. $\frac{1}{3}(8+2c)=\frac{1}{5}(3c-5)$

$\frac{8}{3}+\frac{2}{3}c=\frac{3}{5}c-1$

$\frac{8}{3}+1=\frac{3}{5}c-\frac{2}{3}c$

$\frac{8}{3}+\frac{3}{3}=\frac{9}{15}c-\frac{10}{15}c$

$\frac{11}{3}=-\frac{1}{15}c$

$-\frac{15}{1}\cdot\frac{11}{3}=c$

$-55=c$

54. $9c-3(6-5c)=c-2(3c+9)$

$9c-18+15c=c-6c-18$

$24c-18=-5c-18$

$24c+5c=-18+18$

$29c=0$

$c=0$

56. $10x-2(x+4)=8(x-2)+6$
$10x-2x-8=8x-16+6$
$8x-8=8x-10$
$8x-8x=-10+8$
$0=-2$
This is false for any x. Therefore, the solution set is $\varnothing$.

58. $\frac{n+1}{8}-\frac{2-n}{3}=\frac{5}{6}$
$24\left(\frac{n+1}{8}-\frac{2-n}{3}\right)=24\left(\frac{5}{6}\right)$
$3(n+1)-8(2-n)=4(5)$
$3n+3-16+8n=20$
$11n-13=20$
$11n=33$
$n=3$

60. $10y-18-4y=12y-13$
$6y-18=12y-13$
$6y-12y=-13+18$
$-6y=5$
$y=-\frac{5}{6}$

62. $-4(2x-3)-(10x+7)-2=-(12x-5)-(4x+9)-1$
$-8x+12-10x-7-2=-12x+5-4x-9-1$
$-18x+3=-16x-5$
$-2x=-8$
$x=4$

64. $\frac{1}{5}(2y-1)-2=\frac{1}{2}(3y-5)+3$
$10\cdot\left(\frac{1}{5}(2y-1)-2\right)=10\cdot\left(\frac{1}{2}(3y-5)+3\right)$
$2(2y-1)-20=5(3y-5)+30$
$4y-22=15y+5$
$-11y=27$
$y=-\frac{27}{11}$

66. $3[8-4(n-2)]+5n=-20+2[5(1-n)-6n]$
$3[8-4n+8]+5n=-20+2[5-5n-6n]$
$3(16-4n)+5n=-20+2(5-11n)$
$48-12n+5n=-20+10-22n$
$48-7n=-10-22n$
$15n=-58$
$n=-\frac{58}{15}$

68. Sum means to add: The sum of 8 and a number: $8+x$

70. The difference means to subtract. The difference of 8 and a number: $8 - x$

72. Two more than three times a number: $3x + 2$

74. $-3(-4) = 12$ not -12;

$$\begin{aligned} -3(x-4) &= 10 \\ -3x+12 &= 10 \\ -3x &= -2 \\ \frac{-3x}{-3} &= \frac{-2}{-3} \\ x &= \frac{2}{3} \end{aligned}$$

76. $3\left(\frac{x}{3}+7\right) = x+21$ not $x+7$;

$$\begin{aligned} \frac{x}{3}+7 &= \frac{5x}{3} \\ 3\left(\frac{x}{3}+7\right) &= 3\left(\frac{5x}{3}\right) \\ x+21 &= 5x \\ 21 &= 4x \\ \frac{21}{4} &= \frac{4x}{4} \\ \frac{21}{4} &= x \end{aligned}$$

78. $5x - 3 = 5x - 3$
Since the two sides of the equation are identical, the equation is true for any value of x. All real numbers are solutions.

80. $5x - 2 = 5x - 7$
Subtracting 2 from a number and subtracting 7 from the same number will not result in equal numbers for any value of x. There is no solution.

82. answers may vary

84. answers may vary

86.
$$\begin{aligned} -7.6y - 10 &= -1.1y + 12 \\ -7.6y &= -1.1y + 22 \end{aligned}$$
From this we see that $K = 22$.

88.
$$\begin{aligned} \frac{x}{6}+4 &= \frac{x}{3} \\ 6\left(\frac{x}{6}+4\right) &= 6\left(\frac{x}{3}\right) \\ x+24 &= 2x \end{aligned}$$
From this we see that $K = 24$.

90. answers may vary

92. $7x^2 + 2x - 3 = 6x(x+4) + x^2$

$7x^2 + 2x - 3 = 6x^2 + 24x + x^2$

$7x^2 + 2x - 3 = 7x^2 + 24x$

$2x - 3 = 24x$

$-3 = 22x$

$x = -\frac{3}{22}$

94. $x(x+1) + 16 = x(x+5)$

$x^2 + x + 16 = x^2 + 5x$

$x + 16 = 5x$

$16 = 4x$

$x = 4$

96. $-9.112y = -47.537304$

$y = 5.217$

Check: $-9.112y = -47.537304$

$-9.112(5.217) \stackrel{?}{=} -47.537304$

$-47.537304 = -47.537304$ True

98. $1.25x - 20.175 = -8.15$

$1.25x = -8.15 + 20.175$

$1.25x = 12.025$

$x = 9.62$

Check: $1.25x - 20.175 = -8.15$

$1.25(9.62) - 20.175 \stackrel{?}{=} -8.15$

$-8.15 = -8.15$ True

Section 2.2 Practice Exercises

1. a. In words:

first integer	plus	second odd integer	plus	third odd integer
↓	↓	↓	↓	↓
x	+	$(x + 2)$	+	$(x + 4)$

Translate:

Then $x + (x + 2) + (x + 4) = x + x + 2 + x + 4 = 3x + 6$

b. In words:

side	+	side	+	side	+	side
↓	↓	↓	↓	↓	↓	↓
x	+	$2x$	+	$(x + 2)$	+	$(2x - 3)$

Translate:

Then $x + 2x + (x + 2) + (2x - 3) = x + 2x + x + 2 + 2x - 3 = 6x - 1$

2. If x = number of passengers at Los Angeles International Airport, in millions, then
$x + 3.1$ = passengers at Chicago's O'Hare airport, and
$2x - 31.9$ = passengers at Atlanta's Hartsfield-Jackson airport.

In words:	passengers at Los Angeles	+	passengers at O'Hare	+	passengers at Hartsfield-Jackson
	↓	↓	↓	↓	↓
Translate:	x	+	$(x + 3.1)$	+	$(2x - 31.9)$

Then $x + (x + 3.1) + (2x - 31.9) = x + x + 3.1 + 2x - 31.9 = 4x - 28.8$.

3. Let x = the first number, then $3x - 8$ = the second number, and $5x$ = the third number.
The sum of the three numbers is 118.

$$\begin{aligned} x + (3x - 8) + 5x &= 118 \\ x + 3x + 5x - 8 &= 118 \\ 9x - 8 &= 118 \\ 9x &= 126 \\ x &= 14 \end{aligned}$$

The numbers are 14, $3x - 8 = 3(14) - 8 = 34$, and $5x = 5(14) = 70$.

4. Let x = the original price. Then $0.4x$ = the discount. The original price, minus the discount, is equal to \$270.

$$\begin{aligned} x - 0.4x &= 270 \\ 0.6x &= 270 \\ x &= \frac{270}{0.6} = 450 \end{aligned}$$

The original price was \$450.

5. Let x = width, then $2x - 16$ = length.
The perimeter is 160 inches.

$$\begin{aligned} 2(x) + 2(2x - 16) &= 160 \\ 2x + 4x - 32 &= 160 \\ 6x - 32 &= 160 \\ 6x &= 192 \\ x &= 32 \end{aligned}$$

$2x - 16 = 2(32) - 16 = 48$
The width is 32 inches and the length is 48 inches.

6. Let x = first odd integer, then $x + 2$ = second odd integer, and $x + 4$ = third odd integer.
The sum of the integers is 81.

$$\begin{aligned} x + (x + 2) + (x + 4) &= 81 \\ 3x + 6 &= 81 \\ 3x &= 75 \\ x &= 25 \end{aligned}$$

$x + 2 = 27$
$x + 4 = 29$
The integers are 25, 27, and 29.

Vocabulary, Readiness & Video Check 2.2

1. 130% of a number $\underline{>}$ the number.

2. 70% of a number $\underline{<}$ the number.

3. 100% of a number __=__ the number.

4. 200% of a number __>__ the number.

	First Integer	All Described Integers
5. Four consecutive integers	31	31, 32, 33, 34
6. Three consecutive odd integers	31	31, 33, 35
7. Three consecutive even integers	18	18, 20, 22
8. Four consecutive even integers	92	92, 94, 96, 98
9. Three consecutive integers	y	$y, y+1, y+2$
10. Three consecutive even integers	z (z is even)	$z, z+2, z+4$
11. Four consecutive integers	p	$p, p+1, p+2, p+3$
12. Three consecutive odd integers	s (s is odd)	$s, s+2, s+4$

13. distributive property

14. The original application asks you to find three numbers. The solution $x = 45$ only gives you the first number. You need to INTERPRET this result.

Exercise Set 2.2

2. The perimeter is the sum of the lengths of the four sides.

$$x+(x-5)+x+(x-5) = x+x+x+x-5-5$$
$$= 4x-10$$

4. Let x = first odd integer, then
$x + 2$ = second odd integer, and
$x + 4$ = third odd integer.

$$x+(x+2)+(x+4) = x+x+x+2+4 = 3x+6$$

6. Find the sum of y quarters worth 25¢ each, $7y$ dimes worth 10¢ each, and $(2y - 1)$ nickels worth 5¢ each.

$$25y+10(7y)+5(2y-1) = 25y+70y+10y-5$$
$$= 105y-5$$

The total amount is $(105y - 5)$ cents.

8. $4x + 5(3x - 15) = 4x + 15x - 75 = 19x - 75$

10. The length of the side denoted by ? is $18 - 10 = 8$. Similarly, the length of the unmarked side is $(x + 14) - (x + 8) = x + 14 - x - 8 = 6$.
The perimeter of the floor plan is
$18 + (x + 8) + 10 + 6 + 8 + (x + 14) = 2x + 64$

12. Let x = the number.
$2(x+3) = 5x - 1 - 4x$
$2x + 6 = x - 1$
$x = -7$
The number is −7.

14. Let x = the first number, then
$x - 6$ = the second number, and
$2x$ = the third number.
$x + (x-6) + 2x = 306$
$4x - 6 = 306$
$4x = 312$
$x = 78$
$x - 6 = 72$
$2x = 156$
The numbers are 78, 72, and 156.

16. 90% of 70 = 0.90 · 70 = 63
70 − 63 = 7
7 million acres are not federally owned.

18. 32.2% of 881 = 0.322 · 881 ≈ 284
Approximately 284 tornadoes occurred in the United States during June 2014.

20. Let x be the number of people employed in the restaurant industry. Then x is 10% of 147 million.
x = 0.10(147 million) = 14.7 million
There were 14.7 million people employed in the restaurant industry in the U.S. in 2014.

22. From the circle graph, 39% of time is spent on role-specific tasks.
39% of 47 = 0.39 · 47 ≈ 18.3
An average worker would spend 18.3 hours on role-specific tasks.

24. The percents in the circle graph sum to 100%.
$39 + 2x + 19 + x = 100$
$3x + 58 = 100$
$3x = 42$
$x = 14$
$2x = 2(14) = 28$
28% of an average worker's time at work is spent on e-mail.

26. $3x + x + (x + 10) = 180$
$5x + 10 = 180$
$5x = 170$
$x = 34$
$3x = 3(34) = 102$
$x + 10 = 34 + 10 = 44$
The angles measure 34°, 44°, and 102°.

28. $(2x) + (3.5x) + (3x + 7) = 75$
$8.5x + 7 = 75$
$8.5x = 68$
$x = 8$
$2x = 2(8) = 16$
$3.5x = 3.5(8) = 28$
$3x + 7 = 3(8) + 7 = 31$
The sides measure 16 centimeters, 28 centimeters, and 31 centimeters.

30. $7.3x + (9.2x - 3) + 7.3x + (9.2x - 3) = 324$
$33x - 6 = 324$
$33x = 330$
$x = 10$
$7.3x = 7.3(10) = 73$
$9.2x - 3 = 9.2(10) - 3 = 89$
The sides measure 73 feet, 73 feet, 89 feet, and 89 feet.

32. Let x = the first odd integer, then
$x + 2$ = the second odd integer and
$x + 4$ = the third odd integer.
$x + x + 2 + x + 4 = 327$
$3x + 6 = 327$
$3x = 321$
$x = 107$
The numbers are 107, 109, 111.

34. Let x = first integer, then
$x + 1$ = second integer, and
$x + 2$ = third integer.
$x + (x+1) + 3(x+2) = 2637$
$x + x + 1 + 3x + 6 = 2637$
$5x + 7 = 2637$
$5x = 2630$
$x = 526$
$x + 1 = 527$
$x + 2 = 528$
The score for Alabama was 526, for Louisiana was 527, and for Michigan was 528.

36. $x + (3x - 11) + (2x + 11) = 66$
$x + 3x - 11 + 2x + 11 = 66$
$6x = 66$
$x = 11$
$3x - 11 = 3(11) - 11 = 22$
$2x + 11 = 2(11) + 11 = 33$

Year	Percent of Increase in Social Network Users	Predicted Percent of Increase
2015	x	11%
2016	$3x - 11$	22%
2017	$2x + 11$	33%
Total	66%	

38. Let x be the decline in the number of travel agent jobs (in hundreds). Then $x - 17$ is the decline in the number of reporter or correspondent jobs and $2x - 21$ is the decline in the number of flight attendant jobs.

$$x + (x - 17) + (2x - 21) = 318$$
$$x + x - 17 + 2x - 21 = 318$$
$$4x - 38 = 318$$
$$4x = 356$$
$$x = 89$$

$x - 17 = 89 - 17 = 72$
$2x - 21 = 2(89) - 21 = 157$
The predicted declines are:
travel agent jobs: 89 hundred;
reporter or correspondent jobs: 72 hundred
flight attendant jobs: 157 hundred

40. Let x be the number of seats in Gillette Stadium. Then $x + 11{,}200$ is the number of seats in AT&T Stadium and $x - 3800$ is the number of seats at CenturyLink Field.

$$x + (x + 11{,}200) + (x - 3800) = 213{,}800$$
$$x + x + 11{,}200 + x - 3800 = 213{,}800$$
$$3x + 7400 = 213{,}800$$
$$3x = 206{,}400$$
$$x = 68{,}800$$

$x + 11{,}200 = 68{,}800 + 11{,}200 = 80{,}000$
$x - 3800 = 68{,}800 - 3800 = 65{,}000$
Gillette Stadium seats 68,800, AT&T Stadium seats 80,000, and CenturyLink Field seats 65,000.

42. Let x be the price of the textbook before tax.

$$x + 0.09x = 158.60$$
$$1.09x = 158.60$$
$$x \approx 145.50$$

The human anatomy book cost $145.50 before tax.

44. Let x be the population in 2004.
This population, decreased by 1.96%, is the 2014 population of 80.9 million.

$$x - 0.0196x = 80.9$$
$$0.9804x = 80.9$$
$$x \approx 82.5$$

The population of Germany in 2004 was 82.5 million.

46. Let x be the size of the workforce prior to layoffs.

$$0.15x = 11{,}000$$
$$x \approx 73{,}333$$

Prior to layoffs, Dana's workforce was 73,333 people.

48. Let x = measure of complement; then $2x + 30$ = measure of angle.

$$x + 2x + 30 = 90$$
$$3x = 60$$
$$x = 20$$

$2x + 30 = 2(20) + 30 = 70$
The angles measure 20° and 70°.

50. Let x = base angle; then $3x - 10$ = third angle.

$$2x + 3x - 10 = 180$$
$$5x - 10 = 180$$
$$5x = 190$$
$$x = 38$$

$3x - 10 = 3 \cdot 38 - 10 = 104$
The angles measure 38°, 38°, and 104°.

52. Let x = length of side of pentagon, then $x + 7$ = length of side of square.

$$5x = 4(x + 7)$$
$$5x = 4x + 28$$
$$x = 28$$

$x + 7 = 28 + 7 = 35$
The pentagon has a side length of 28 inches and the square has a side length of 35 inches.

54. Let x = first integer, then
$x + 1$ = second integer, and
$x + 2$ = third integer, and
$x + 3$ = fourth integer.

$$(x + 1) + (x + 3) = 110$$
$$2x + 4 = 110$$
$$2x = 106$$
$$x = 53$$

$x + 1 = 54$
$x + 2 = 55$
$x + 3 = 56$
The integers are 53, 54, 55, and 56.

56. Let x be the payroll for the Montreal Canadiens. Then $x - 5{,}049{,}585$ was the payroll for the San Jose Sharks.

$$\begin{aligned} x + (x - 5{,}049{,}585) &= 129{,}215{,}719 \\ 2x - 5{,}049{,}585 &= 129{,}215{,}719 \\ 2x &= 134{,}265{,}304 \\ x &= 67{,}132{,}652 \end{aligned}$$

$$\begin{aligned} x - 5{,}049{,}585 &= 67{,}132{,}652 - 5{,}049{,}585 \\ &= 62{,}083{,}067 \end{aligned}$$

The 2014–2015 payroll for the Montreal Canadiens was \$67,132,652 and the payroll for the San Jose Sharks was \$62,083,067.

58. Let x be the number of passengers at Los Angeles International Airport, in millions. Then $x + 3.1$ is the number of passengers at Chicago's O'Hare airport, and $2x - 31.9$ is the number of passengers at Atlanta's Hartsfield-Jackson airport.

$$\begin{aligned} x + (x + 3.1) + (2x - 31.9) &= 226 \\ 4x - 28.8 &= 226 \\ 4x &= 254.8 \\ x &= 63.7 \end{aligned}$$

$x + 3.1 = 63.7 + 3.1 = 66.8$
$2x - 31.9 = 2(63.7) - 31.9 = 95.5$
The numbers of passengers are:
Los Angeles: 63.7 million;
Chicago: 66.8 million;
Atlanta: 95.5 million

60.

$$\begin{aligned} (x + 2) + 2x + x + (2x - 3) &= 110 \\ 6x - 1 &= 110 \\ 6x &= 111 \\ x &= 18.5 \end{aligned}$$

$x + 2 = 18.5 + 2 = 20.5$
$2x = 2(18.5) = 37$
$2x - 3 = 2(18.5) - 3 = 34$
The bases measure 18.5 meters and 37 meters, and the sides measure 20.5 meters and 34 meters.

62. Let x be the energy cost of an LED bulb. Then $x + 26$ is the energy cost of a CFL bulb, and $6x + 18$ is the energy cost of an incandescent bulb.

$$\begin{aligned} x + (x + 26) + (6x + 18) &= 476 \\ 8x + 44 &= 476 \\ 8x &= 432 \\ x &= 54 \end{aligned}$$

$x + 26 = 54 + 26 = 80$
$6x + 18 = 6(54) + 18 = 342$
The energy costs are:
LED bulb: \$54
CFL bulb: \$80
Incandescent bulb: \$342

64. Let x be the number of medals won by the Netherlands. Then Canada won $x + 1$ medals and Norway won $x + 2$ medals.

$$\begin{aligned} x + (x + 1) + (x + 2) &= 75 \\ 3x + 3 &= 75 \\ 3x &= 72 \\ x &= 24 \end{aligned}$$

$x + 1 = 24 + 1 = 25$
$x + 2 = 24 + 2 = 26$
In the 2014 winter Olympics, the Netherlands won 24 medals, Canada won 25 medals, and Norway won 26 medals.

66. Let x = height, then $2x + 12$ = length.

$$\begin{aligned} 2(x) + 2(2x + 12) &= 312 \\ 2x + 4x + 24 &= 312 \\ 6x + 24 &= 312 \\ 6x &= 288 \\ x &= 48 \end{aligned}$$

$2x + 12 = 2(48) + 12 = 108$
The height is 48 inches and the length is 108 inches.

68. $ab + 6bc = 0(-1) + 6(-1)(9) = 0 - 6(9) = -54$

70.

$$\begin{aligned} 2n^2 + 3m^2 &= 2(-2)^2 + 3(7)^2 \\ &= 2(4) + 3(49) \\ &= 8 + 147 \\ &= 155 \end{aligned}$$

72. $\frac{1}{3}lwh = \frac{1}{3}(37.8)(5.6)(7.9) = 557.424$

74. answers may vary

76. Let $x°$ be the measure of an angle. Then its complement measures $(90 - x)°$ and its supplement measures $(180 - x)°$.

$$\begin{aligned} 180 - x &= 2(90 - x) + 50 \\ 180 - x &= 180 - 2x + 50 \\ 180 - x &= 230 - 2x \\ 180 + x &= 230 \\ x &= 50 \end{aligned}$$

The angle measures 50°.

78. $y = -80.6x + 2054$
$y = -80.6(17) + 2054 \approx 684$
The average number of cigarettes smoked by an American adult is predicted to be 684 in 2017.

80. The average number of cigarettes smoked daily in 2017 is predicted to be $\frac{684}{365} \approx 2$.

This does not represent the average number of cigarettes smoked by an American smoker, because it is the average for *all* Americans, both smokers and non-smokers.

82. Let x be the first odd integer. Then $x + 2$ is the next consecutive odd integer.

$7x = 5(x+2)+54$
$7x = 5x+10+54$
$7x = 5x+64$
$2x = 64$
$x = 32$

No such odd integers exist.

84. $R = C$
$60x = 50x+5000$
$10x = 5000$
$x = 500$
$50x+5000 = 50(500)+5000$
$= 25,000+5000$
$= 30,000$

500 computer boards must be sold to break even. It costs \$30,000 to produce the 500 boards.

86. The company makes a profit if it makes and sells more products than the break-even number.

Section 2.3 Practice Exercises

1. $I = PRT$
$\frac{I}{PR} = \frac{PRT}{PR}$
$\frac{I}{PR} = T$ or $T = \frac{I}{PR}$

2. $7x-2y = 5$
$7x-2y-7x = 5-7x$
$-2y = 5-7x$
$\frac{-2y}{-2} = \frac{5-7x}{-2}$
$y = \frac{7}{2}x - \frac{5}{2}$

3. $A = P+Prt$
$A-P = P+Prt-P$
$A-P = Prt$
$\frac{A-P}{Pt} = \frac{Prt}{Pt}$
$\frac{A-P}{Pt} = r$ or $r = \frac{A-P}{Pt}$

4. Let $P = 8000$, $r = 6\% = 0.06$, $t = 4$, $n = 2$.
$A = P\left(1+\frac{r}{n}\right)^{nt}$
$A = 8000\left(1+\frac{0.06}{2}\right)^{2\cdot 4}$
$A = 8000(1.03)^8$
$A \approx 8000(1.266770081)$
$A \approx 10,134.16$

Russ will have \$10,134.16 in his account.

5. Let $d = 190$ and $r = 7.5$.
$d = rt$
$190 = 7.5t$
$\frac{190}{7.5} = \frac{7.5t}{7.5}$
$25\frac{1}{3} = t$

They spent $25\frac{1}{3}$ hours cycling, or 25 hours 20 minutes.

Vocabulary, Readiness & Video Check 2.3

1. $2x+y = 5$
$y = 5-2x$

2. $7x-y = 3$
$-y = 3-7x$
$y = -3+7x$ or $y = 7x-3$

3. $a-5b = 8$
$a = 5b+8$

4. $7r+s = 10$
$s = 10-7r$

5. $5j+k-h = 6$
$5j+k = h+6$
$k = h-5j+6$

6. $w-4y+z=0$
$w+z=4y$
$z=4y-w$

7. That the specified variable will equal some expression and that this expression should not contain the specified variable.

8. The only way to check the solution is in the formula used, because if the wrong formula is used, a wrong answer may seem to check correctly.

Exercise Set 2.3

2. $W=gh$
$\frac{W}{h}=\frac{gh}{h}$
$\frac{W}{h}=g$
$g=\frac{W}{h}$

4. $V=lwh$
$\frac{V}{wh}=\frac{lwh}{wh}$
$\frac{V}{wh}=l$
$l=\frac{V}{wh}$

6. $2x+3y=17$
$2x+3y-2x=17-2x$
$3y=17-2x$
$\frac{3y}{3}=\frac{17-2x}{3}$
$y=\frac{17-2x}{3}$

8. $A=3M-2N$
$A+2N=3M$
$2N=3M-A$
$\frac{2N}{2}=\frac{3M-A}{2}$
$N=\frac{3M-A}{2}$

10. $y=mx+b$
$y-b=mx$
$\frac{y-b}{m}=\frac{mx}{m}$
$x=\frac{y-b}{m}$

12. $A=Prt+P$
$A=P(rt+1)$
$\frac{A}{rt+1}=\frac{P(rt+1)}{rt+1}$
$P=\frac{A}{rt+1}$

14. $A=5H(b+B)$
$A=5Hb+5HB$
$A-5HB=5Hb$
$\frac{A-5HB}{5H}=\frac{5Hb}{5H}$
$\frac{A-5HB}{5H}=b$
$b=\frac{A-5HB}{5H}$

16. $S=2\pi r^2+2\pi rh$
$S-2\pi r^2=2\pi rh$
$\frac{S-2\pi r^2}{2\pi r}=\frac{2\pi rh}{2\pi r}$
$\frac{S-2\pi r^2}{2\pi r}=h$
$h=\frac{S-2\pi r^2}{2\pi r}$

18. $A=P(1+rt)$
$A=P+Prt$
$A-P=Prt$
$\frac{A-P}{Pr}=\frac{Prt}{Pr}$
$\frac{A-P}{Pr}=t$
$t=\frac{A-P}{Pr}$

20.
$$C = \frac{5}{9}(F-32)$$
$$9C = 5(F-32)$$
$$9C = 5F-160$$
$$9C+160 = 5F$$
$$\frac{9C+160}{5} = \frac{5F}{5}$$
$$\frac{9C+160}{5} = F$$
$$F = \frac{9}{5}C+32$$

22.
$$L = a+(n-1)d$$
$$L-a = (n-1)d$$
$$\frac{L-a}{n-1} = \frac{(n-1)d}{n-1}$$
$$\frac{L-a}{n-1} = d$$
$$d = \frac{L-a}{n-1}$$

24.
$$T = 3vs-4ws+5vw$$
$$T+4ws = 3vs+5vw$$
$$T+4ws = v(3s+5w)$$
$$\frac{T+4ws}{3s+5w} = \frac{v(3s+5w)}{3s+5w}$$
$$\frac{T+4ws}{3s+5w} = v$$
$$v = \frac{T+4ws}{3s+5w}$$

26. $A = P\left(1+\frac{r}{n}\right)^{nt} = 5000\left(1+\frac{0.06}{n}\right)^{15n}$

n	1	2	4	12	365
A	\$11,982.79	\$12,136.31	\$12,216.10	\$12,270.47	\$12,297.11

28. a. Using the formula $A = P\left(1+\frac{r}{n}\right)^{nt}$, we have

$$A = 25{,}000\left(1+\frac{0.05}{2}\right)^{2\cdot 2}$$
$$= 25{,}000(1.025)^4$$
$$\approx 25{,}000(1.103812891)$$
$$\approx 27{,}595.32$$

The amount in the account is \$27,595.32.

b. $A = 25{,}000\left(1+\frac{0.05}{4}\right)^{4\cdot 2}$

$= 25{,}000(1.0125)^8$

$\approx 25{,}000(1.104486101)$

$\approx 27{,}612.15$

The amount in the account is \$27,612.15.

c. $A = 25{,}000\left(1+\frac{0.05}{12}\right)^{12\cdot 2}$

$\approx 25{,}000(1.00416666)^{24}$

$\approx 25{,}000(1.104941335)$

$\approx 27{,}623.53$

The amount in the account is \$27,623.53.

30. Roundtrip distance = 154 + 154 = 308 miles

$d = r \cdot t$

$308 = r\left(5\frac{1}{2}\right)$

$\frac{308}{5\frac{1}{2}} = r$

$r = 56$

Their average speed was 56 mph.

32. Using the formula $F = \frac{9}{5}C + 32,$ we have

$F = \frac{9}{5}C + 32 = \frac{9}{5}(-15) + 32 = -27 + 32 = 5$

The temperature was 5°F.

34. The total area of the ceiling is 18(12) = 216 square feet. Each package can cover up to 50 square feet. Thus, the number of packages needed is $\frac{216}{50} = 4.32.$ Therefore, 5 packages must be purchased.

36. Using the formula $A = P\left(1+\frac{r}{n}\right)^{nt}$, we have

$A = 4000\left(1+\frac{0.055}{2}\right)^{2\cdot 3}$

$A = 4000(1.0275)^6$

$A \approx 4000(1.176768361)$

$A \approx 4707.07$

Yes, the amount is enough.

38. Note that the wall covers $21 \cdot 8 = 168$ square feet. Because we wish to paint three coats, we actually must cover a total of $168 \cdot 3 = 504$ square feet. Since each gallon covers 300 square feet, we need $\frac{504}{300} = 1.68$ gallons of paint. 2 gallons should be purchased.

40. $V = \pi r^2 h$

$825\pi = \pi(5)^2 h$

$825\pi = 25\pi h$

$825 = 25h$

$33 = h$

The height is 33 mm.

42. a. $V = \frac{4}{3}\pi r^3;\ \ r = \frac{d}{2} = \frac{18}{2} = 9$

$V = \frac{4}{3}\pi(9)^3$

$V = \frac{4}{3}\pi(729)$

$V = 972\pi$

The volume is 972π cubic cm.

b. $V = 972\pi \approx 3053.63$ cubic cm

44. a. $V = \pi r^2 h$

$V = \pi(4)^2(15)$

$V \approx 753.98$

The volume of the cylinder is 753.98 cubic millimeters.

b. $V = \frac{4}{3}\pi r^3$

$V = \frac{4}{3}\pi(4)^3$

$V \approx 268.08$

The volume of the sphere is 268.08 cubic millimeters.

c. $V = 753.98 + 268.08 = 1022.06$

The volume of the vitamin is 1022.06 cubic millimeters.

46. Note that the radius of the circle is equal to 22,248 + 4000 = 26,248.

$C = 2\pi r$

$C = 2\pi(26{,}248)$

$C = 52{,}496\pi$

$C \approx 164{,}921.0479$

The "length" of the Clarke belt is approximately 164,921 miles.

48. $8 \text{ miles} \times \frac{5280 \text{ ft}}{1 \text{ mile}} = 42,240 \text{ ft}$

$7.5 \text{ hours} \times \frac{60 \text{ min}}{1 \text{ hour}} \times \frac{60 \text{ sec}}{1 \text{ min}} = 27,000 \text{ sec}$

Using $d = rt$ we have:

$42,240 = r(27,000)$

$r = \frac{42,240}{27,000} \approx 1.6$

The drill can be removed at a rate of 1.6 ft/sec.

50. Using the formula $V = \frac{4}{3}\pi r^3$, we have

$V = \frac{4}{3}\pi(20.6)^3$

$V \approx 36,618$

The volume of Eartha is about 36,618 cu ft.

52. $d = rt$

$135 = 60t$

$t = 2.25$

It will take Mark 2.25 hours or 2 hours 15 minutes.

54. $C = 4h + 9f + 4p$

$4h = C - 9f - 4p$

$h = \frac{C - 9f - 4p}{4}$

56. $C = 4h + 9f + 4p$

$C = 4(30) + 9(9) + 4(2)$

$C = 209$

There are 209 calories in this serving.

58. $f = \frac{C - 4h - 4p}{9}$

$f = \frac{120 - 4(21) - 4(5)}{9}$

$f \approx 1.8$

There are 1.8 grams of fat per serving.

60. 2, 3 satisfy $x > 1$.

62. $-3, -2, -1, 0, 1, 2, 3$, satisfy $x - 3 \geq -7$ or $x \geq -4$.

64. answers may vary

	Planet	AU from Sun
66.	Earth	$\frac{92.9}{92.9} = 1.000$
68.	Jupiter	$\frac{483.3}{92.9} \approx 5.202$
70.	Uranus	$\frac{1783}{92.9} \approx 19.193$
72.	Pluto	$\frac{3670}{92.9} = 39.505$

74. answers may vary

76. answers may vary

78. Two of the 8 sectors are yellow.

$P(\text{yellow}) = \frac{2}{8} = \frac{1}{4}$

80. Three of the 8 sectors are blue.

$P(\text{blue}) = \frac{3}{8}$

82. Three of the sectors are black or yellow.

$P(\text{black or yellow}) = \frac{3}{8}$

84. Six of the sectors are yellow, blue, or black.

$P(\text{yellow, blue, or black}) = \frac{6}{8} = \frac{3}{4}$

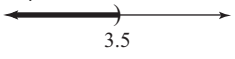
86. All of the sectors are red, yellow, green, blue, or black.

$P(\text{red, yellow, green, blue, or black}) = \frac{8}{8} = 1$

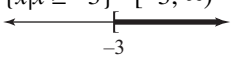
88. $P(\text{event sure to occur}) = 1$

Section 2.4 Practice Exercises

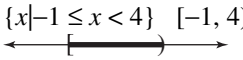
1. a. $\{x|x < 3.5\}$ $(-\infty, 3.5)$



b. $\{x|x \geq -3\}$ $[-3, \infty)$



c. $\{x|-1 \leq x < 4\}$ $[-1, 4)$

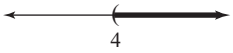


2. $x+5>9$

$x+5-5>9-5$

$x>4$

$(4, \infty)$



3. $3x+1\le 2x-3$

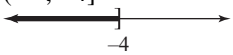
$3x+1-2x\le 2x-3-2x$

$x+1\le -3$

$x+1-1\le -3-1$

$x\le -4$

$(-\infty, -4]$

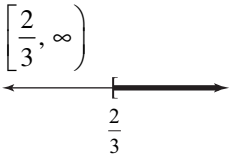


4. a. $\frac{2}{5}x\ge\frac{4}{15}$

$\frac{5}{2}\cdot\frac{2}{5}x\ge\frac{5}{2}\cdot\frac{4}{15}$

$x\ge\frac{2}{3}$

$\left[\frac{2}{3}, \infty\right)$

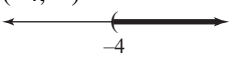


b. $-2.4x<9.6$

$\frac{-2.4x}{-2.4}>\frac{9.6}{-2.4}$

$x>-4$

$(-4, \infty)$



5. $-(4x+6)\le 2(5x+9)+2x$

$-4x-6\le 10x+18+2x$

$-4x-6\le 12x+18$

$-4x-6+4x\le 12x+18+4x$

$-6\le 16x+18$

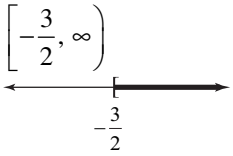
$-6-18\le 16x+18-18$

$-24\le 16x$

$\frac{-24}{16}\le\frac{16x}{16}$

$-\frac{3}{2}\le x$

$\left[-\frac{3}{2}, \infty\right)$



6. $\frac{3}{5}(x-3) \geq x-7$

$5\left[\frac{3}{5}(x-3)\right] \geq 5(x-7)$

$3(x-3) \geq 5(x-7)$

$3x-9 \geq 5x-35$

$3x-9-5x \geq 5x-35-5x$

$-2x-9 \geq -35$

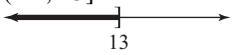
$-2x-9+9 \geq -35+9$

$-2x \geq -26$

$\frac{-2x}{-2} \leq \frac{-26}{-2}$

$x \leq 13$

$(-\infty, 13]$



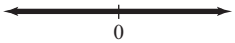
7. $4(x-2) < 4x+5$

$4x-8 < 4x+5$

$4x-8-4x < 4x+5-4x$

$-8 < 5$

This is a true statement for all values of x. The solution set is $\{x|x \text{ is a real number}\}$ or $(-\infty, \infty)$.



8. In words: | 900 | + | commission (15% of sales) | ≥ | 2400 |

Translate: $900 + 0.15x \geq 2400$

$900+0.15x \geq 2400$

$900+0.15x-900 \geq 2400-900$

$0.15x \geq 1500$

$x \geq 10,000$

Sales must be greater than or equal to \$10,000 per month.

9. $-11.8t+390 < 175$

$-11.8t < -215$

$t >$ approximately 18.2

The annual consumption of cigarettes will be less than 175 billion more than 18.2 years after 2004, or in approximately 18 + 2004 = 2022 and after.

Vocabulary, Readiness & Video Check 2.4

1. d. $(-\infty, -5)$

2. c. $[-11, \infty)$

3. b. $\left(-2.5, \frac{7}{4}\right]$

4. a. $\left[-\frac{10}{3}, 0.2\right)$

5. The set $\{x|x \geq -0.4\}$ written in interval notation is $[-0.4, \infty)$.

6. The set $\{x|x < -0.4\}$ written in interval notation is $(-\infty, -0.4)$.

7. The set $\{x|x \leq -0.4\}$ written in interval notation is $(-\infty, -0.4]$.

8. The set $\{x|x > -0.4\}$ written in interval notation is $(-0.4, \infty)$.

9. The graph of Example 1 is shaded from $-\infty$ to, but not including, -3, as indicated by a parenthesis. To write interval notation, write down what is shaded for the inequality from left to right. A parenthesis is always used with $-\infty$, so from the graph, the interval notation is $(-\infty, -3)$.

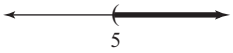
10. We can add the same number to (or subtract the same number from) both sides of a linear inequality in one variable and have an equivalent inequality; addition property of equality.

11. If you multiply or divide both sides of an inequality by the same nonzero negative number, you must reverse the direction of the inequality symbol.

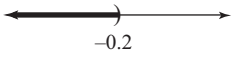
12. maximum, or less

Exercise Set 2.4

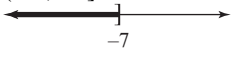
2. $\{x|x > 5\}$
$(5, \infty)$



4. $\{x|x < -0.2\}$
$(-\infty, -0.2)$



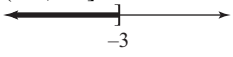
6. $\{x|-7 \geq x\}$
$(-\infty, -7]$



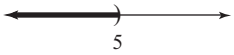
8. $\{x|-5 \leq x \leq -1\}$
$[-5, -1]$

10. $\{x|-3 > x \geq -7\}$
$[-7, -3)$

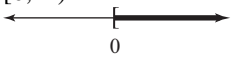
12. $x + 2 \leq -1$
$x \leq -3$
$(-\infty, -3]$



14. $11x < 10x + 5$
$x < 5$
$(-\infty, 5)$



16. $7x - 1 \geq 6x - 1$
$x \geq 0$
$[0, \infty)$



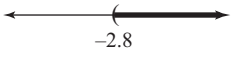
18. $\frac{5}{6}x \geq 5$

$\frac{6}{5} \cdot \frac{5}{6}x \geq \frac{6}{5} \cdot 5$

$x \geq 6$

$[6, \infty)$

20. $4x > -11.2$
$x > -2.8$
$(-2.8, \infty)$

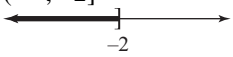


22. $-4x \geq 8$

$\frac{-4x}{-4} \leq \frac{8}{-4}$

$x \leq -2$

$(-\infty, -2]$



24. $8 - 5x \leq 23$
$-5x \leq 15$
$x \geq -3$
$[-3, \infty)$

26. $20 + x < 6x - 15$
$20 - 5x < -15$
$-5x < -35$
$\frac{-5x}{-5} > \frac{-35}{-5}$
$x > 7$
$(7, \infty)$

28. $6(2 - 3x) \geq 12$
$12 - 18x \geq 12$
$-18x \geq 0$
$x \leq 0$
$(-\infty, 0]$

30. $5(x + 4) \leq 4(2x + 3)$
$5x + 20 \leq 8x + 12$
$-3x \leq -8$
$x \geq \frac{8}{3}$
$\left[\frac{8}{3}, \infty\right)$

32. $\frac{1 - 2x}{3} + \frac{3x + 7}{7} > 1$
$21\left(\frac{1 - 2x}{3} + \frac{3x + 7}{7}\right) > 21(1)$
$7(1 - 2x) + 3(3x + 7) > 21$
$7 - 14x + 9x + 21 > 21$
$-5x + 28 > 21$
$-5x > -7$
$x < \frac{7}{5}$
$\left(-\infty, \frac{7}{5}\right)$

34. $-2(4x + 2) > -5[1 + 2(x - 1)]$
$-8x - 4 > -5(1 + 2x - 2)$
$-8x - 4 > -5(2x - 1)$
$-8x - 4 > -10x + 5$
$2x - 4 > 5$
$2x > 9$
$x > \frac{9}{2}$
$\left(\frac{9}{2}, \infty\right)$

36. $x - 9 < -12$
$x - 9 + 9 < -12 + 9$
$x < -3$
$(-\infty, -3)$

38. $-x > -2$
$\frac{-x}{-1} < \frac{-2}{-1}$
$x < 2$
$(-\infty, 2)$

40. $-6x \leq 4.2$
$\frac{-6x}{-6} \geq \frac{4.2}{-6}$
$x \geq -0.7$
$[-0.7, \infty)$

42. $\frac{3}{4} - \frac{2}{3} \geq \frac{x}{6}$
$12\left(\frac{3}{4} - \frac{2}{3}\right) \geq 12\left(\frac{x}{6}\right)$
$9 - 8 \geq 2x$
$1 \geq 2x$
$\frac{1}{2} \geq x$
$\left(-\infty, \frac{1}{2}\right]$

44. $-6x + 2 < -3(x + 4)$
$-6x + 2 < -3x - 12$
$2 < 3x - 12$
$14 < 3x$
$\frac{14}{3} < x$
$\left(\frac{14}{3}, \infty\right)$

46. $\frac{4}{5}(x + 1) \leq x + 1$
$5\left[\frac{4}{5}(x + 1)\right] \leq 5(x + 1)$
$4(x + 1) \leq 5(x + 1)$
$4x + 4 \leq 5x + 5$
$-x + 4 \leq 5$
$-x \leq 1$
$x \geq -1$
$[-1, \infty)$

48. $0.7x - x > 0.45$
$-0.3x > 0.45$
$x < -1.5$
$(-\infty, -1.5)$

50. $7(2x+3)+4x \le 7+5(3x-4)+x$
$14x+21+4x \le 7+15x-20+x$
$18x+21 \le -13+16x$
$2x+21 \le -13$
$2x \le -34$
$x \le -17$
$(-\infty, -17]$

52. $13y-(9y+2) \le 5(y-6)+10$
$13y-9y-2 \le 5y-30+10$
$4y-2 \le 5y-20$
$-2 \le y-20$
$18 \le y$ or $y \ge 18$
$[18, \infty)$

54. $8(x+3) \le 7(x+5)+x$
$8x+24 \le 7x+35+x$
$8x+24 \le 8x+35$
$24 \le 35$
$(-\infty, \infty)$

56. $7x < 7(x-2)$
$7x < 7x-14$
$0 < -14$ False
No solution; $\varnothing$

58. $0.2(8x-2) < 1.2(x-3)$
$10[0.2(8x-2)] < 10[1.2(x-3)]$
$2(8x-2) < 12(x-3)$
$16x-4 < 12x-36$
$4x-4 < -36$
$4x < -32$
$x < -8$
$(-\infty, -8)$

60. $\frac{7}{12}x-\frac{1}{3} \le \frac{3}{8}x-\frac{5}{6}$
$24\left[\frac{7}{12}x-\frac{1}{3}\right] \le 24\left[\frac{3}{8}x-\frac{5}{6}\right]$
$2 \cdot 7x-8 \le 3 \cdot 3x-4 \cdot 5$
$14x-8 \le 9x-20$
$5x-8 \le -20$
$5x \le -12$
$x \le -\frac{12}{5}$
$\left(-\infty, -\frac{12}{5}\right]$

62. $\frac{2}{3}(x+3) < \frac{1}{6}(2x-8)+2$
$6\left[\frac{2}{3}(x+3)\right] < 6\left[\frac{1}{6}(2x-8)+2\right]$
$4(x+3) < (2x-8)+12$
$4x+12 < 2x+4$
$2x+12 < 4$
$2x < -8$
$x < -4$
$(-\infty, -4)$

64. $\frac{3-4x}{6}-\frac{1-2x}{12} \le -2$
$12\left(\frac{3-4x}{6}-\frac{1-2x}{12}\right) \le 12(-2)$
$2(3-4x)-(1-2x) \le -24$
$6-8x-1+2x \le -24$
$5-6x \le -24$
$-6x \le -29$
$x \ge \frac{29}{6}$
$\left[\frac{29}{6}, \infty\right)$

66. $\frac{x-4}{2}-\frac{x-2}{3} > \frac{5}{6}$
$6\left(\frac{x-4}{2}-\frac{x-2}{3}\right) > 6\left(\frac{5}{6}\right)$
$3(x-4)-2(x-2) > 5$
$3x-12-2x+4 > 5$
$x-8 > 5$
$x > 13$
$(13, \infty)$

68. $\frac{3x+2}{18}-\frac{1+2x}{6} \le -\frac{1}{2}$
$18\left(\frac{3x+2}{18}-\frac{1+2x}{6}\right) \le 18\left(-\frac{1}{2}\right)$
$3x+2-3(1+2x) \le -9$
$3x+2-3-6x \le -9$
$-3x-1 \le -9$
$-3x \le -8$
$x \ge \frac{8}{3}$
$\left[\frac{8}{3}, \infty\right)$

70. a. Let x be Holden's time on his last trial.

$$\frac{6.85+7.04+6.92+x}{4}<7$$
$$4\left(\frac{6.85+7.04+6.92+x}{4}\right)<4(7)$$
$$6.85+7.04+6.92+x<28$$
$$20.81+x-20.81<28-20.81$$
$$x<7.19$$

The solution is $\{x|x<7.19\}$.

b. A time of 7.19 minutes or less will result in an average time under 7.0 minutes.

72. a. Let x be the number of additional ouces.

$$98+21x\le 300$$
$$21x\le 202$$
$$x\le \text{ approximately } 9.6$$

The solution is $\{x|x\le 9.6\}$.

b. Since x represents the number of ounces after the first ounce, you can mail at most 1 ounce plus 9 additional ounces, or 10 ounces.

74. a. Let x be the number of additional half-hour intervals parked.

$$1.0+0.6x\le 4$$
$$10+6x\le 40$$
$$6x\le 30$$
$$x\le 5$$

The solution is $\{x|x\le 5\}$.

b. Since x represents the number of half hours after the first hour, you can park for at most 1 hour plus 5 additional half hours, or 1 + 2.5 = 3.5 hours total.

76. a. Let n = number of calls made in a given month.

$$25<13+0.06n$$
$$12<0.06n$$
$$200<n$$
$$\{n|n>200\}$$

b. Plan 1 is more economical than Plan 2 when 200 or more calls are made.

78. Given that $F\ge 977$, we know the following:

$$C\ge\frac{5}{9}(F-32)$$
$$C\ge\frac{5}{9}(977-32)$$
$$C\ge\frac{5}{9}(945)$$
$$C\ge 525$$
$$\{C|C\ge 525\}$$

So stibnite melts when the temperature is at least 525°C.

80. a.

$$-11.8t+390<50$$
$$-11.8t<-340$$
$$t>\text{ approximately } 28.8$$

2004 + 28.8 = 2032.8
The consumption will be less than 50 billion during the year 2032 and after.

b. answers may vary

82. Consumption of skim milk is decreasing over time; answers may vary.

84. 2024 is 20 years after 2004, so 2024 corresponds to t = 20.
$s = -0.22t + 27.4$
$s = -0.22(20) + 27.4 = -4.4 + 27.4 = 23$
The average consumption of skim milk is predicted to be 23 pounds per person per year in 2024.

86. answers may vary

88. answers may vary

90. answers may vary

92. $x\ge 0$ and $x\le 7$
The integers are 0, 1, 2, 3, 4, 5, 6, 7.

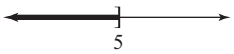
94. $x<6$ and $x<-5$
The integers are −6, −7, −8, ...

96.

$$3x-12=3$$
$$3x-12+12=3+12$$
$$3x=15$$
$$\frac{3x}{3}=\frac{15}{3}$$
$$x=5$$

98. $-5x-4=-x-4$
$-5x+x=-4+4$
$-4x=0$
$\frac{-4x}{-4}=\frac{0}{-4}$
$x=0$

100. $\{x|x>-4\}$; $(-4, \infty)$

102. 

$(-\infty, 5]$

104. $\{x|-3.7 \le x < 4\}$


106. To solve $3x > -14$, both sides must be divided by 3, so the inequality symbol will not be reversed.

108. To solve $-x \le 9$, both sides must be divided by -1, so the inequality symbol will be reversed.

110. $2x-3>5$
$2x>8$
$x>4$
The solution set is $(4, \infty)$.

112. answers may vary

114. answers may vary

116. answers may vary

Integrated Review

1. $-4x=20$
$\frac{-4x}{-4}=\frac{20}{-4}$
$x=-5$

2. $-4x<20$
$\frac{-4x}{-4}>\frac{20}{-4}$
$x>-5$
$(-5, \infty)$

3. $\frac{3x}{4} \ge 2$
$4\left(\frac{3x}{4}\right) \ge 4(2)$
$3x \ge 8$
$x \ge \frac{8}{3}$
$\left[\frac{8}{3}, \infty\right)$

4. $5x+3 \ge 2+4x$
$x+3 \ge 2$
$x \ge -1$
$[-1, \infty)$

5. $6(y-4)=3(y-8)$
$6y-24=3y-24$
$3y=0$
$y=0$

6. $-4x \le \frac{2}{5}$
$-20x \le 2$
$x \ge -\frac{1}{10}$
$\left[-\frac{1}{10}, \infty\right)$

7. $-3x \ge \frac{1}{2}$
$2(-3x) \ge 2\left(\frac{1}{2}\right)$
$-6x \ge 1$
$x \le -\frac{1}{6}$
$\left(-\infty, -\frac{1}{6}\right]$

8. $5(y+4)=4(y+5)$
$5y+20=4y+20$
$y=0$

9. $7x<7(x-2)$
$7x<7x-14$
$0<-14$ (False)
No solution; $\varnothing$

10. $\dfrac{-5x+11}{2} \le 7$

$2\left(\dfrac{-5x+11}{2}\right) \le 2(7)$

$-5x+11 \le 14$

$-5x \le 3$

$x \ge -\dfrac{3}{5}$

$\left[-\dfrac{3}{5}, \infty\right)$

11. $-5x+1.5 = -19.5$

$-5x+1.5-1.5 = -19.5-1.5$

$-5x = -21$

$\dfrac{-5x}{-5} = \dfrac{-21}{-5}$

$x = 4.2$

12. $-5x+4 = -26$

$-5x = -30$

$x = 6$

13. $5+2x-x = -x+3-14$

$5+x = -x-11$

$5+2x = -11$

$2x = -16$

$x = -8$

14. $12x+14 < 11x-2$

$x+14 < -2$

$x < -16$

$(-\infty, -16)$

15. $\dfrac{x}{5}-\dfrac{x}{4} = \dfrac{x-2}{2}$

$20\left(\dfrac{x}{5}-\dfrac{x}{4}\right) = 20\left(\dfrac{x-2}{2}\right)$

$4x-5x = 10(x-2)$

$-x = 10x-20$

$-11x = -20$

$x = \dfrac{20}{11}$

16. $12x-12 = 8(x-1)$

$12x-12 = 8x-8$

$4x-12 = -8$

$4x = 4$

$x = 1$

17. $2(x-3) > 70$

$2x-6 > 70$

$2x > 76$

$x > 38$

$(38, \infty)$

18. $-3x-4.7 = 11.8$

$-3x-4.7+4.7 = 11.8+4.7$

$-3x = 16.5$

$\dfrac{-3x}{-3} = \dfrac{16.5}{-3}$

$x = -5.5$

19. $-2(b-4)-(3b-1) = 5b+3$

$-2b+8-3b+1 = 5b+3$

$-5b+9 = 5b+3$

$-10b = -6$

$b = \dfrac{-6}{-10} = \dfrac{3}{5}$

20. $8(x+3) < 7(x+5)+x$

$8x+24 < 7x+35+x$

$8x+24 < 8x+35$

$24 < 35$ (True for all x)

All real numbers; $(-\infty, \infty)$

21. $\dfrac{3t+1}{8} = \dfrac{5+2t}{7}+2$

$56\left(\dfrac{3t+1}{8}\right) = 56\left(\dfrac{5+2t}{7}\right)+56(2)$

$7(3t+1) = 8(5+2t)+112$

$21t+7 = 40+16t+112$

$21t+7 = 16t+152$

$5t = 145$

$t = 29$

22. $4(x-6)-x = 8(x-3)-5x$

$4x-24-x = 8x-24-5x$

$3x-24 = 3x-24$

$-24 = -24$ (True for all x)

The solution is all real numbers.

23. $\frac{x}{6}+\frac{3x-2}{2}<\frac{2}{3}$

$6\left(\frac{x}{6}+\frac{3x-2}{2}\right)<6\left(\frac{2}{3}\right)$

$x+3(3x-2)<4$

$x+9x-6<4$

$10x-6<4$

$10x<10$

$x<1$

$(-\infty, 1)$

24. $\frac{y}{3}+\frac{y}{5}=\frac{y+3}{10}$

$30\left(\frac{y}{3}\right)+30\left(\frac{y}{5}\right)=30\left(\frac{y+3}{10}\right)$

$10y+6y=3(y+3)$

$16y=3y+9$

$13y=9$

$y=\frac{9}{13}$

25. $5(x-6)+2x>3(2x-1)-4$

$5x-30+2x>6x-3-4$

$7x-30>6x-7$

$x>23$

$(23, \infty)$

26. $14(x-1)-7x\le 2(3x-6)+4$

$14x-14-7x\le 6x-12+4$

$7x-14\le 6x-8$

$x\le 6$

$(-\infty, 6]$

27. $\frac{1}{4}(3x+2)-x\ge\frac{3}{8}(x-5)+2$

$8\left[\frac{1}{4}(3x+2)-x\right]\ge 8\left[\frac{3}{8}(x-5)+2\right]$

$2(3x+2)-8x\ge 3(x-5)+16$

$6x+4-8x\ge 3x-15+16$

$-2x+4\ge 3x+1$

$3\ge 5x$

$\frac{3}{5}\ge x$ or $x\le\frac{3}{5}$

$\left(-\infty, \frac{3}{5}\right]$

28. $\frac{1}{3}(x-10)-4x>\frac{5}{6}(2x+1)-1$

$6\left[\frac{1}{3}(x-10)-4x\right]>6\left[\frac{5}{6}(2x+1)-1\right]$

$2(x-10)-24x>5(2x+1)-6$

$2x-20-24x>10x+5-6$

$-22x-20>10x-1$

$-19>32x$

$-\frac{19}{32}>x$ or $x<-\frac{19}{32}$

$\left(-\infty, -\frac{19}{32}\right)$

Section 2.5 Practice Exercises

1. $A = \{1, 3, 5, 7, 9\}$ and $B = \{1, 2, 3, 4\}$
The numbers 1 and 3 are in sets A and B.
The intersection is $\{1, 3\}$. $A \cap B = \{1, 3\}$.

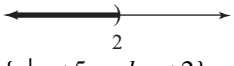
2. $x+3<8$ *and* $2x-1<3$

$x<5$ *and* $2x<4$

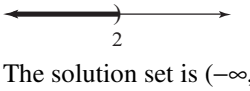
$x<5$ *and* $x<2$

$\{x|x<5\}, (-\infty, 5)$

$\{x|x<2\}, (-\infty, 2)$



$\{x|x<5 \text{ and } x<2\} = \{x|x<2\}$



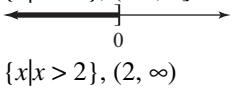
The solution set is $(-\infty, 2)$.

3. $4x\le 0$ *and* $3x+2>8$

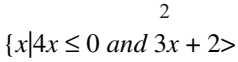
$x\le 0$ *and* $3x>6$

$x\le 0$ *and* $x>2$

$\{x|x\le 0\}, (-\infty, 0]$



$\{x|x>2\}, (2, \infty)$



$\{x|4x\le 0 \text{ and } 3x+2>8\} = \{\quad\}$ or $\varnothing$

4. $3 < 5 - x < 9$

$3 - 5 < 5 - x - 5 < 9 - 5$

$-2 < -x < 4$

$\frac{-2}{-1} > \frac{-x}{-1} > \frac{4}{-1}$

$2 > x > -4$

or $-4 < x < 2$

The solution set is $(-4, 2)$.

5. $-4 \le \frac{x}{2} - 1 \le 3$

$2(-4) \le 2\left(\frac{x}{2} - 1\right) \le 2(3)$

$-8 \le x - 2 \le 6$

$-8 + 2 \le x - 2 + 2 \le 6 + 2$

$-6 \le x \le 8$

The solution set is $[-6, 8]$.

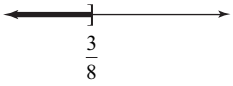
6. $A = \{1, 3, 5, 7, 9\}$ and $B = \{2, 3, 4, 5, 6\}$. The numbers that are in either set or both sets are $\{1, 2, 3, 4, 5, 6, 7, 9\}$. This set is the union, $A \cup B$.

7. $8x + 5 \le 8$ *or* $x - 1 \ge 2$

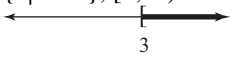
$8x \le 3$ *or* $x \ge 3$

$x \le \frac{3}{8}$ *or* $x \ge 3$

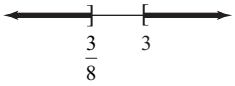
$\left\{x \middle| x \le \frac{3}{8}\right\}, \left(-\infty, \frac{3}{8}\right]$



$\{x|x \ge 3\}, [3, \infty)$



$\left\{x \middle| x \le \frac{3}{8} \text{ or } x \ge 3\right\} = \left(-\infty, \frac{3}{8}\right] \cup [3, \infty)$



The solution set is $\left(-\infty, \frac{3}{8}\right] \cup [3, \infty)$.

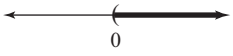
8. $-3x - 2 > -8$ *or* $5x > 0$

$-3x > -6$ *or* $x > 0$

$x < 2$ *or* $x > 0$

$\{x|x < 2\}, (-\infty, 2)$

$\{x|x > 0\}, (0, \infty)$



$\{x|x < 2 \text{ or } x > 0\}, (-\infty, \infty)$

The solution set is $(-\infty, \infty)$.

Vocabulary, Readiness & Video Check 2.5

1. Two inequalities joined by the words "and" or "or" are called compound inequalities.

2. The word and means intersection.

3. The word or means union.

4. The symbol $\cap$ means intersection.

5. The symbol $\cup$ represents union.

6. The symbol $\varnothing$ is the empty set.

7. For an element to be in the intersection of sets A and B, the element must be in set A and in set B.

8. Graph the two intervals, each on its own number line, so you can see their intersection. Graph this intersection on the third number line—this intersection is the solution set.

9. For an element to be in the union of sets A and B, the element must be in set A or in set B.

10. Graph the two intervals, each on its own number line, so you can see their union. Graph this union on the third number line—this union is the solution set.

Exercise Set 2.5

2. $C \cap D = \{4, 5\}$

4. $A \cup D = \{x|x \text{ is an even integer or } x = 5 \text{ or } x = 7\}$

6. $A \cap B = \varnothing$

8. $B \cup D = \{x|x \text{ is an odd integer or } x = 4 \text{ or } x = 6\}$

10. $B \cap C = \{3, 5\}$

12. $A \cup C = \{x|x \text{ is an even integer or } x = 3 \text{ or } x = 5\}$

14. $x \le 0$ *and* $x \ge -2$

$-2 \le x \le 0$

$[-2, 0]$

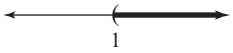
16. $x < 2$ *and* $x > 4$

$\varnothing$

18. $x \geq -4$ *and* $x > 1$

$x > 1$

$(1, \infty)$



20. $x + 2 \geq 3$ *and* $5x - 1 \geq 9$

$x \geq 1$ *and* $5x \geq 10$

$x \geq 2$

$x \geq 2$

$[2, \infty)$

22. $2x + 4 > 0$ *and* $4x > 0$

$2x > -4$ *and* $x > 0$

$x > -2$

$(0, \infty)$

24. $-7x \leq -21$ *and* $x - 20 \leq -15$

$x \geq 3$ *and* $x \leq 5$

$3 \leq x \leq 5$

$[3, 5]$

26. $-2 \leq x + 3 \leq 0$

$-5 \leq x \leq -3$

$[-5, -3]$

28. $1 < 4 + 2x < 7$

$1 - 4 < 4 + 2x - 4 < 7 - 4$

$-3 < 2x < 3$

$\frac{-3}{2} < x < \frac{3}{2}$

$\left(-\frac{3}{2}, \frac{3}{2}\right)$

30. $-2 < \frac{1}{2}x - 5 < 1$

$3 < \frac{1}{2}x < 6$

$6 < x < 12$

$(6, 12)$

32. $-4 \leq \frac{-2x + 5}{3} \leq 1$

$3(-4) \leq 3\left(\frac{-2x + 5}{3}\right) \leq 3(1)$

$-12 \leq -2x + 5 \leq 3$

$-17 \leq -2x \leq -2$

$\frac{17}{2} \geq x \geq 1$

$1 \leq x \leq \frac{17}{2}$

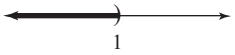
$\left[1, \frac{17}{2}\right]$

34. $x \geq -2$ *or* $x \leq 2$

$(-\infty, \infty)$

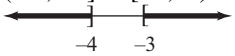
36. $x < 0$ *or* $x < 1$

$(-\infty, 1)$



38. $x \geq -3$ *or* $x \leq -4$

$(-\infty, -4] \cup [-3, \infty)$



40. $-5x \leq 10$ *or* $3x - 5 \geq 1$

$x \geq -2$ *or* $3x \geq 6$

$x \geq 2$

$x \geq -2$

$[-2, \infty)$

42. $x + 9 < 0$ *or* $4x > -12$

$x < -9$ *or* $x > -3$

$(-\infty, -9) \cup (-3, \infty)$

44. $5(x - 1) \geq -5$ *or* $5 + x \leq 11$

$x - 1 \geq -1$ *or* $x \leq 6$

$x \geq 0$

$(-\infty, \infty)$

46. $x < \frac{5}{7}$ *and* $x < 1$

$x < \frac{5}{7}$

$\left(-\infty, \frac{5}{7}\right)$

48. $x < \frac{5}{7}$ *or* $x < 1$

$x < 1$

$(-\infty, 1)$

50. $3 < 5x + 1 < 11$

$2 < 5x < 10$

$\frac{2}{5} < x < 2$

$\left(\frac{2}{5}, 2\right)$

52. $\frac{2}{3} < x + \frac{1}{2} < 4$

$6\left(\frac{2}{3}\right) < 6\left(x + \frac{1}{2}\right) < 6(4)$

$4 < 6x + 3 < 24$

$1 < 6x < 21$

$\frac{1}{6} < x < \frac{7}{2}$

$\left(\frac{1}{6}, \frac{7}{2}\right)$

54. $2x - 1 \geq 3$ *and* $-x > 2$

$2x \geq 4$ *and* $x < -2$

$x \geq 2$ *and* $x < -2$

$\varnothing$

56. $\frac{3}{8}x + 1 \leq 0$ *or* $-2x < -4$

$\frac{3}{8}x \leq -1$ *or* $x > 2$

$x \leq -\frac{8}{3}$ *or* $x > 2$

$\left(-\infty, -\frac{8}{3}\right] \cup (2, \infty)$

58. $-2 < \frac{-2x - 1}{3} < 2$

$3(-2) < 3\left(\frac{-2x - 1}{3}\right) < 3(2)$

$-6 < -2x - 1 < 6$

$-5 < -2x < 7$

$\frac{-5}{-2} > x > \frac{7}{-2}$

$-\frac{7}{2} < x < \frac{5}{2}$

$\left(-\frac{7}{2}, \frac{5}{2}\right)$

60. $-5 < 2(x + 4) < 8$

$-5 < 2x + 8 < 8$

$-13 < 2x < 0$

$-\frac{13}{2} < x < 0$

$\left(-\frac{13}{2}, 0\right)$

62. $5x \leq 0$ *and* $-x + 5 < 8$

$x \leq 0$ *and* $-x < 3$

$x \leq 0$ *and* $x > -3$

$(-3, 0]$

64. $-x < 7$ *or* $3x + 1 < -20$

$x > -7$ *or* $3x < -21$

$x > -7$ *or* $x < -7$

$(-\infty, -7) \cup (-7, \infty)$

66. $-2x < -6$ *or* $1 - x > -2$

$x > 3$ *or* $-x > -3$

$x > 3$ *or* $x < 3$

$(-\infty, 3) \cup (3, \infty)$

68. $-\frac{1}{2} \leq \frac{3x - 1}{10} < \frac{1}{2}$

$10\left(-\frac{1}{2}\right) \leq 10\left(\frac{3x - 1}{10}\right) < 10\left(\frac{1}{2}\right)$

$-5 \leq 3x - 1 < 5$

$-4 \leq 3x < 6$

$-\frac{4}{3} \leq x < 2$

$\left[-\frac{4}{3}, 2\right)$

70. $$-\frac{1}{4} < \frac{6-x}{12} < -\frac{1}{6}$$
$$12\left(-\frac{1}{4}\right) < 12\left(\frac{6-x}{12}\right) < 12\left(-\frac{1}{6}\right)$$
$$-3 < 6 - x < -2$$
$$-9 < -x < -8$$
$$9 > x > 8$$
(8, 9)

72. $$-0.7 \le 0.4x + 0.8 < 0.5$$
$$-1.5 \le 0.4x < -0.3$$
$$-3.75 \le x < -0.75$$
$[-3.75, -0.75)$

74. $|-7 - 19| = |-26| = 26$

76. $|-4| - (-4) + |-20| = 4 + 4 + 20 = 28$

78. $|x| = 5$
$x = -5, 5$

80. $|x| = -2$
$\varnothing$

82. From the graph, we see that the number of single-family housing starts were less than 500 or the number of single-family housing completions greater than 1500 are for the years 2004, 2005, 2006, 2009, 2010, and 2011.

84. answers may vary

86. $x + 3 < 2x + 1 < 4x + 6$
$x + 3 < 2x + 1$ *and* $2x + 1 < 4x + 6$
$2 < x$ *and* $-5 < 2x$
$x > 2$ *and* $-\frac{5}{2} < x$
$x > 2$ *and* $x > -\frac{5}{2}$
$(2, \infty)$

88. $7x - 1 \le 7 + 5x \le 3(1 + 2x)$
$7x - 1 \le 7 + 5x$ *and* $7 + 5x \le 3 + 6x$
$2x \le 8$ *and* $4 \le x$
$x \le 4$ *and* $x \ge 4$
$\{4\}$

90. $1 + 2x < 3(2 + x) < 1 + 4x$
$1 + 2x < 6 + 3x$ *and* $6 + 3x < 1 + 4x$
$-5 < x$ *and* $5 < x$
$x > -5$ *and* $x > 5$
$(5, \infty)$

92. $$-10 \le C \le 18$$
$$-10 \le \frac{5}{9}(F - 32) \le 18$$
$$\frac{9}{5}(-10) \le \frac{9}{5}\left(\frac{5}{9}(F - 32)\right) \le \frac{9}{5}(18)$$
$$-18 \le F - 32 \le \frac{162}{5}$$
$$14 \le F \le 64.4$$
$14° \le F \le 64.4°$

94. Let x be Wendy's grade on the final exam.
$$80 \le \frac{1}{6}(2x + 80 + 90 + 82 + 75) \le 89$$
$$480 \le 2x + 327 \le 534$$
$$153 \le 2x \le 207$$
$$76.5 \le x \le 103.5$$
$$76.5 \le x \le 100$$
If Wendy scores between 76.5 and 100 inclusive on her final exam, she will receive a B in the course.

Section 2.6 Practice Exercises

1. $|q| = 13$
$q = 13$ or $q = -13$
The solution set is $\{-13, 13\}$.

2. $|2x - 3| = 5$
$2x - 3 = 5$ or $2x - 3 = -5$
$2x = 8$ or $2x = -2$
$x = 4$ or $x = -1$
The solution set is $\{-1, 4\}$.

3. $\left|\frac{x}{5} + 1\right| = 15$
$\frac{x}{5} + 1 = 15$ or $\frac{x}{5} + 1 = -15$
$\frac{x}{5} = 14$ or $\frac{x}{5} = -16$
$x = 70$ or $x = -80$
The solutions are -80 and 70.

4. $|3x| + 8 = 14$
$|3x| = 6$
$3x = 6$ or $3x = -6$
$x = 2$ or $x = -2$
The solutions are -2 and 2.

5. $|z| = 0$
The solution is 0.

6. $3|z|+9=7$
$3|z|=-2$
$|z|=-\frac{2}{3}$
The absolute value of a number is never negative, so there is no solution. The solution set is { } or ∅.

7. $\left|\frac{5x+3}{4}\right|=-8$
The absolute value of a number is never negative, so there is no solution. The solution set is { } or ∅.

8. $|2x+4|=|3x-1|$
$2x+4=3x-1$ or $2x+4=-(3x-1)$
$-x+4=-1$ $2x+4=-3x+1$
$-x=-5$ $5x+4=1$
$x=5$ $5x=-3$
$x=-\frac{3}{5}$
The solutions are $-\frac{3}{5}$ and 5.

9. $|x-2|=|8-x|$
$x-2=8-x$ or $x-2=-(8-x)$
$2x-2=8$ $x-2=-8+x$
$2x=10$ $-2=-8$ False
$x=5$
The solution is 5.

Vocabulary, Readiness & Video Check 2.6

1. $|x-2|=5$
C. $x-2=5$ or $x-2=-5$

2. $|x-2|=0$
A. $x-2=0$

3. $|x-2|=|x+3|$
B. $x-2=x+3$ or $x-2=-(x+3)$

4. $|x+3|=5$
E. $x+3=5$ or $x+3=-5$

5. $|x+3|=-5$
D. ∅

6. If a is negative, $|X|=a$ has no solution. (Also, if a is 0, we solve $X=0$.)

Exercise Set 2.6

2. $|y|=15$
$y=-15$ or $y=15$

4. $|6n|=12.6$
$6n=12.6$ or $6n=-12.6$
$n=2.1$ or $n=-2.1$

6. $|6+2n|=4$
$6+2n=-4$ or $6+2n=4$
$2n=-10$ or $2n=-2$
$n=-5$ or $n=-1$

8. $\left|\frac{n}{3}+2\right|=4$
$\frac{n}{3}+2=-4$ or $\frac{n}{3}+2=4$
$\frac{n}{3}=-6$ or $\frac{n}{3}=2$
$n=-18$ or $n=6$

10. $|x|+1=3$
$|x|=2$
$x=-2$ or $x=2$

12. $|2x|-6=4$
$|2x|=10$
$2x=-10$ or $2x=10$
$x=-5$ or $x=5$

14. $|7z|=0$
$7z=0$
$z=0$

16. $|3z-2|+8=1$
$|3z-2|=-7$
which is impossible.
The solution set is ∅.

18. $|3y+2|=0$
$3y+2=0$
$3y=-2$
$y=-\frac{2}{3}$

20. $|9y+1|=|6y+4|$

$9y+1=-(6y+4)$ or $9y+1=6y+4$

$9y+1=-6y-4$ or $3y=3$

$15y=-5$ or $y=1$

$y=-\frac{1}{3}$ or $y=1$

22. $|2x-5|=|2x+5|$

$2x-5=-(2x+5)$ or $2x-5=2x+5$

$2x-5=-2x-5$ or $-5=5$

$4x=0$ or false

$x=0$

The only solution is 0.

24. $|x|=1$

$x=1$ or $x=-1$

26. $|y|=8$

$y=8$ or $y=-8$

28. The absolute value of any expression is never negative, so no solution exists. The solution set is $\varnothing$.

30. $|4m+5|=5$

$4m+5=5$ or $4m+5=-5$

$4m=0$ or $4m=-10$

$m=0$ or $m=-\frac{10}{4}$

$m=0$ or $m=-\frac{5}{2}$

32. $|7z|+1=22$

$|7z|=21$

$7z=21$ or $7z=-21$

$z=3$ or $z=-3$

34. The absolute value of any expression is never negative, so no solution exists. The solution set is $\varnothing$.

36. $|x+4|-4=1$

$|x+4|=5$

$x+4=5$ or $x+4=-5$

$x=1$ or $x=-9$

38. The absolute value of any expression is never negative, so no solution exists. The solution set is $\varnothing$.

40. The absolute value of any expression is never negative, so no solution exists. The solution set is $\varnothing$.

42. $|5x-2|=0$

$5x-2=0$

$5x=2$

$x=\frac{2}{5}$

44. $|2+3m|-9=-7$

$|2+3m|=2$

$2+3m=2$ or $2+3m=-2$

$3m=0$ or $3m=-4$

$m=0$ or $m=-\frac{4}{3}$

46. $|8-6c|=1$

$8-6c=1$ or $8-6c=-1$

$-6c=-7$ or $-6c=-9$

$c=\frac{-7}{-6}$ or $c=\frac{-9}{-6}$

$c=\frac{7}{6}$ or $c=\frac{3}{2}$

48. $|3x+5|=|-4|$

$|3x+5|=4$

$3x+5=4$ or $3x+5=-4$

$3x=-1$ or $3x=-9$

$x=-\frac{1}{3}$ or $x=-3$

50. $|3+6n|=|4n+11|$

$3+6n=4n+11$ or $3+6n=-(4n+11)$

$2n=8$ or $3+6n=-4n-11$

$n=4$ or $10n=-14$

$n=4$ or $n=-\frac{7}{5}$

52. $|4-5y|=-|-3|$

$|4-5y|=-3$

The absolute value of any expression is never negative, so no solution exists. The solution set is $\varnothing$.

54. $|4n+5| = |4n+3|$

$4n+5 = -(4n+3)$ or $4n+5 = 4n+3$

$4n+5 = -4n-3$ or $5 = 3$

$8n = -8$ or false

$n = -1$

The only solution is -1.

56. $\left|\frac{1+3n}{4}\right| = 4$

$\frac{1+3n}{4} = 4$ or $\frac{1+3n}{4} = -4$

$1+3n = 16$ or $1+3n = -16$

$3n = 15$ or $3n = -17$

$n = 5$ or $n = -\frac{17}{3}$

58. $8 + |4m| = 24$

$|4m| = 16$

$4m = 16$ or $4m = -16$

$m = 4$ or $m = -4$

60. $\left|\frac{5x+2}{2}\right| = |-6|$

$\left|\frac{5x+2}{2}\right| = 6$

$\frac{5x+2}{2} = 6$ or $\frac{5x+2}{2} = -6$

$5x+2 = 12$ or $5x+2 = -12$

$5x = 10$ or $5x = -14$

$x = 2$ or $x = -\frac{14}{5}$

62. $|5z-1| = |7-z|$

$5z-1 = -(7-z)$ or $5z-1 = 7-z$

$5z-1 = -7+z$ or $6z = 8$

$4z = -6$ or $z = \frac{4}{3}$

$z = -\frac{3}{2}$

64. $\left|\frac{2r-6}{5}\right| = |-2|$

$\left|\frac{2r-6}{5}\right| = 2$

$\frac{2r-6}{5} = 2$ or $\frac{2r-6}{5} = -2$

$2r-6 = 10$ or $2r-6 = -10$

$2r = 16$ or $2r = -4$

$r = 8$ or $r = -2$

66. $|8-y| = |y+2|$

$8-y = -(y+2)$ or $8-y = y+2$

$8-y = -y-2$ or $6 = 2y$

$8 = -2$ or $3 = y$

false or $3 = y$

The only solution is 3.

68. $\left|\frac{5d+1}{6}\right| = -|-9|$

$\left|\frac{5d+1}{6}\right| = -9$

The absolute value of any expression is never negative, so no solution exists. The solution set is $\varnothing$.

70. From the circle graph, mozzarella cheese had the highest U.S. production in 2014.

72. In 2014, cream cheese accounted for 7.6% of the total cheese production.
7.6% of 11,201,000,000 is
0.076(11,201,000,000) = 851,276,000
Therefore, 851,276,000 pounds of cream cheese was produced in the U.S. in 2014.

74. answers may vary

76. no solution

78. Since absolute value is never negative, the solution set is $\varnothing$.

80. All numbers whose distance from 0 is 2 units is written as $|x| = 2$.

82. answers may vary

84. $|x-7| = 2$

86. answers may vary

88. $|2x-1| = 4$

90. $|ax + b| = c$

a. one solution if $c = 0$

b. no solution if c is a negative number

c. two solutions if c is a positive number

Section 2.7 Practice Exercises

1. $|x| < 5$

The solution set of this inequality contains all numbers whose distance from 0 is less than 5.

The solution set is $(-5, 5)$.

2. $|b + 1| < 3$

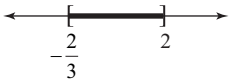
$$-3 < b+1 < 3$$
$$-3-1 < b+1-1 < 3-1$$
$$-4 < b < 2$$

$(-4, 2)$

3. $|3x-2|+5 \le 9$

$$|3x-2| \le 9-5$$
$$|3x-2| \le 4$$
$$-4 \le 3x-2 \le 4$$
$$-4+2 \le 3x-2+2 \le 4+2$$
$$-2 \le 3x \le 6$$
$$-\frac{2}{3} \le x \le 2$$

$\left[-\frac{2}{3}, 2\right]$



4. $\left|3x+\frac{5}{8}\right| < -4$

The absolute value of a number is always nonnegative and can never be less than –4. The solution set is { } or $\varnothing$.

5. $\left|\frac{3(x-2)}{5}\right| \le 0$

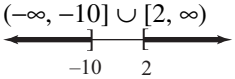
$$\frac{3(x-2)}{5} = 0$$
$$5\left[\frac{3(x-2)}{5}\right] = 5(0)$$
$$3(x-2) = 0$$
$$3x-6 = 0$$
$$3x = 6$$
$$x = 2$$

The solution set is $\{2\}$.

6. $|y + 4| \ge 6$

$$y+4 \le -6 \quad \text{or} \quad y+4 \ge 6$$
$$y+4-4 \le -6-4 \quad \text{or} \quad y+4-4 \ge 6-4$$
$$y \le -10 \quad \text{or} \quad y \ge 2$$

$(-\infty, -10] \cup [2, \infty)$



7. $|4x+3|+5 > 3$

$$|4x+3|+5-5 > 3-5$$
$$|4x+3| > -2$$

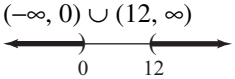
The absolute value of any number is always nonnegative and thus is always greater than –2.

$(-\infty, \infty)$

8. $\left|\frac{x}{2}-3\right|-5 > -2$

$$\left|\frac{x}{2}-3\right|-5+5 > -2+5$$
$$\left|\frac{x}{2}-3\right| > 3$$
$$\frac{x}{2}-3 < -3 \quad \text{or} \quad \frac{x}{2}-3 > 3$$
$$2\left(\frac{x}{2}-3\right) < 2(-3) \quad \text{or} \quad 2\left(\frac{x}{2}-3\right) > 2(3)$$
$$x-6 < -6 \quad \text{or} \quad x-6 > 6$$
$$x < 0 \quad \text{or} \quad x > 12$$

$(-\infty, 0) \cup (12, \infty)$



Vocabulary, Readiness & Video Check 2.7

1. D

2. E

3. C

4. B

5. A

6. The left side of the inequality is an absolute value, which must be nonnegative—it must be 0 or positive. Therefore, there is no value of x that can make the value of this absolute value be less than the negative value on the right side of the inequality.

7. The solution set involves "or" and "or" means "union."

Exercise Set 2.7

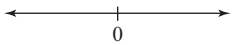
2. $|x| < 6$
$-6 < x < 6$
The solution set is $(-6, 6)$.


4. $|y - 7| \le 5$
$-5 \le y - 7 \le 5$
$2 \le y \le 12$
The solution set is $[2, 12]$.

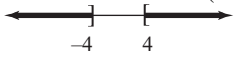

6. $|x + 4| < 6$
$-6 < x + 4 < 6$
$-10 < x < 2$
The solution set is $(-10, 2)$.

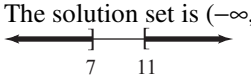

8. $|5x - 3| \le 18$
$-18 \le 5x - 3 \le 18$
$-15 \le 5x \le 21$
$-3 \le x \le \frac{21}{5}$
The solution set is $\left[-3, \frac{21}{5}\right]$.


10. $|x| + 6 \le 7$
$|x| \le 1$
$-1 \le x \le 1$
The solution set is $[-1, 1]$.

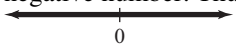

12. $|8x - 3| < -2$
The absolute value of an expression is never negative, so no solution exists. The solution set is $\varnothing$.


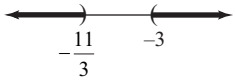
14. $|z + 2| - 7 < -3$
$|z + 2| < 4$
$-4 < z + 2 < 4$
$-4 - 2 < z + 2 - 2 < 4 - 2$
$-6 < z < 2$
The solution set is $(-6, 2)$.


16. $|y| \ge 4$
$y \le -4$ or $y \ge 4$
The solution set is $(-\infty, -4] \cup [4, \infty)$.


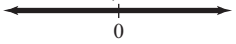
18. $|x - 9| \ge 2$
$x - 9 \le -2$ or $x - 9 \ge 2$
$x \le 7$ or $x \ge 11$
The solution set is $(-\infty, 7] \cup [11, \infty)$.


20. $|x| - 1 > 3$
$|x| > 4$
$x < -4$ or $x > 4$
The solution set is $(-\infty, -4) \cup (4, \infty)$.

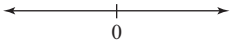

22. $|4x - 11| > -1$
An absolute value is always greater than a negative number. Thus, the answer is $(-\infty, \infty)$.


24. $|10 + 3x| + 1 > 2$
$|10 + 3x| > 1$
$10 + 3x < -1$ or $10 + 3x > 1$
$3x < -11$ or $3x > -9$
$x < -\frac{11}{3}$ or $x > -3$
The solution set is $\left(-\infty, -\frac{11}{3}\right) \cup (-3, \infty)$.


26. $|x| \geq 0$
An absolute value is always greater than or equal to 0. Thus, the answer is $(-\infty, \infty)$.

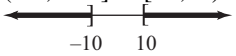


28. $|5x - 6| < 0$
The absolute value of an expression is never negative, so no solution exists. The solution set is $\varnothing$.



30. $|z| < 8$
$-8 < z < 8$
$(-8, 8)$

32. $|x| \geq 10$
$x \leq -10$ or $x \geq 10$
$(-\infty, -10] \cup [10, \infty)$

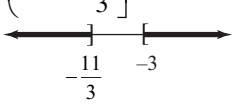


34. $|-3 + x| \leq 10$
$-10 \leq -3 + x \leq 10$
$-7 \leq x \leq 13$
$[-7, 13]$

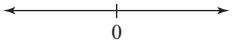
36. $|1 + 0.3x| \geq 0.1$

$$1 + 0.3x \leq -0.1 \quad \text{or} \quad 1 + 0.3x \geq 0.1$$
$$0.3x \leq -1.1 \quad \text{or} \quad 0.3x \geq -0.9$$
$$\frac{0.3x}{0.3} \leq -\frac{1.1}{0.3} \quad \text{or} \quad \frac{0.3x}{0.3} \geq -\frac{0.9}{0.3}$$
$$x \leq -\frac{11}{3} \quad \text{or} \quad x \geq -3$$

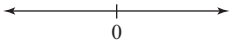
$\left(-\infty, -\frac{11}{3}\right] \cup [-3, \infty)$



38. $8 + |x| < 1$
$|x| < -7$
An absolute value is never negative, so no solution exists. The solution set is $\varnothing$.



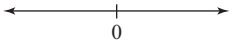
40. $|x| \leq -7$
An absolute value is never negative, so no solution exists. The solution set is $\varnothing$.



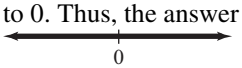
42. $|5x + 2| < 8$
$-8 < 5x + 2 < 8$
$-10 < 5x < 6$
$-2 < x < \frac{6}{5}$
The solution set is $\left(-2, \frac{6}{5}\right)$.

44. $|-1 + x| - 6 > 2$
$|-1 + x| - 6 + 6 > 2 + 6$
$|-1 + x| > 8$
$-1 + x < -8$ or $-1 + x > 8$
$x < -7$ or $x > 9$
$(-\infty, -7) \cup (9, \infty)$

46. $|x| < 0$
An absolute value is never negative, so no solution exists. The solution set is $\varnothing$.



48. $5 + |x| \geq 4$
$|x| \geq -1$
An absolute value is always greater than or equal to 0. Thus, the answer is $(-\infty, \infty)$.



50. $-3 + |5x - 2| \leq 4$
$|5x - 2| \leq 7$
$-7 \leq 5x - 2 \leq 7$
$-5 \leq 5x \leq 9$
$-1 \leq x \leq \frac{9}{5}$
The solution set is $\left[-1, \frac{9}{5}\right]$.

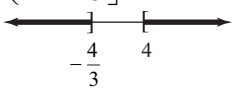
52. $\left|\frac{3}{4}x-1\right| \geq 2$

$\frac{3}{4}x-1 \leq -2 \quad \text{or} \quad \frac{3}{4}x-1 \geq 2$

$\frac{3}{4}x \leq -1 \quad \text{or} \quad \frac{3}{4}x \geq 3$

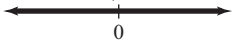
$x \leq -\frac{4}{3} \quad \text{or} \quad x \geq 4$

$\left(-\infty, -\frac{4}{3}\right] \cup [4, \infty)$



54. $|4 + 9x| \geq -6$

An absolute value is always greater than or equal to 0. Thus, the answer is $(-\infty, \infty)$.



56. $\left|\frac{5x+6}{2}\right| \leq 0$

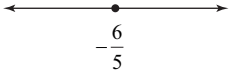
$\frac{5x+6}{2} = 0$

$5x+6 = 0$

$5x = -6$

$x = -\frac{6}{5}$

$\left\{-\frac{6}{5}\right\}$



58. $|7x-3|-1 \leq 10$

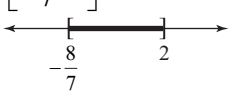
$|7x-3| \leq 11$

$-11 \leq 7x-3 \leq 11$

$-8 \leq 7x \leq 14$

$-\frac{8}{7} \leq x \leq 2$

$\left[-\frac{8}{7}, 2\right]$



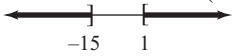
60. $\left|\frac{7+x}{2}\right| \geq 4$

$\frac{7+x}{2} \leq -4 \quad \text{or} \quad \frac{7+x}{2} \geq 4$

$7+x \leq -8 \quad \text{or} \quad 7+x \geq 8$

$x \leq -15 \quad \text{or} \quad x \geq 1$

The solution set is $(-\infty, -15] \cup (1, \infty]$.



62. $-9+|3+4x| < -4$

$-9+|3+4x|+9 < -4+9$

$|3+4x| < 5$

$-5 < 3+4x < 5$

$-8 < 4x < 2$

$-2 < x < \frac{2}{4}$

$-2 < x < \frac{1}{2}$

$\left(-2, \frac{1}{2}\right)$

64. $\left|\frac{3}{5}+4x\right|-6 < -1$

$\left|\frac{3}{5}+4x\right| < 5$

$-5 < \frac{3}{5}+4x < 5$

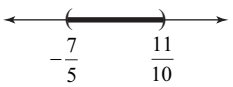
$-25 < 3+20x < 25$

$-28 < 20x < 22$

$-\frac{28}{20} < \frac{20x}{20} < \frac{22}{20}$

$-\frac{7}{5} < x < \frac{11}{10}$

$\left(-\frac{7}{5}, \frac{11}{10}\right)$



66. $|2x-3| > 7$

$2x-3 < -7 \quad \text{or} \quad 2x-3 > 7$

$2x < -4 \quad \text{or} \quad 2x > 10$

$x < -2 \quad \text{or} \quad x > 5$

$(-\infty, -2) \cup (5, \infty)$

68. $|5 - 6x| = 29$

$5 - 6x = -29$ or $5 - 6x = 29$

$-6x = -34$ or $-6x = 24$

$x = \frac{17}{3}$ or $x = -4$

70. $|x + 4| \geq 20$

$x + 4 \leq -20$ or $x + 4 \geq 20$

$x \leq -24$ or $x \geq 16$

The solution set is $(-\infty, -24] \cup [16, \infty)$.

72. $|9 + 4x| \geq 0$

An absolute value is always greater than or equal to 0. Thus, the answer is $(-\infty, \infty)$.

74. $8 + |5x - 3| \geq 11$

$|5x - 3| \geq 3$

$5x - 3 \leq -3$ or $5x - 3 \geq 3$

$5x \leq 0$ or $5x \geq 6$

$x \leq 0$ or $x \geq \frac{6}{5}$

The solution set is $(-\infty, 0] \cup \left[\frac{6}{5}, \infty\right)$.

76. $|5x - 3| + 2 = 4$

$|5x - 3| = 2$

$5x - 3 = -2$ or $5x - 3 = 2$

$5x = 1$ or $5x = 5$

$x = \frac{1}{5}$ or $x = 1$

78. $|4x - 4| = -3$

An absolute value is never negative, so no solution exists. The solution set is $\varnothing$.

80. $\left|\frac{6 - x}{4}\right| = 5$

$\frac{6 - x}{4} = -5$ or $\frac{6 - x}{4} = 5$

$6 - x = -20$ or $6 - x = 20$

$26 = x$ or $-14 = x$

82. $\left|\frac{4x - 7}{5}\right| < 2$

$-2 < \frac{4x - 7}{5} < 2$

$-10 < 4x - 7 < 10$

$-3 < 4x < 17$

$-\frac{3}{4} < x < \frac{17}{4}$

The solution set is $\left(-\frac{3}{4}, \frac{17}{4}\right)$.

84. $P(\text{rolling a } 5) = \frac{1}{6}$

86. $P(\text{rolling a } 0) = 0$

88. $P(\text{rolling a 1, 2, 3, 4, 5, or 6}) = 1$

90. $3x - 4y = 12$

$3x - 4(-1) = 12$

$3x + 4 = 12$

$3x = 8$

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

92. $3x - 4y = 12$

$3(4) - 4y = 12$

$12 - 4y = 12$

$-4y = 0$

$y = 0$

94. $|x| > 4$

96. $|x| > 1$

98. answers may vary

100. $\left|0.2 - \frac{51}{256}\right| = |0.2 - 0.19921875|$

$= |0.00078125|$

$= 0.00078125$

The absolute error is 0.00078125.

Chapter 2 Vocabulary Check

1. The statement "$x < 5$ *or* $x > 7$" is called a compound inequality.

2. An equation in one variable that has no solution is called a contradiction.

3. The intersection of two sets is the set of all elements common to both sets.

4. The union of two sets is the set of all elements that belong to either of the sets.

5. An equation in one variable that has every number (for which the equation is defined) as a solution is called an identity.

6. The equation $d = rt$ is also called a formula.

7. A number's distance from 0 is called its absolute value.

8. When a variable in an equation is replaced by a number and the resulting equation is true, then that number is called a solution of the equation.

9. The integers 17, 18, 19 are examples of consecutive integers.

10. The statement $5x - 0.2 < 7$ is an example of a linear inequality in one variable.

11. The statement $5x - 0.2 = 7$ is an example of a linear equation in one variable.

Chapter 2 Review

1.
$$\begin{aligned} 4(x-5) &= 2x-14 \\ 4x-20 &= 2x-14 \\ 2x &= 6 \\ x &= 3 \end{aligned}$$

2.
$$\begin{aligned} x+7 &= -2(x+8) \\ x+7 &= -2x-16 \\ 3x &= -23 \\ x &= -\frac{23}{3} \end{aligned}$$

3.
$$\begin{aligned} 3(2y-1) &= -8(6+y) \\ 6y-3 &= -48-8y \\ 14y &= -45 \\ y &= -\frac{45}{14} \end{aligned}$$

4.
$$\begin{aligned} -(z+12) &= 5(2z-1) \\ -z-12 &= 10z-5 \\ -11z &= 7 \\ z &= -\frac{7}{11} \end{aligned}$$

5.
$$\begin{aligned} n-(8+4n) &= 2(3n-4) \\ n-8-4n &= 6n-8 \\ -3n &= 6n \\ -9n &= 0 \\ n &= 0 \end{aligned}$$

6.
$$\begin{aligned} 4(9v+2) &= 6(1+6v)-10 \\ 36v+8 &= 6+36v-10 \\ 36v+8 &= 36v-4 \\ 8 &= -4 \end{aligned}$$
No solution, or $\varnothing$

7.
$$\begin{aligned} 0.3(x-2) &= 1.2 \\ 10[0.3(x-2)] &= 10(1.2) \\ 3(x-2) &= 12 \\ 3x-6 &= 12 \\ 3x &= 18 \\ x &= 6 \end{aligned}$$

8.
$$\begin{aligned} 1.5 &= 0.2(c-0.3) \\ 1.5 &= 0.2c-0.06 \\ 100(1.5) &= 100(0.2c-0.06) \\ 150 &= 20c-6 \\ 156 &= 20c \\ 7.8 &= c \end{aligned}$$

9.
$$\begin{aligned} -4(2-3x) &= 2(3x-4)+6x \\ -8+12x &= 6x-8+6x \\ -8+12x &= 12x-8 \\ -8 &= -8 \end{aligned}$$
All real numbers

10.
$$\begin{aligned} 6(m-1)+3(2-m) &= 0 \\ 6m-6+6-3m &= 0 \\ 3m &= 0 \\ m &= 0 \end{aligned}$$

11.
$$\begin{aligned} 6-3(2g+4)-4g &= 5(1-2g) \\ 6-6g-12-4g &= 5-10g \\ -6-10g &= 5-10g \\ -6 &= 5 \end{aligned}$$
No solution, $\varnothing$

12.
$$\begin{aligned} 20-5(p+1)+3p &= -(2p-15) \\ 20-5p-5+3p &= -2p+15 \\ 15-2p &= -2p+15 \\ 15 &= 15 \end{aligned}$$
All real numbers

13. $\frac{x}{3}-4=x-2$

$3\left(\frac{x}{3}-4\right)=3(x-2)$

$x-12=3x-6$

$-2x=6$

$x=-3$

14. $\frac{9}{4}y=\frac{2}{3}y$

$12\left(\frac{9}{4}y\right)=12\left(\frac{2}{3}y\right)$

$27y=8y$

$19y=0$

$y=0$

15. $\frac{3n}{8}-1=3+\frac{n}{6}$

$24\left(\frac{3n}{8}-1\right)=24\left(3+\frac{n}{6}\right)$

$9n-24=72+4n$

$5n=96$

$n=\frac{96}{5}$

16. $\frac{z}{6}+1=\frac{z}{2}+2$

$6\left(\frac{z}{6}+1\right)=6\left(\frac{z}{2}+2\right)$

$z+6=3z+12$

$-2z=6$

$z=-3$

17. $\frac{y}{4}-\frac{y}{2}=-8$

$4\left(\frac{y}{4}-\frac{y}{2}\right)=4(-8)$

$y-2y=-32$

$-y=-32$

$y=32$

18. $\frac{2x}{3}-\frac{8}{3}=x$

$2x-8=3x$

$-8=x$

19. $\frac{b-2}{3}=\frac{b+2}{5}$

$5(b-2)=3(b+2)$

$5b-10=3b+6$

$2b=16$

$b=8$

20. $\frac{2t-1}{3}=\frac{3t+2}{15}$

$15\left(\frac{2t-1}{3}\right)=15\left(\frac{3t+2}{15}\right)$

$5(2t-1)=3t+2$

$10t-5=3t+2$

$7t=7$

$t=1$

21. $\frac{2(t+1)}{3}=\frac{2(t-1)}{3}$

$3\left[\frac{2(t+1)}{3}\right]=3\left[\frac{2(t-1)}{3}\right]$

$2(t+1)=2(t-1)$

$2t+2=2t-2$

$2=-2$

No solution, $\varnothing$

22. $\frac{3a-3}{6}=\frac{4a+1}{15}+2$

$30\left(\frac{3a-3}{6}\right)=30\left(\frac{4a+1}{15}+2\right)$

$5(3a-3)=2(4a+1)+30(2)$

$15a-15=8a+2+60$

$15a-15=8a+62$

$7a=77$

$a=11$

23. Let x = the number.

$2(x-3)=3x+1$

$2x-6=3x+1$

$-7=x$

The number is -7.

24. Let x = smaller number, then

$x+5$ = larger number.

$x+x+5=285$

$2x=280$

$x=140$

$x+5=145$

The numbers are 140 and 145.

25. $40\%\cdot 130=0.40\cdot 130=52$

26. $1.5\% \cdot 8 = 0.015 \cdot 8 = 0.12$

27. Let x = width of the playing field, then
$2x - 5$ = length of the playing field.
$$2x + 2(2x - 5) = 230$$
$$2x + 4x - 10 = 230$$
$$6x = 240$$
$$x = 40$$
Then $2x - 5 = 2(40) - 5 = 75$. The field is 75 meters long and 40 meters wide.

28. Let x be the median weekly earnings for a young adult with an associate's degree in 2013.
$$x + 0.43x = 1108$$
$$1.43x = 1108$$
$$x \approx 775$$
The median weekly earnings for a young adult with an associate's degree in 2013 was \$775.

29. Let n = the first integer, then
$n + 1$ = the second integer,
$n + 2$ = the third integer, and
$n + 3$ = the fourth integer.
$$(n+1) + (n+2) + (n+3) - 2n = 16$$
$$n + 6 = 16$$
$$n = 10$$
Therefore, the integers are 10, 11, 12, and 13.

30. Let x = smaller odd integer, then
$x + 2$ = larger odd integer.
$$5x = 3(x+2) + 54$$
$$5x = 3x + 6 + 54$$
$$2x = 60$$
$$x = 30$$
Since this is not odd, no such consecutive odd integers exist.

31. Let m = number of miles of driven.
$$2(19.95) + 0.12(m - 200) = 46.86$$
$$39.90 + 0.12m - 24 = 46.86$$
$$0.12m + 15.90 = 46.86$$
$$0.12m = 30.96$$
$$m = 258$$
He drove 258 miles.

32. Solve $R = C$.
$$16.50x = 4.50x + 3000$$
$$12x = 3000$$
$$x = 250$$
Thus, 250 calculators must be produced and sold in order to break even.

33. $V = lwh$
$$w = \frac{V}{lh}$$

34. $C = 2\pi r$
$$\frac{C}{2\pi} = r$$

35. $5x - 4y = -12$
$$5x + 12 = 4y$$
$$y = \frac{5x + 12}{4}$$

36. $5x - 4y = -12$
$$5x = 4y - 12$$
$$x = \frac{4y - 12}{5}$$

37. $y - y_1 = m(x - x_1)$
$$m = \frac{y - y_1}{x - x_1}$$

38. $y - y_1 = m(x - x_1)$
$$y - y_1 = mx - mx_1$$
$$y - y_1 + mx_1 = mx$$
$$\frac{y - y_1 + mx_1}{m} = x$$

39. $E = I(R + r)$
$$E = IR + Ir$$
$$I - IR = Ir$$
$$\frac{E - IR}{I} = r$$

40. $S = vt + gt^2$
$$S - vt = gt^2$$
$$\frac{S - vt}{t^2} = g$$

41. $T = gr + gvt$
$$T = g(r + vt)$$
$$g = \frac{T}{r + vt}$$

42. $I = Prt + P$
$$I = P(rt + 1)$$
$$\frac{I}{rt + 1} = P$$

43. $A = P\left(1+\frac{r}{n}\right)^{nt} = 3000\left(1+\frac{0.03}{n}\right)^{7n}$

a. $A = 3000\left(1+\frac{0.03}{2}\right)^{14} \approx \$3695.27$

b. $A = 3000\left(1+\frac{0.03}{52}\right)^{364} \approx \$3700.81$

44. $C = \frac{5}{9}(F-32)$

$C = \frac{5}{9}(90-32)$

$C = \frac{5}{9}(58)$

$C = \frac{290}{9} \approx 32.2$

90°F is $\left(\frac{290}{9}\right)$°C ≈ 32.2°C.

45. Let x = original width, then
$x + 2$ = original length.

$(x+4)(x+2+4) = x(x+2)+88$

$(x+4)(x+6) = x^2+2x+88$

$x^2+10x+24 = x^2+2x+88$

$8x = 64$

$x = 8$

$x + 2 = 10$

The original width is 8 in. and the original length is 10 in.

46. Area $= 18\times 21 = 378$ ft^2

Packages $= \frac{378}{24} = 15.75$

There are 16 packages needed.

47. $3(x-5) > -(x+3)$

$3x-15 > -x-3$

$4x > 12$

$x > 3$

$(3, \infty)$

48. $-2(x+7) \ge 3(x+2)$

$-2x-14 \ge 3x+6$

$-5x \ge 20$

$x \le -4$

$(-\infty, -4]$

49. $4x-(5+2x) < 3x-1$

$4x-5-2x < 3x-1$

$2x-5 < 3x-1$

$-x < 4$

$x > -4$

$(-4, \infty)$

50. $3(x-8) < 7x+2(5-x)$

$3x-24 < 7x+10-2x$

$3x-24 < 5x+10$

$-2x < 34$

$x > -17$

$(-17, \infty)$

51. $24 \ge 6x-2(3x-5)+2x$

$24 \ge 6x-6x+10+2x$

$24 \ge 10+2x$

$14 \ge 2x$

$7 \ge x$

$(-\infty, 7]$

52. $\frac{x}{3}+\frac{1}{2} > \frac{2}{3}$

$6\left(\frac{x}{3}+\frac{1}{2}\right) > 6\left(\frac{2}{3}\right)$

$2x+3 > 4$

$2x > 1$

$x > \frac{1}{2}$

$\left(\frac{1}{2}, \infty\right)$

53. $x+\frac{3}{4} < -\frac{x}{2}+\frac{9}{4}$

$4\left(x+\frac{3}{4}\right) < 4\left(-\frac{x}{2}+\frac{9}{4}\right)$

$4x+3 < -2x+9$

$6x < 6$

$x < 1$

$(-\infty, 1)$

54. $\frac{x-5}{2} \le \frac{3}{8}(2x+6)$

$8\left(\frac{x-5}{2}\right) \le 8\left[\frac{3}{8}(2x+6)\right]$

$4(x-5) \le 3(2x+6)$

$4x-20 \le 6x+18$

$-2x \le 38$

$x \ge -19$

$[-19, \infty)$

55. Let n = number of pounds of laundry.
$15 < 0.5(10) + 0.4(n - 10)$
$15 < 5 + 0.4n - 4$
$15 < 1 + 0.4n$
$14 < 0.4n$
$35 < n$
It is more economical to use the housekeeper for more than 35 pounds of laundry per week.

56. Let x = the score from the last judge.
$$\frac{9.5 + 9.7 + 9.9 + 9.7 + 9.7 + 9.6 + 9.5 + x}{8} \geq 9.65$$
$$67.6 + x \geq 77.2$$
$$x \geq 9.6$$
The last judge must give Nana at least a 9.6 for her to win the silver medal.

57. $1 \leq 4x - 7 \leq 3$
$8 \leq 4x \leq 10$
$2 \leq x \leq \frac{5}{2}$
$\left[2, \frac{5}{2}\right]$

58. $-2 \leq 8 + 5x < -1$
$-10 \leq 5x \leq -9$
$-2 \leq x \leq -\frac{9}{5}$
$\left[-2, \frac{9}{5}\right)$

59. $-3 < 4(2x - 1) < 12$
$-3 < 8x - 4 < 12$
$1 < 8x < 16$
$\frac{1}{8} < x < 2$
$\left(\frac{1}{8}, 2\right)$

60. $-6 < x - (3 - 4x) < -3$
$-6 < x - 3 + 4x < -3$
$-6 < 5x - 3 < -3$
$-3 < 5x < 0$
$-\frac{3}{5} < x < 0$
$\left(-\frac{3}{5}, 0\right)$

61. $\frac{1}{6} < \frac{4x - 3}{3} \leq \frac{4}{5}$
$30\left(\frac{1}{6}\right) < 30\left(\frac{4x - 3}{3}\right) \leq 30\left(\frac{4}{5}\right)$
$5 < 10(4x - 3) \leq 24$
$5 < 40x - 30 \leq 24$
$35 < 40x < 54$
$\frac{7}{8} < x \leq \frac{27}{20}$
$\left(\frac{7}{8}, \frac{27}{20}\right]$

62. $x \leq 2$ *and* $x > -5$
$-5 < x \leq 2$
$(-5, 2]$

63. $3x - 5 > 6$ *or* $-x < -5$
$3x > 11$ *or* $x > 5$
$x > \frac{11}{3}$ *or* $x > 5$
$x > \frac{11}{3}$
$\left(\frac{11}{3}, \infty\right)$

64. $500 \leq F \leq 1000$
$500 \leq \frac{9}{5}C + 32 \leq 1000$
$468 \leq \frac{9}{5}C \leq 968$
$260 \leq C \leq 538$
Rounded to the nearest degree, firing temperatures range from 260°C to 538°C.

65. Let x = the amount saved each summer.
$4000 \leq 2x + 500 \leq 8000$
$3500 \leq 2x \leq 7500$
$1750 \leq x \leq 3750$
She must save between \$1750 and \$3750 each summer.

66. $|x - 7| = 9$
$x - 7 = 9$ or $x - 7 = -9$
$x = 16$ or $x = -2$

67. $|8 - x| = 3$
$8 - x = 3$ or $8 - x = -3$
$-x = -5$ or $-x = -11$
$x = 5$ or $x = 11$

68. $|2x + 9| = 9$

$2x + 9 = 9$ or $2x + 9 = -9$

$2x = 0$ or $2x = -18$

$x = 0$ or $x = -9$

69. $|-3x + 4| = 7$

$-3x + 4 = 7$ or $-3x + 4 = -7$

$-3x = 3$ or $-3x = -11$

$x = -1$ or $x = \frac{11}{3}$

70. $|3x - 2| + 6 = 10$

$|3x - 2| = 4$

$3x - 2 = 4$ or $3x - 2 = -4$

$3x = 6$ or $3x = -2$

$x = 2$ or $x = -\frac{2}{3}$

71. $5 + |6x + 1| = 5$

$|6x + 1| = 0$

$6x + 1 = 0$

$6x = -1$

$x = -\frac{1}{6}$

72. $-5 = |4x - 3|$

The solution set is $\varnothing$.

73. $|5 - 6x| + 8 = 3$

$|5 - 6x| = -5$

The solution set is $\varnothing$.

74. $-8 = |x - 3| - 10$

$2 = |x - 3|$

$x - 3 = 2$ or $x - 3 = -2$

$x = 5$ or $x = 1$

75. $\left|\frac{3x - 7}{4}\right| = 2$

$\frac{3x - 7}{4} = 2$ or $\frac{3x - 7}{4} = -2$

$3x - 7 = 8$ or $3x - 7 = -8$

$3x = 15$ or $3x = -1$

$x = 5$ or $x = -\frac{1}{3}$

76. $|6x + 1| = |15 + 4x|$

$6x + 1 = 15 + 4x$ or $6x + 1 = -(15 + 4x)$

$2x = 14$ or $6x + 1 = -15 - 4x$

$x = 7$ or $10x = -16$

$x = -\frac{8}{5}$

77. $|5x - 1| < 9$

$-9 < 5x - 1 < 9$

$-8 < 5x < 10$

$-\frac{8}{5} < x < 2$

$\left(-\frac{8}{5}, 2\right)$

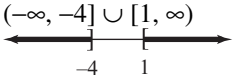
78. $|6 + 4x| \geq 10$

$6 + 4x \leq -10$ or $6 + 4x \geq 10$

$4x \leq -16$ or $4x \geq 4$

$x \leq -4$ or $x \geq 1$

$(-\infty, -4] \cup [1, \infty)$



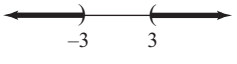
79. $|3x| - 8 > 1$

$|3x| > 9$

$3x < -9$ or $3x > 9$

$x < -3$ or $x > 3$

$(-\infty, -3) \cup (3, \infty)$



80. $9 + |5x| < 24$

$|5x| < 15$

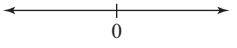
$-15 < 5x < 15$

$-3 < x < 3$

$(-3, 3)$

81. $|6x - 5| \leq -1$

The solution set is $\varnothing$.



82. $\left|3x+\frac{2}{5}\right| \ge 4$

$3x+\frac{2}{5} \le -4$ or $3x+\frac{2}{5} \ge 4$

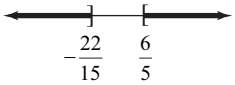
$5\left(3x+\frac{2}{5}\right) \le 5(-4)$ or $5\left(3x+\frac{2}{5}\right) \ge 5(4)$

$15x+2 \le -20$ or $15x+2 \ge 20$

$15x \le -22$ or $15x \ge 18$

$x \le -\frac{22}{15}$ or $x \ge \frac{6}{5}$

$\left(-\infty, -\frac{22}{15}\right] \cup \left[\frac{6}{5}, \infty\right)$



83. $\left|\frac{x}{3}+6\right|-8 > -5$

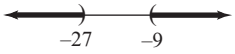
$\left|\frac{x}{3}+6\right| > 3$

$\frac{x}{3}+6 < -3$ or $\frac{x}{3}+6 > 3$

$\frac{x}{3} < -9$ or $\frac{x}{3} > -3$

$x < -27$ or $x > -9$

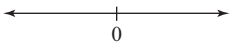
$(-\infty, -27) \cup (-9, \infty)$



84. $\left|\frac{4(x-1)}{7}\right|+10 < 2$

$\left|\frac{4(x-1)}{7}\right| < -8$

The solution set is $\varnothing$.



85. $\frac{x-2}{5}+\frac{x+2}{2}=\frac{x+4}{3}$

$30\left(\frac{x-2}{5}+\frac{x+2}{2}\right)=30\left(\frac{x+4}{3}\right)$

$6(x-2)+15(x+2)=10(x+4)$

$6x-12+15x+30=10x+40$

$21x+18=10x+40$

$11x=22$

$x=2$

86. $\frac{2z-3}{4}-\frac{4-z}{2}=\frac{z+1}{3}$

$12\left(\frac{2z-3}{4}-\frac{4-z}{2}\right)=12\left(\frac{z+1}{3}\right)$

$3(2z-3)-6(4-z)=4(z+1)$

$6z-9-24+6z=4z+4$

$12z-33=4z+4$

$8z=37$

$z=\frac{37}{8}$

87. $A=\frac{h}{2}(B+b)$

$2A=hB+hb$

$2A-hb=hB$

$\frac{2A-hb}{h}=B$

88. $V=\frac{1}{3}\pi r^2 h$

$3V=\pi r^2 h$

$\frac{3V}{\pi r^2}=h$

89. Let x = number of tourists for France, then
$x+9$ = number of tourists for United States, and
$x+44$ = number of tourists for China.

$x+(x+9)+(x+44)=332$

$3x+53=332$

$3x=279$

$x=93$

$x+9=102$

$x+44=137$

China is predicted to have 137 million tourists, whereas the United States is predicted to have 102 million and France, 93 million.

90. $d=rt$ or $r=\frac{d}{t}$

11:00 a.m. to 1:15 p.m. is 2.25 hours.

$r=\frac{130}{2.25}\approx 58$

His average speed was 58 mph.

91. $V_{\text{box}}=lwh=8\cdot 5\cdot 3=120 \text{ in}^3$, while

$V_{\text{cyl}}=\pi r^2 h=\pi\cdot 3^2\cdot 6=54\pi\approx 170 \text{ in}^3$

Therefore, the cylinder holds more ice cream.

92. $48 + x \ge 5(2x + 4) - 2x$
$48 + x \ge 10x + 20 - 2x$
$48 + x \ge 8x + 20$
$28 \ge 7x$
$4 \ge x$
$(-\infty, 4]$

93. $\dfrac{3(x-2)}{5} > \dfrac{-5(x-2)}{3}$
$15\left[\dfrac{3(x-2)}{5}\right] > 15\left[\dfrac{-5(x-2)}{3}\right]$
$9(x-2) > -25(x-2)$
$9x - 18 > -25x + 50$
$34x > 68$
$x > 2$
$(2, \infty)$

94. $0 \le \dfrac{2(3x+4)}{5} \le 3$
$5(0) \le 5\left[\dfrac{2(3x+4)}{5}\right] \le 5(3)$
$0 \le 2(3x+4) \le 15$
$0 \le 6x + 8 \le 15$
$-8 \le 6x \le 7$
$-\dfrac{4}{3} \le x \le \dfrac{7}{6}$
$\left[-\dfrac{4}{3}, \dfrac{7}{6}\right]$

95. $x \le 2$ *or* $x > -5$
$(-\infty, \infty)$

96. $-2x \le 6$ *and* $-2x + 3 < -7$
$x \ge -3$ *and* $-2x < -10$
$x \ge -3$ *and* $x > 5$
$x > 5$
$(5, \infty)$

97. $|7x| - 26 = -5$
$|7x| = 21$
$7x = 21$ or $7x = -21$
$x = 3$ or $x = -3$

98. $\left|\dfrac{9-2x}{5}\right| = -3$
The solution set is $\varnothing$.

99. $|x - 3| = |7 + 2x|$
$x - 3 = 7 + 2x$ or $x - 3 = -(7 + 2x)$
$-10 = x$ or $x - 3 = -7 - 2x$
$3x = -4$
$x = -\dfrac{4}{3}$

100. $|6x - 5| \ge -1$
Since $|6x - 5|$ is nonnegative for all numbers x, the solution set is $(-\infty, \infty)$.

101. $\left|\dfrac{4x-3}{5}\right| < 1$
$-1 < \dfrac{4x-3}{5} < 1$
$-5 < 4x - 3 < 5$
$-2 < 4x < 8$
$-\dfrac{1}{2} < x < 2$
$\left(-\dfrac{1}{2}, 2\right)$

Chapter 2 Getting Ready for the Test

1. $x - 9 = -6x - 9$
$7x = 0$
$x = 0$
The solution is 0; C.

2. $4x + 8 = 2(x + 4)$
$4x + 8 = 2x + 8$
$2x = 0$
The solution is 0; C.

3. $5(2x - 4) = 10(x - 2)$
$10x - 20 = 10x - 20$
Both sides of the equation are identical, so all real numbers are solutions; A.

4. $3(x + 2) + x = 4(x - 1) + 1$
$3x + 6 + x = 4x - 4 + 1$
$4x + 6 = 4x - 3$
$6 = -3$ False
$6 = -3$ is false for all values of x, so the equation has no solution; B.

5. $\{x|x \le -11\}$ is $(-\infty, -11]$; A.

6. $\{x|-5 < x\}$ is $(-5, \infty)$; B.

7. A. $|-7-3| \stackrel{?}{=} 7$ $\quad$ $|7-3| \stackrel{?}{=} 7$

$|-10| \stackrel{?}{=} 7$ $\quad$ $|4| \stackrel{?}{=} 7$

$10 \neq 7$ $\quad$ $4 \neq 7$

B. $|-10-3| \stackrel{?}{=} 7$ $\quad$ $|10-3| \stackrel{?}{=} 7$

$|-13| \stackrel{?}{=} 7$ $\quad$ $|7| \stackrel{?}{=} 7$

$13 \neq 7$ $\quad$ $7 = 7$

C. $|4-3| \stackrel{?}{=} 7$ $\quad$ $|10-3| \stackrel{?}{=} 7$

$|1| \stackrel{?}{=} 7$ $\quad$ $|7| \stackrel{?}{=} 7$

$1 \neq 7$ $\quad$ $7 = 7$

D. $|-4-3| \stackrel{?}{=} 7$ $\quad$ $|10-3| \stackrel{?}{=} 7$

$|-7| \stackrel{?}{=} 7$ $\quad$ $|7| \stackrel{?}{=} 7$

$7 = 7$ $\quad$ $7 = 7$

D gives the correct solutions.

8. $|5x - 2| \le 4$ is equivalent to $-4 \le 5x - 2 \le 4$; C.

9. $|5x - 2| = 4$ is equivalent to $5x - 2 = 4$ or $5x - 2 = -4$; A.

10. $|5x - 2| \ge 4$ is equivalent to $5x - 2 \ge 4$ or $5x - 2 \le -4$; E.

11. $|5x| - 2 = 4$ or $|5x| = 6$ is equivalent to $5x = 6$ or $5x = -6$; B.

12. An absolute value will never be negative, so $|x + 3| = -9$ has no solution, or $\varnothing$; A.

13. An absolute value will never be negative, so $|x + 3| < -9$ has no solution, or $\varnothing$; A.

14. An absolute value will always be greater than equal to 0, so $|x + 3| > -9$ has all real numbers as solutions, or $(-\infty, \infty)$; B.

Chapter 2 Test

1.
$$\begin{aligned} 8x+14 &= 5x+44 \\ 3x &= 30 \\ x &= 10 \end{aligned}$$

2.
$$\begin{aligned} 9(x+2) &= 5[11-2(2-x)+3] \\ 9x+18 &= 5[11-4+2x+3] \\ 9x+18 &= 5[10+2x] \\ 9x+18 &= 50+10x \\ -x &= 32 \\ x &= -32 \end{aligned}$$

3.
$$\begin{aligned} 3(y-4)+y &= 2(6+2y) \\ 3y-12+y &= 12+4y \\ 4y-12 &= 12+4y \\ -12 &= 12 \end{aligned}$$

No solution, $\varnothing$

4.
$$\begin{aligned} 7n-6+n &= 2(4n-3) \\ 8n-6 &= 8n-6 \\ -6 &= -6 \end{aligned}$$

All real numbers

5.
$$\begin{aligned} \frac{7w}{4}+5 &= \frac{3w}{10}+1 \\ 20\left(\frac{7w}{4}+5\right) &= 20\left(\frac{3w}{10}+1\right) \\ 35w+100 &= 6w+20 \\ 29w &= -80 \\ w &= -\frac{80}{29} \end{aligned}$$

6.
$$\begin{aligned} \frac{z+7}{9}+1 &= \frac{2z+1}{6} \\ 18\left(\frac{z+7}{9}+1\right) &= 18\left(\frac{2z+1}{6}\right) \\ 2(z+7)+18 &= 3(2z+1) \\ 2z+14+18 &= 6z+3 \\ 2z+32 &= 6z+3 \\ 2z-6z &= 3-32 \\ -4z &= -29 \\ z &= \frac{29}{4} \end{aligned}$$

7.
$$\begin{aligned} |6x-5|-3 &= -2 \\ |6x-5| &= 1 \end{aligned}$$

$6x-5=1$ or $6x-5=-1$

$6x=6$ or $6x=4$

$x=1$ or $x=\frac{2}{3}$

8. $|8 - 2t| = -6$

No solution, $\varnothing$

9. $|2x - 3| = |4x + 5|$

$2x-3=4x+5$ or $2x-3=-(4x+5)$

$2x-4x=5+3$ or $2x-3=-4x-5$

$-2x=8$ or $2x+4x=-5+3$

$x=-4$ or $6x=-2$

$x=-4$ or $x=-\frac{1}{3}$

10. $|x-5| = |x+2|$

$x-5 = x+2$ or $x-5 = -(x+2)$

$-5 = 2$ False or $x-5 = -x-2$

$2x = 3$

$x = \frac{3}{2}$

Since $-5 = 2$ is not possible, the only solution is $\frac{3}{2}$.

11. $3x-4y = 8$

$3x-8 = 4y$

$y = \frac{3x-8}{4}$

12. $S = gt^2 + gvt$

$S = g(t^2 + vt)$

$g = \frac{S}{t^2+vt}$

13. $F = \frac{9}{5}C + 32$

$F - 32 = \frac{9}{5}C$

$C = \frac{5}{9}(F-32)$

14. $3(2x-7) - 4x > -(x+6)$

$6x - 21 - 4x > -x - 6$

$2x - 21 > -x - 6$

$3x > 15$

$x > 5$

$(5, \infty)$

15. $\frac{3x-2}{3} - \frac{5x+1}{4} \geq 0$

$12\left[\frac{3x-2}{3} - \frac{5x+1}{4}\right] \geq 12(0)$

$4(3x-2) - 3(5x+1) \geq 0$

$12x - 8 - 15x - 3 \geq 0$

$-3x - 11 \geq 0$

$-3x \geq 11$

$x \leq -\frac{11}{3}$

$\left(-\infty, -\frac{11}{3}\right]$

16. $-3 < 2(x-3) \leq 4$

$-3 < 2x - 6 \leq 4$

$3 < 2x \leq 10$

$\frac{3}{2} < x \leq 5$

$\left(\frac{3}{2}, 5\right]$

17. $|3x+1| > 5$

$3x+1 < -5$ or $3x+1 > 5$

$3x < -6$ or $3x > 4$

$x < -2$ or $x > \frac{4}{3}$

$(-\infty, -2) \cup \left(\frac{4}{3}, \infty\right)$

18. $|x-5| - 4 < -2$

$|x-5| < 2$

$-2 < x-5 < 2$

$3 < x < 7$

$(3, 7)$

19. $x \geq 5$ *and* $x \geq 4$

$[5, \infty)$

20. $x \geq 5$ *or* $x \geq 4$

$[4, \infty)$

21. $-1 \leq \frac{2x-5}{3} < 2$

$3(-1) \leq 3\left(\frac{2x-5}{3}\right) < 3(2)$

$-3 \leq 2x - 5 < 6$

$-3 + 5 \leq 2x - 5 + 5 < 6 + 5$

$2 \leq 2x < 11$

$\frac{2}{2} \leq \frac{2x}{2} < \frac{11}{2}$

$1 \leq x < \frac{11}{2}$

$\left[1, \frac{11}{2}\right)$

22. $6x+1 > 5x+4$ *or* $1-x > -4$

$x > 3$ *or* $5 > x$

$(-\infty, \infty)$

23. $12\% \cdot 80 = 0.12 \cdot 80 = 9.6$

24. Let x be the number of new vehicles sold by Ford in 2010. The number of new vehicles sold is increased by 29.1%, or by $0.291x$.

$$x + 0.291x = 2,480,942$$
$$1.291x = 2,480,942$$
$$x \approx 1,922,000$$

Ford sold approximately 1,922,000 new vehicles in 2010.

25. Recall that $C = 2\pi r$. Here $C = 78.5$.

$$78.5 = 2\pi r$$
$$r = \frac{78.5}{2\pi} = \frac{39.25}{\pi}$$

Also recall that $A = \pi r^2$.

$$A = \pi\left(\frac{39.25}{\pi}\right)^2 = \frac{39.25^2}{\pi} \approx \frac{39.25^2}{3.14} \approx 491$$

The area of the pen is about 491 square feet. Each dog requires at least 60 square feet of space, and $\frac{491}{60} \approx 8.18$. At most 8 dogs could be kept in the pen.

26. Let x be the number of people employed as registered nurses in 2012. The number of people employed in this field in 2022 is x increased by 19%.

$$x + 0.19x = 3,240,000$$
$$1.19x = 3,240,000$$
$$x \approx 2,723,000$$

In 2012, there were 2,723,000 registered nurses employed.

27. Use $A = P\left(1 + \frac{r}{n}\right)^{nt}$ where $P = 2500$, $r = 3.5\% = 0.035$, $t = 10$, and $n = 4$.

$$A = 2500\left(1 + \frac{0.035}{4}\right)^{4 \cdot 10}$$
$$A = 2500(1.00875)^{40}$$
$$A \approx \$3542.27$$

28. Let x be the amount of money international travelers spend in New York. Then $x + 4$ is the amount of money international travelers spend in California and $2x - 1$ is the amount of money international travelers spend in Florida.

$$x + (x + 4) + (2x - 1) = 39$$
$$4x + 3 = 39$$
$$4x = 36$$
$$x = 9$$
$$x + 4 = 9 + 4 = 13$$
$$2x - 1 = 2(9) - 1 = 18 - 1 = 17$$

International travelers spend \$9 billion in New York, \$13 billion in California, and \$17 billion in Florida.

Chapter 2 Cumulative Review

1. a. {101, 102, 103, ...}

b. {2, 3, 4, 5}

2. a. {−2, −1, 0, 1, 2, 3, 4}

b. {4}

3. a. $|3| = 3$

b. $\left|-\frac{1}{7}\right| = \frac{1}{7}$

c. $-|2.7| = -2.7$

d. $-|-8| = -8$

e. $|0| = 0$

4. a. The opposite of $\frac{2}{3}$ is $-\frac{2}{3}$.

b. The opposite of −9 is 9.

c. The opposite of 1.5 is −1.5.

5. a. $-3 + (-11) = -14$

b. $3 + (-7) = -4$

c. $-10 + 15 = 5$

d. $-8.3 + (-1.9) = -10.2$

e. $-\frac{1}{4} + \frac{1}{2} = -\frac{1}{4} + \frac{2}{4} = \frac{1}{4}$

f. $-\frac{2}{3} + \frac{3}{7} = -\frac{14}{21} + \frac{9}{21} = -\frac{5}{21}$

6. a. $-2 - (-10) = -2 + 10 = 8$

b. $1.7 - 8.9 = -7.2$

c. $-\frac{1}{2} - \frac{1}{4} = -\frac{2}{4} - \frac{1}{4} = -\frac{3}{4}$

7. a. $\sqrt{9} = 3$ since $3^2 = 9$.

b. $\sqrt{25} = 5$ since $5^2 = 25$.

c. $\sqrt{\frac{1}{4}} = \frac{1}{2}$ since $\left(\frac{1}{2}\right)^2 = \frac{1}{4}$.

d. $-\sqrt{36} = -6$ since $6^2 = 36$.

e. $\sqrt{-36}$ is not a real number.

8. a. $-3(-2) = 6$

b. $-\frac{3}{4}\left(-\frac{4}{7}\right) = \frac{3}{7}$

c. $\frac{0}{-2} = 0$

d. $\frac{-20}{-2} = 10$

9. Let $x = 4$, $y = -3$.

a. $3x - 7y = 3(4) - 7(-3) = 12 + 21 = 33$

b. $-2y^2 = -2(-3)^2 = -2(9) = -18$

c.
$$\frac{\sqrt{x}}{y} - \frac{y}{x} = \frac{\sqrt{4}}{-3} - \frac{-3}{4}$$
$$= -\frac{2}{3} + \frac{3}{4}$$
$$= -\frac{8}{12} + \frac{9}{12}$$
$$= \frac{1}{12}$$

10. a. $\sqrt[4]{1} = 1$ since $1^4 = 1$.

b. $\sqrt[3]{8} = 2$ since $2^3 = 8$.

c. $\sqrt[4]{81} = 3$ since $3^4 = 81$.

11. a. $x + 5 = 20$

b. $2(3 + y) = 4$

c. $x - 8 = 2x$

d. $\frac{z}{9} = 9 + z$

12. a. $-3 > -5$ since -3 is to the right of -5 on a number line.

b. $\frac{-12}{-4} = 3$

c. $0 > -2$ since 0 is to the right of -2 on a number line.

13. $7x + 5 = 5 + 7x$

14. $5 \cdot (7x) = (5 \cdot 7)x = 35x$

15.
$$2x + 5 = 9$$
$$2x = 4$$
$$x = 2$$

16.
$$11.2 = 1.2 - 5x$$
$$10 = -5x$$
$$-2 = x$$

17.
$$6x - 4 = 2 + 6(x - 1)$$
$$6x - 4 = 2 + 6x - 6$$
$$6x - 4 = 6x - 4$$
$$-4 = -4, \text{ which is always true.}$$
All real numbers

18.
$$2x + 1.5 = -0.2 + 1.6x$$
$$0.4x = -1.7$$
$$x = -4.25$$

19. a. Let x = the first integer. Then
$x + 1$ = the second integer and
$x + 2$ = the third integer.
$x + (x + 1) + (x + 2) = 3x + 3$

b. $x + (5x) + (6x - 3) = 12x - 3$

20. a. Let x = the first integer. Then
$x + 2$ = the second even integer and
$x + 4$ = the third even integer.
$x + (x + 2) + (x + 4) = 3x + 6$

b. $4(3x + 1) = 12x + 4$

21. Let x = first number, then
$2x + 3$ = second number and
$4x$ = third number.
$$x + (2x + 3) + 4x = 164$$
$$7x + 3 = 164$$
$$7x = 161$$
$$x = 23$$
$2x + 3 = 2(23) + 3 = 49$

$4x = 4(23) = 92$
The three numbers are 23, 49 and 92.

22. Let x = first number, then
$3x + 2$ = second number.

$$(3x+2)-x=24$$
$$2x+2=24$$
$$2x=22$$
$$x=11$$

$3x + 2 = 3(11) + 2 = 35$
The two numbers are 11 and 35.

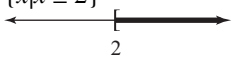
23.
$$3y-2x=7$$
$$3y=2x+7$$
$$y=\frac{2x+7}{3}, \text{ or } y=\frac{2x}{3}+\frac{7}{3}$$

24.
$$7x-4y=10$$
$$7x=4y+10$$
$$x=\frac{4y+10}{7}, \text{ or } x=\frac{4y}{7}+\frac{10}{7}$$

25.
$$A=\frac{1}{2}(B+b)h$$
$$2A=(B+b)h$$
$$2A=Bh+bh$$
$$2A-Bh=bh$$
$$\frac{2A-Bh}{h}=b$$

26.
$$P=2l+2w$$
$$P-2w=2l$$
$$\frac{P-2w}{2}=l$$

27. a. $\{x|x \geq 2\}$

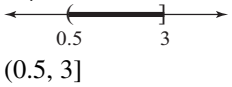


$[2, \infty)$

b. $\{x|x < -1\}$

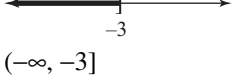
$(-\infty, -1)$

c. $\{x|0.5 < x \leq 3\}$



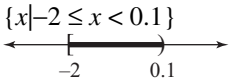
(0.5, 3]

28. a. $\{x|x \leq -3\}$



$(-\infty, -3]$

b. $\{x|-2 \leq x < 0.1\}$



$[-2, 0.1)$

29.
$$-(x-3)+2 \leq 3(2x-5)+x$$
$$-x+3+2 \leq 6x-15+x$$
$$-x+5 \leq 7x-15$$
$$20 \leq 8x$$
$$\frac{5}{2} \leq x$$

$$\left[\frac{5}{2}, \infty\right)$$

30.
$$2(7x-1)-5x > -(-7x)+4$$
$$14x-2-5x > 7x+4$$
$$9x-2 > 7x+4$$
$$2x > 6$$
$$x > 3$$

$(3, \infty)$

31.
$$2(x+3) > 2x+1$$
$$2x+6 > 2x+1$$
$$6 > 1; \text{ True for all real numbers } x.$$

$(-\infty, \infty)$

32.
$$4(x+1)-3 < 4x+1$$
$$4x+4-3 < 4x+1$$
$$4x+1 < 4x+1$$
$$1 < 1 \quad \text{Never true}$$

$\varnothing$

33. $A = \{2, 4, 6, 8\}$, $B = \{3, 4, 5, 6\}$; the numbers 4 and 6 are in both sets so the intersection of A and B is $\{4, 6\}$.

34. The elements in either set or both sets are −2, −1, 0, 1, 2, 3, 4, and 5, so the union is $\{-2, -1, 0, 1, 2, 3, 4, 5\}$.

35.
$$x-7 < 2 \quad \textit{and} \quad 2x+1 < 9$$
$$x < 9 \quad \textit{and} \quad 2x < 8$$
$$x < 4$$

$x < 4$
$(-\infty, 4)$

36.
$$x+3 \leq 1 \quad \textit{or} \quad 3x-1 < 8$$
$$x \leq -2 \quad \textit{or} \quad 3x < 9$$
$$x < 3$$

$x < 3$
$(-\infty, 3)$

37. $A = \{2, 4, 6, 8\}$ and $B = \{3, 4, 5, 6\}$, so the union of A and B is $\{2, 3, 4, 5, 6, 8\}$.

38. $\varnothing$; there are no elements in common.

39. $-2x - 5 < -3$ *or* $6x < 0$
$-2x < 2$ *or* $x < 0$
$x > -1$
All real numbers
$(-\infty, \infty)$

40. $-2x - 5 < -3$ *and* $6x < 0$
$-2x < 2$ *and* $x < 0$
$x > -1$
$-1 < x < 0$
$(-1, 0)$

41. $|p| = 2$
$p = 2$ or $p = -2$

42. $|x| = 5$
$x = 5$ or $x = -5$

43. $\left|\frac{x}{2} - 1\right| = 11$
$\frac{x}{2} - 1 = 11$ or $\frac{x}{2} - 1 = -11$
$\frac{x}{2} = 12$ or $\frac{x}{2} = -10$
$x = 24$ or $x = -20$

44. $\left|\frac{y}{3} + 2\right| = 10$
$\frac{y}{3} + 2 = 10$ or $\frac{y}{3} + 2 = -10$
$\frac{y}{3} = 8$ or $\frac{y}{3} = -12$
$y = 24$ or $y = -36$

45. $|x - 3| = |5 - x|$
$x - 3 = 5 - x$ or $x - 3 = -(5 - x)$
$2x = 8$ or $x - 3 = -5 + x$
$x = 4$ or $-3 = -5$
Since $-3 = -5$ is not possible, the only solution is 4.

46. $|x + 3| = |7 - x|$
$x + 3 = 7 - x$ or $x + 3 = -(7 - x)$
$2x = 4$ or $x - 3 = -7 + x$
$x = 2$ or $-3 = -7$
Since $-3 = -7$ is not possible, the only solution is 2.

47. $|x| \le 3$
$-3 \le x \le 3$
$[-3, 3]$

48. $|x| > 1$
$x < -1$ or $x > 1$
$(-\infty, -1) \cup (1, \infty)$

49. $|2x + 9| + 5 > 3$
$|2x + 9| > -2$
Since $|2x + 9|$ is nonnegative for all numbers x, the solution set is $(-\infty, \infty)$.

50. $|3x + 1| + 9 < 1$
$|3x + 1| < -8$
The solution set is $\varnothing$.