Chapter 2: Linear Equations and Inequalities

Section 2.1 Introduction to Equations

1. solution
2. true
3. false
4. solution set
5. solutions
6. Equivalent
7. $b+c$
8. subtraction
9. bc
10. division
11. equivalent
12. given
13. 22
14. $-\frac{1}{6}$
15. 3
16. $\frac{1}{4}$
17. $x+5=0 \Rightarrow x+5-5=0-5 \Rightarrow x+0=-5 \Rightarrow x=-5;$ To check your answer, substitute -5 for x in the original equation, $-5+5=0.$ This statement is true. Thus, the solution $x=-5$ is correct.
18. $x+3=7 \Rightarrow x+3-3=7-3 \Rightarrow x+0=4 \Rightarrow x=4;$ To check your answer, substitute 4 for x in the original equation, $4 + 3 = 7$. This statement is true. Thus, the solution $x = 4$ is correct.
19. $a-12=-3 \Rightarrow a-12+12=-3+12 \Rightarrow a+0=9 \Rightarrow a=9$
20. $a-19=-11 \Rightarrow a-19+19=-11+19 \Rightarrow a+0=8 \Rightarrow a=8$
21. $9=y-8 \Rightarrow 9+8=y-8+8 \Rightarrow 17=y+0 \Rightarrow 17=y \Rightarrow y=17$
22. $97=-23+y \Rightarrow 97+23=23+(-23)+y \Rightarrow 120=0+y \Rightarrow y=120$

23. $\frac{1}{5} = z - \frac{3}{2} \Rightarrow \frac{1}{5} + \frac{3}{2} = z - \frac{3}{2} + \frac{3}{2} \Rightarrow \frac{17}{10} = z + 0 \Rightarrow \frac{17}{10} = z \Rightarrow z = \frac{17}{10}$

24. $\frac{3}{2} + z = -\frac{1}{2} \Rightarrow \frac{3}{2} + \left(-\frac{3}{2}\right) + z = -\frac{1}{2} + \left(-\frac{3}{2}\right) \Rightarrow 0 + z = -\frac{5}{2} \Rightarrow z = -\frac{5}{2}$

$4 \qquad 2 \quad 4 \left| \left(\quad 4 \right) \right| \qquad 2 \left| \left(\quad 4 \right) \right| \qquad 4 \qquad 4$

25. $t - 0.8 = 4.3 \Rightarrow t - 0.8 + 0.8 = 4.3 + 0.8 \Rightarrow t + 0 = 5.1 \Rightarrow t = 5.1$

26. $y - 1.23 = -0.02 \Rightarrow y - 1.23 + 1.23 = -0.02 + 1.23 \Rightarrow y + 0 = 1.21 \Rightarrow y = 1.21$

27. $4 + x = 1 \Rightarrow 4 - 4 + x = 1 - 4 \Rightarrow 0 + x = -3 \Rightarrow x = -3$

28. $16 + x = -2 \Rightarrow 16 - 16 + x = -2 - 16 \Rightarrow 0 + x = -18 \Rightarrow x = -18$

29. $1 = \frac{1}{3} + y \Rightarrow 1 - \frac{1}{3} = \frac{1}{3} - \frac{1}{3} + y \Rightarrow \frac{2}{3} = 0 + y \Rightarrow \frac{2}{3} = y \Rightarrow y = \frac{2}{3}$

30. $\frac{7}{2} = -2 + y \Rightarrow \frac{7}{2} + 2 = -2 + 2 + y \Rightarrow \frac{11}{2} = 0 + y \Rightarrow \frac{11}{2} = y \Rightarrow y = \frac{11}{2}$

31. a

32. a

33. $\frac{1}{5}$

34. $\frac{3}{4}$

35. 6

36. 0.2

37. $5x = 15 \Rightarrow \frac{5x}{5} = \frac{15}{5} \Rightarrow x = 3$

38. $-2x = 8 \Rightarrow \frac{-2x}{-2} = \frac{8}{-2} \Rightarrow x = -4$

39. $-7x = 0 \Rightarrow \frac{-7x}{-7} = \frac{0}{-7} \Rightarrow x = 0$

40. $25x = 0 \Rightarrow \frac{25x}{25} = \frac{0}{25} \Rightarrow x = 0$

41. $-35 = -5a \Rightarrow \frac{-35}{-5} = \frac{-5a}{-5} \Rightarrow 7 = a \Rightarrow a = 7$

42. $-32 = -4a \Rightarrow \frac{-32}{-4} = \frac{-4a}{-4} \Rightarrow 8 = a \Rightarrow a = 8$

43. $-18 = 3a \Rightarrow \frac{-18}{3} = \frac{3a}{3} \Rightarrow -6 = a \Rightarrow a = -6$

44. $-70 = 10a \Rightarrow \frac{-70}{10} = \frac{10a}{10} \Rightarrow -7 = a \Rightarrow a = -7$

45. $\frac{1}{2}x = \frac{3}{2} \Rightarrow \frac{2}{1} \cdot \frac{1}{2}x = \frac{3}{2} \cdot \frac{2}{1} \Rightarrow x = 3$

46. $\frac{3}{4}x = \frac{5}{8} \Rightarrow \frac{4}{3} \cdot \frac{3}{4}x = \frac{5}{8} \cdot \frac{4}{3} \Rightarrow x = \frac{5}{6}$

47. $\frac{1}{2} = \frac{2}{5}z \Rightarrow \frac{5}{2} \cdot \frac{1}{2} = \frac{5}{2} \cdot \frac{2}{5}z \Rightarrow \frac{5}{4} = z \Rightarrow z = \frac{5}{4}$

48. $-\frac{3}{4} = -\frac{1}{8}z \Rightarrow -\frac{3}{4} \cdot \left(-\frac{8}{1}\right) = -\frac{8}{1} \cdot \left(-\frac{1}{8}\right)z \Rightarrow 6 = z \Rightarrow z = 6$

49. $0.5t = 3.5 \Rightarrow \frac{0.5t}{0.5} = \frac{3.5}{0.5} \Rightarrow t = 7$

50. $2.2t = -9.9 \Rightarrow \frac{2.2t}{2.2} = \frac{-9.9}{2.2} \Rightarrow t = -\frac{9.9}{2.2} \Rightarrow t = -4.5$

51. $-1.7 = 0.2x \Rightarrow \frac{-1.7}{0.2} = \frac{0.2x}{0.2} \Rightarrow -8.5 = x \Rightarrow x = -8.5$

52. $6.4 = 1.6x \Rightarrow \frac{6.4}{1.6} = \frac{1.6x}{1.6} \Rightarrow 4 = x \Rightarrow x = 4$

53. *a*

54. *a*

55. (a) See Figure 55.

(b) Let R represent total rainfall and let x represent the number of hours past noon. Start with 3 inches of rain and then add $\frac{1}{2}$, or 0.5, inches per hour after noon, $3 + 0.5x = R$, or equivalently $R = 0.5x + 3$.

(c) At 3 pm, $x = 3$. Substituting x with 3 in the formula, $R = 0.5 \cdot 3 + 3 \Rightarrow R = 4.5$ inches. This answer agrees with the table from part (a).

(d) At 2:15 pm, $x = 2.25$. Substituting x with 2.25 in the formula, $R = 0.5 \cdot 2.25 + 3 \Rightarrow R = 4.125$ inches.

Hours (x)	0	1	2	3	4	5	6
Rainfall (R)	3	3.5	4	4.5	5	5.5	6

Figure 55

Hours (x)	0	1	2	3	4	5	6	7
Temp. (T)	0	10	20	30	40	50	60	70

Figure 56

56. (a) See Figure 56.

(b) Let T represent the temperature and let x represent the number of hours past midnight. Since the temperature increases 10°F per hour, $T = 10x$.

(c) At 5 am, $x = 5$. Substituting x with 5 in the formula, $T = 10 \cdot 5 \Rightarrow T = 50°$ F. This agrees with the table from part (a).

(d) At 2:45 am, $x = 2.75$. Substituting x with 2.75 in the formula, $T = 10 \cdot 2.75 \Rightarrow T = 27.5°$ F.

57. (a) Let L be the length of the football fields and x be the number of fields. Because each field x contains 300 feet, $L = 300x$.

(b) Substitute L with 870. Then $870 = 300x$.

(c) $870 = 300x \Rightarrow \frac{870}{300} = \frac{300x}{300} \Rightarrow x = \frac{870}{300} \Rightarrow x = 2.9$

58. (a) Let A represent the number of acres and let S represent the number of square feet. Because each acre contains 43,560 square feet, let $S = 43{,}560A$.

(b) Substitute S with 871,200. Then, $871{,}200 = 43{,}560A$.

(c) $871,200 = 43,560A \Rightarrow \frac{871,200}{43,560} = \frac{43,560A}{43,560} \Rightarrow A = \frac{871,200}{43,560} \Rightarrow A = 20$

59. The formula for this scenario is $T = 0.3x$ where x is in days and T is in millions. To find the number of days needed for Twitter to add 15 million new accounts, replace the variable T in the formula with 15. $T = 0.3x \Rightarrow 15 = 0.3x \Rightarrow \frac{15}{0.3} = \frac{0.3x}{0.3} \Rightarrow 50 = x$ At this rate it takes 50 days to add 15 million accounts.

60. The formula for this scenario is $W = 14{,}000x$ where x is in days and W is the number of visitors. To find the number of days for the Web site to add 98,000 new visitors, replace the variable W in the formula with 98,000. $W = 14{,}000x \Rightarrow 98{,}000 = 14{,}000x \Rightarrow \frac{98{,}000}{14{,}000} = \frac{14{,}000x}{14{,}000} \Rightarrow 7 = x$ At this rate it takes 7 days to add 98,000 new visitors.

61. a) The latitude of Winnipeg to the nearest degree is 50° N

    b) The sun at the equator will be approximately $\frac{325}{57} \approx 5.7$ times as intense as they are in Winnipeg on March 21st.

62. a) The latitude of Columbus, Ohio to the nearest degree is 40° N

    b) The sun in Limon, Costa Rica will be approximately $\frac{275}{199} \approx 1.4$ times as intense as they are in Columbus on June 21st.

63. Let x represent the cost of the car to obtain the equation $0.07x = 1750$. Then the solution is $\frac{0.07x}{0.07} = \frac{1750}{0.07} \Rightarrow x = \frac{1750}{0.07} \Rightarrow x = 25{,}000.$ Thus, the cost of the car is \$25,000.

64. Let S represent the employee's current salary to obtain the equation $1.06S = 58{,}300$. Then the solution is $\frac{1.06S}{1.06} = \frac{58{,}300}{1.06} \Rightarrow S = \frac{58{,}300}{1.06} \Rightarrow S = 55{,}000.$ Thus, the employee's current salary is

$55,000.

Section 2.2 Linear Equations

1. constant
2. $ax + b = 0$
3. Exactly one
4. numerically
5. addition, multiplication
6. LCD
7. None
8. Infinitely many
9. $3x - 7 = 0$ is a linear equation. $a = 3$ and $b = -7$.

10. $-2x + 1 = 4$ is a linear equation. $-2x + 1 = 4 \Rightarrow -2x + 1 - 4 = 4 - 4 \Rightarrow -2x - 3 = 0$.

    $a = -2$ and $b = -3$.

11. $\frac{1}{2}x = 0$ is a linear equation. $a = \frac{1}{2}$ and $b = 0$.

12. $-\frac{3}{4}x = 0$ is a linear equation. $a = -\frac{3}{4}$ and $b = 0$.

13. $4x^2 - 6 = 11$ is not a linear equation because it cannot be written in the form $ax + b = 0$. It has a non-zero term containing x^2.

14. $-2x^2 + x = 4$ is not a linear equation because it cannot be written in the form $ax + b = 0$. It has a non-zero term containing x^2.

15. $\frac{6}{x} - 4 = 2$ is not a linear equation because it cannot be written in the form $ax + b = 0$. It has the variable x in the denominator.

16. $2\sqrt{x} - 1 = 0$ is not a linear equation because it cannot be written in the form $ax + b = 0$. It has a non-zero term containing $\sqrt{x}$.

17. $1.1x + 0.9 = 1.8$ is a linear equation.
    $1.1x + 0.9 = 1.8 \Rightarrow 1.1x + 0.9 - 1.8 = 1.8 - 1.8 \Rightarrow 1.1x - 0.9 = 0$. $a = 1.1$ and $b = -0.9$.

18. $-5.7x - 3.4 = -6.8$ is a linear equation.
    $-5.7x - 3.4 = 6.8 \Rightarrow -5.7x - 3.4 + 6.8 = -6.8 + 6.8 \Rightarrow -5.7x + 3.4 = 0$. $a = -5.7$ and $b = 3.4$.

19. $2(x - 3) = 0$ is a linear equation. Use the distributive property to obtain

    $2x - 6 = 0$. $a = 2$ and $b = -6$.

20. $\frac{1}{2}(x + 4) = 0$ is a linear equation. Use the distributive property to obtain

$\frac{1}{2}x + 2 = 0$. $a = \frac{1}{2}$ and $b = 2$.

21. $|3x| + 2 = 1$ is not a linear equation because it cannot be written in the form $ax + b = 0$. It has a non-zero term containing $|x|$.

22. $3x = 4x^3$ is not a linear equation because it cannot be written in the form $ax + b = 0$. It has a non-zero term containing x^3.

23. For $x = -1$, substitute -1 for x and solve: $-1-3=-4$.

For $x = 0$, substitute 0 for x and solve: $0-3=-3$.

For $x = 1$, substitute 1 for x and solve : $1-3=-2$.

For $x = 2$, substitute 2 for x and solve : $2-3=-1$.

For $x = 3$, substitute 3 for x and solve : $3-3=0$.

See Figure 23. From the table, we see that the equation $x-3=-1$ is true when $x=2$. Therefore, the solution to the equation $x-3=-1$ is $x=2$.

x	-1	0	1	2	3
$x-3$	-4	-3	-2	-1	0

Figure 23

x	-2	-1	0	1	2
$-2x$	4	2	0	-2	-4

Figure 24

24. For $x=-2$, substitute -2 for x and solve: $-2(-2)=4$.

For $x=-1$, substitute -1 for x and solve: $-2(-1)=2$. For

$x = 0$, substitute 0 for x and solve: $-2(0)=0$.

For $x=1$, substitute 1 for x and solve: $-2(1)=-2$.

For $x = 2$, substitute 2 for x and solve : $-2(2)+7=-4$.

See Figure 24. From the table, we see that the equation $-2x=0$ is true when $x=0$. Therefore, the solution to the equation $-2x=0$ is $x=0$.

25. For $x = 0$, substitute 0 for x and solve : $-3(0)+7=0+7=7$.

For $x = 1$, substitute 1 for x and solve: $-3(1)+7=-3+7=4$. For

$x = 2$, substitute 2 for x and solve : $-3(2)+7=-6+7=1$. For x

$= 3$, substitute 3 for x and solve : $-3(3)+7=-9+7=-2$.

For $x = 4$, substitute 4 for x and solve : $-3(4)+7=-12+7=-5$.

See Figure 25. From the table, we see that the equation $-3x+7=1$ is true when $x=2$. Therefore, the solution to the equation $-3x+7=1$ is $x=2$.

x	0	1	2	3	4
$-3x+7$	7	4	1	-2	-5

Figure 25

x	-1	0	1	2	3
$5x-2$	-7	-2	3	8	13

Figure 26

27. For x =

r $x = 0$, substitute 0 for x and solve: $5(0) - 2 = 0 - 2 = -2$.

For $x = 1$, substitute 1 for x and solve: $5(1) - 2 = 5 - 2 = 3$. For

$x = 2$, substitute 2 for x and solve: $5(2) - 2 = 10 - 2 = 8$. For

$x = 3$, substitute 3 for x and solve: $5(3) - 2 = 15 - 2 = 13$.

See Figure 26. From the table, we see that the equation $5x - 2 = 3$ is true when $x = 1$. t solution to the equation $5x - 2 = 3$ is $x = 1$.

For $x = -2$, substitute -2 for x and solve: $4 - 2(-2) = 4 + 4 = 8$.

Therefore, the

For $x = -1$, substitute -1 for x and solve: $4 - 2(-1) = 4 + 2 = 6$.

For $x = 0$, substitute 0 for x and solve: $4 - 2(0) = 4 - 0 = 4$. e

–1, sub s it ut –1 for *x* and solve: 5(–1) – 2 = –5 – 2 = –7. Fo

For $x = 1$, substitute 1 for x and solve : $4 - 2(1) = 4 - 2 = 2$.

For $x = 2$, substitute 2 for x and solve : $4 - 2(2) = 4 - 4 = 0$.

See Figure 27. From the table, we see that the equation $4 - 2x = 6$ is true when $x = -1$. Therefore, the solution to the equation $4 - 2x = 6$ is $x = -1$.

x	-2	-1	0	1	2
$4 - 2x$	8	6	4	2	0

Figure 27

x	-2	-1	0	1	2
$9 - (x + 3)$	8	7	6	5	4

Figure 28

28. For $x = -2$, substitute -2 for x and solve : $9 - (-2 + 3) = 9 - 1 = 8$.

For $x = -1$, substitute -1 for x and solve : $9 - (-1 + 3) = 9 - 2 = 7$.

For $x = 0$, substitute 0 for x and solve : $9 - (0 + 3) = 9 - 3 = 6$.

For $x = 1$, substitute 1 for x and solve : $9 - (1 + 3) = 9 - 4 = 5$.

For $x = 2$, substitute 2 for x and solve : $9 - (2 + 3) = 9 - 5 = 4$.

See Figure 28. From the table, we see that the equation $9 - (x + 3) = 4$ is true when $x = 2$. Therefore, the solution to the equation $9 - (x + 3) = 4$ is $x = 2$.

29. $11x = 3 \Rightarrow \frac{11x}{11} = \frac{3}{11} \Rightarrow x = \frac{3}{11}$

30. $-5x = 15 \Rightarrow \frac{-5x}{-5} = \frac{15}{-5} \Rightarrow x = -3$

31. $x - 18 = 5 \Rightarrow x - 18 + 18 = 5 + 18 \Rightarrow x = 23$

32. $8 = 5 + 3x \Rightarrow 8 - 5 = 5 - 5 + 3x \Rightarrow 3 = 3x \Rightarrow \frac{3}{3} = \frac{3x}{3} \Rightarrow 1 = x \Rightarrow x = 1$

33. $\frac{1}{2}x - 1 = 13 \Rightarrow \frac{1}{2}x - 1 + 1 = 13 + 1 \Rightarrow \frac{1}{2}x = 14 \Rightarrow 2 \cdot \frac{1x}{2} = 2 \cdot 14 \Rightarrow x = 28$

34. $\frac{1}{4}x + 3 = 9 \Rightarrow \frac{1}{4}x + 3 - 3 = 9 - 3 \Rightarrow \frac{1}{4}x = 6 \Rightarrow 4 \cdot \frac{1x}{4} = 4 \cdot 6 \Rightarrow x = 24$

35. $-6 = 5x + 5 \Rightarrow -6 - 5 = 5x + 5 - 5 \Rightarrow -11 = 5x \Rightarrow \frac{-11}{5} = \frac{5x}{5} \Rightarrow x = -\frac{11}{5}$

36. $31 = -7x - 4 \Rightarrow 31 + 4 = -7x - 4 + 4 \Rightarrow 35 = -7x \Rightarrow \frac{35}{-7} = \frac{-7x}{-7} \Rightarrow x = -5$

37. $3z + 2 = z - 5 \Rightarrow 3z + 2 - 2 = z - 5 - 2 \Rightarrow 3z = z - 7 \Rightarrow 3z - z = z - z - 7 \Rightarrow 2z = -7 \Rightarrow$

$\frac{2z}{2} = \frac{-7}{2} \Rightarrow z = -\frac{7}{2}$

38. $z - 5 = 5z - 3 \Rightarrow z - 5 + 5 = 5z - 3 + 5 \Rightarrow z = 5z + 2 \Rightarrow z - 5z = 5z - 5z + 2 \Rightarrow -4z = 2 \Rightarrow$

$\frac{-4z}{-4} = \frac{2}{-4} \Rightarrow z = -\frac{1}{2}$

$\frac{}{-4}\quad\frac{}{-4}\qquad\frac{}{2}$

39. $12y-6=33-y \Rightarrow 12y-6+6=33+6-y \Rightarrow 12y=39-y \Rightarrow 12y+y=39-y+y \Rightarrow$

$13y=39 \Rightarrow \frac{13y}{13}=\frac{39}{13} \Rightarrow y=3$

40. $-13y+2=22-3y \Rightarrow -13y+2-2=22-2-3y \Rightarrow -13y=20-3y \Rightarrow$

$-13y+3y=20-3y+3y \Rightarrow -10y=20 \Rightarrow \frac{-10y}{-10}=\frac{20}{-10} \Rightarrow y=-2$

41. $4(x-1)=5 \Rightarrow 4x-4=5 \Rightarrow 4x-4+4=5+4 \Rightarrow 4x=9 \Rightarrow \frac{4x}{4}=\frac{9}{4} \Rightarrow x=\frac{9}{4}$

42. $-2(2x+7)=1 \Rightarrow -4x-14=1 \Rightarrow -4x-14+14=1+14 \Rightarrow -4x=15 \Rightarrow \frac{-4x}{-4}=\frac{15}{-4} \Rightarrow x=-\frac{15}{4}$

43. $1-(3x+1)=5-x \Rightarrow 1-3x-1=5-x \Rightarrow -3x=5-x \Rightarrow -3x+x=5-x+x \Rightarrow$

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

44. $6+2(x-7)=10-3(x-3) \Rightarrow 6+2x-14=10-3x+9 \Rightarrow 2x-8=19-3x \Rightarrow$

$2x+3x-8=19-3x+3x \Rightarrow 5x-8=19 \Rightarrow 5x-8+8=19+8 \Rightarrow 5x=27 \Rightarrow \frac{5x}{5}=\frac{27}{5} \Rightarrow x=\frac{27}{5}$

45. $(5t-6)=2(t+1)+2 \Rightarrow 5t-6=2t+2+2 \Rightarrow 5t-6=2t+4 \Rightarrow 5t-2t-6+6=2t-2t+6+4 \Rightarrow$

$3t=10 \Rightarrow \frac{3t}{3}=\frac{10}{3} \Rightarrow t=\frac{10}{3}$

46. $-2(t-7)-(t+5)=5 \Rightarrow -2t+14-t-5=5 \Rightarrow -3t+9=5 \Rightarrow -3t+9-9=5-9 \Rightarrow$

$-3t=-4 \Rightarrow \frac{-3t}{-3}=\frac{-4}{-3} \Rightarrow t=\frac{4}{3}$

47. $3(4z-1)-2(z+2)=2(z+1) \Rightarrow 12z-3-2z-4=2z+2 \Rightarrow 10z-7=2z+2 \Rightarrow$

$10z-7+7=2z+2+7 \Rightarrow 10z=2z+9 \Rightarrow 10z-2z=2z-2z+9 \Rightarrow 8z=9 \Rightarrow \frac{8z}{8}=\frac{9}{8} \Rightarrow z=\frac{9}{8}$

48. $-(z+4)+(3z+1)=-2(z+1) \Rightarrow -z-4+3z+1=-2z-2 \Rightarrow 2z-3=-2z-2 \Rightarrow$

$2z-3+3=-2z-2+3 \Rightarrow 2z=-2z+1 \Rightarrow 2z+2z=-2z+2z+1 \Rightarrow 4z=1 \Rightarrow \frac{4z}{4}=\frac{1}{4} \Rightarrow z=\frac{1}{4}$

49. $7.3x-1.7=5.6 \Rightarrow 7.3x-1.7+1.7=5.6+1.7 \Rightarrow 7.3x=7.3 \Rightarrow \frac{7.3x}{7.3}=\frac{7.3}{7.3} \Rightarrow x=1$

50. $5.5x+3x=51 \Rightarrow 8.5x=51 \Rightarrow \frac{8.5x}{8.5}=\frac{51}{8.5} \Rightarrow x=6$

51. $-9.5x-0.05=10.5x+1.05 \Rightarrow -9.5x-10.5x-0.05=10.5x-10.5x+1.05 \Rightarrow$

$-20x-0.05=1.05 \Rightarrow -20x-0.05+0.05=1.05+0.05 \Rightarrow -20x=1.1 \Rightarrow \frac{-20x}{-20}=\frac{1.1}{-20} \Rightarrow x=-0.055$

52. $0.04x+0.03=0.02x-0.1$ $0.04x$ $0.02x$ 0.03 $0.02x$ $0.02x$ 0.1 $0.02x+0.03=-0.1\Rightarrow$

$0.02x+0.03-0.03=-0.1-0.03\Rightarrow 0.02x=-0.13\Rightarrow \frac{0.02x}{0.02}=\frac{-0.13}{0.02}\Rightarrow x=-6.5$

53. $\frac{1}{2}x-\frac{3}{2}=\frac{5}{2}\Rightarrow \frac{1}{2}x-\frac{3}{2}+\frac{3}{2}=\frac{5}{2}+\frac{3}{2}\Rightarrow \frac{1}{2}x=4\Rightarrow 2\cdot\frac{1}{2}x=4\cdot 2\Rightarrow x=8$

54. $-\frac{1}{4}x+\frac{5}{4}=\frac{3}{4}\Rightarrow -\frac{1}{4}x+\frac{5}{4}-\frac{5}{4}=\frac{3}{4}-\frac{5}{4}\Rightarrow -\frac{1}{4}x=-\frac{2}{4}\Rightarrow(-4)\cdot\left(-\frac{1}{4}x\right)=-\frac{2}{4}\cdot(-4)\Rightarrow x=2$

55. $-\frac{3}{8}x+\frac{1}{4}=\frac{1}{8}\Rightarrow -\frac{3}{8}x=-\frac{1}{4}+\frac{1}{8}\Rightarrow -\frac{3}{8}x=-\frac{1}{8}\Rightarrow x=\frac{1}{3}$

$\Rightarrow$

$8\quad 4\quad 8\qquad 8\qquad 4\quad 8\qquad 8\qquad 8\qquad \left(-\frac{8}{3}\right)\left(-\frac{3}{8}\right)x=\left(-\frac{1}{8}\right)\left(-\frac{8}{3}\right)\Rightarrow x=\frac{1}{3}$

56. $\frac{1}{3}x+\frac{1}{4}=\frac{1}{6}-x\Rightarrow \frac{1}{3}x+x+\frac{1}{4}=\frac{1}{6}-x+x\Rightarrow \frac{4}{3}x+\frac{1}{4}=\frac{1}{6}\Rightarrow \frac{4}{3}x+\frac{1}{4}-\frac{1}{4}=\frac{1}{6}-\frac{1}{4}\Rightarrow$

$\frac{4}{3}x=-\frac{1}{12}\Rightarrow \frac{3}{4}\cdot\frac{4}{3}x=-\frac{1}{12}\cdot\frac{3}{4}\Rightarrow x=-\frac{3}{48}\Rightarrow x=-\frac{1}{16}$

57. $4y-2(y+1)=0\Rightarrow 4y-2y-2=0\Rightarrow 2y-2=0\Rightarrow 2y-2+2=0+2\Rightarrow 2y=2\Rightarrow \frac{2y}{2}=\frac{2}{2}\Rightarrow y=1$

58. $(15y+20)-5y=5-10y\Rightarrow 10y+20=5-10y\Rightarrow 10y+10y+20=5-10y+10y\Rightarrow$

$20y+20=5\Rightarrow 20y+20-20=5-20\Rightarrow 20y=-15\Rightarrow \frac{20y}{20}=\frac{-15}{20}\Rightarrow y=-\frac{3}{4}$

59. $ax+b=0\Rightarrow ax+b-b=0-b\Rightarrow ax=-b\Rightarrow \frac{ax}{a}=\frac{-b}{a}\Rightarrow x=-\frac{b}{a}$

60. $\frac{1}{a}x-b=0\Rightarrow \frac{1}{a}x-b+b=0+b\Rightarrow \frac{1}{a}x=b\Rightarrow a\cdot\frac{1}{a}x=a\cdot b\Rightarrow x=ab$

61. $5x=5x+1\Rightarrow 5x-5x=5x-5x+1\Rightarrow 0=1$

Because the equation $0=1$ is always false, there are no solutions.

62. $2(x-3)=2x-6\Rightarrow 2x-6=2x-6\Rightarrow 2x-2x-6=2x-2x-6\Rightarrow -6=-6$

Since the equation $-6=-6$ is always true, there are infinitely many solutions.

63. $8x=0\Rightarrow \frac{8x}{8}=\frac{0}{8}\Rightarrow x=0$ Thus, there is one solution.

64. $9x=x+1\Rightarrow 9x-x=x-x+1\Rightarrow 8x=1\Rightarrow \frac{8x}{8}=\frac{1}{8}\Rightarrow x=\frac{1}{8}$ Thus, there is one solution.

65. $4x=5(x+3)-x\Rightarrow 4x=5x+15-x\Rightarrow 4x=4x+15\Rightarrow 4x-4x=4x-4x+15\Rightarrow 0=15$

Because the equation $0=15$ is always false, there are no solutions.

66. $5x=15-2(x+7)\Rightarrow 5x=15-2x-14\Rightarrow 5x+2x=15-2x+2x-14\Rightarrow 7x=1\Rightarrow$

$$\frac{7x}{7} = \frac{1}{7} \Rightarrow x = \frac{1}{7}$$

Thus, there is one solution.

67. $5(2x + 7) - (10x + 5) = 30 \Rightarrow 10x + 35 - 10x - 5 = 30 \Rightarrow 30 = 30$

Since the equation 30 = 30 is always true, there are infinitely many solutions.

68. $4(x+2)-2(2x+3)=10 \Rightarrow 4x+8-4x-6=10 \Rightarrow 8-6=10 \Rightarrow 2=10$

Because the equation 2 = 10 is always false, there are no solutions.

69. $x - (3x + 2) = 15 - 2x \Rightarrow x - 3x - 2 = 15 - 2x \Rightarrow -2x - 2 = 15 - 2x \Rightarrow$

$-2x + 2x - 2 = 15 - 2x + 2x \Rightarrow -2 = 15$

Because the equation $-2 = 15$ is always false, there are no solutions.

70. $2x-(x+5)=x-5 \Rightarrow 2x-x-5=x-5 \Rightarrow x-5=x-5 \Rightarrow x-x-5=x-x-5 \Rightarrow$ $-5 = -5$ Since the equation $-5 = -5$ is always true, there are infinitely many solutions.

71. (a) See Figure 71.

(b) Let D represent the distance from home and x represent the number of hours. Then $D = 4 + 8x$.

(c) Substitute 3 for x. Then, $D = 4 + 8(3) = 28$ miles. This agrees with the value found in the table.

(d) Using the formula $D = 4 + 8x$, substitute 22 for D. Then, $22 = 4 + 8x$. Then, solving for x:

$22-4=4-4+8x \Rightarrow 18=8x \Rightarrow \frac{18}{8}=\frac{8x}{8} \Rightarrow \frac{9}{4}=x \Rightarrow x=2.25$ hours. Thus, the bicyclist is 22 miles from home after 2 hours and 15 minutes.

Hours (x)	0	1	2	3	4
Distance (D)	4	12	20	28	36

Figure 71

72. (a) Let D represent distance from home and x represent hours. Note that each hour spent running decreases the distance from home by 6 miles. Thus, set the formula to $D = 16 - 6x$.

(b) Using the formula, substitute 1.5 for x and solve for D.

$D = 16 - 6(1.5) \Rightarrow D = 16 - 9 \Rightarrow D = 7$ miles.

(c) Substitute 5.5 for D and solve for x. $5.5 = 16 - 6x \Rightarrow 5.5 - 16 = 16 - 16 - 6x \Rightarrow -10.5 = -6x \Rightarrow$

$\frac{-10.5}{-6} = \frac{-6x}{-6} \Rightarrow 1.75 = x \Rightarrow x = 1.75$ Thus, the athlete is 5.5 miles from home after 1 hour and

$-6 \quad -6$

45 minutes of running.

73. Using the formula, substitute 1730 for I and solve for x. $1730 = 241x - 482{,}440 \Rightarrow$

$$1730 + 482{,}440 = 241x - 482{,}440 + 482{,}440 \Rightarrow 484{,}170 = 241x \Rightarrow \frac{484{,}170}{241} = \frac{241x}{241} \Rightarrow x \approx 2009$$

74. Using the formula, substitute 970 for N and solve for x.

$970 = 42x - 83{,}197 \Rightarrow 970 + 83{,}197 \Rightarrow 42x - 83{,}197 + 83{,}197$

$$\Rightarrow 84{,}167 = 42x \Rightarrow \frac{84{,}167}{42} = \frac{42x}{42} \Rightarrow x \approx 2004$$

75. Using the formula, substitute 1.5 for N and solve for x.

$1.5 = 0.03x - 58.62 \Rightarrow 1.5 + 58.62 = 0.03x - 58.62 + 58.62$

$$\Rightarrow 60.12 = 0.03x \Rightarrow \frac{60.12}{0.03} = \frac{0.03x}{0.03} \Rightarrow x = 2004$$

76. Using the formula, substitute 6.6 for C and solve for x. $6.6 = 0.35x - 684 \Rightarrow$

$$6.6 + 684 = 0.35x - 684 + 684 \Rightarrow 690.6 = 0.35x \Rightarrow \frac{690.6}{0.35} = \frac{0.35x}{0.35} \Rightarrow 1973.143 \approx x \Rightarrow$$

$x \approx 1973.143$ Thus, the cost reached \$6.6 billion sometime in the year 1973.

77. Using the formula, substitute 2841 for H and solve for x. $2841 = -33x + 69{,}105 \Rightarrow$

$$2841 - 69{,}105 = -33x - 69{,}105 + 69{,}105 \Rightarrow -66264 = -33x \Rightarrow \frac{-66264}{-33} = \frac{-33x}{-33} \Rightarrow 2008 = x$$

Thus, the number of hospitals reached 2841 in 2008.

78. Using the formula, substitute 2504 for F and solve for x. $2504 = 34x - 65,734 \Rightarrow$

$$2504 + 65{,}734 = 34x - 65,734 + 65{,}734 \Rightarrow 68,238 = 34x \Rightarrow \frac{68,238}{34} = \frac{34x}{34} \Rightarrow 2007 = x$$

Thus, the average home size reached 2504 square feet in 2007.

Checking Basic Concepts Sections 2.1 and 2.2

1. (a) $4x^3 - 2 = 0$ is not linear because it cannot be written in the form $ax + b = 0$. It has a non-zero term containing x^3.

   (b) $2(x+1) = 4$ is a linear equation. Use the distributive property to obtain $2x + 2 = 4$, then

   $2x + 2 - 4 = 4 - 4 \Rightarrow 2x - 2 = 0$. $a = 2$ and $b = -2$.

2. For $x = 3$, substitute 3 for x and solve: $4(3) - 3 = 12 - 3 = 9$

   For $x = 3.5$, substitute 3.5 for x and solve: $4(3.5) - 3 = 14 - 3 = 11$

   For $x = 4$, substitute 4 for x and solve: $4(4) - 3 = 16 - 3 = 13$

For $x = 4.5$, substitute 4.5 for x and solve: $4(4.5) - 3 = 18 - 3 = 15$

For $x = 5$, substitute 5 for x and solve: $4(5) - 3 = 20 - 3 = 17$

See Figure 2. To solve $4x - 3 = 13$, the table tells us that when $x = 4$, $4x - 3 = 13$.

x	3	3.5	4	4.5	5
$4x - 3$	9	11	13	15	17

Figure 2

3. (a) $x-12=6 \Rightarrow x-12+12=6+12 \Rightarrow x=18$ To check the answer, substitute 18 for x in the original equation $x - 12 = 6$. $18 - 12 = 6 \Rightarrow 6 = 6$. Since this is true $x = 18$ is correct.

(b) $\frac{3}{4}z = \frac{1}{8} \Rightarrow \frac{4}{3} \cdot \frac{3}{4}z = \frac{1}{8} \cdot \frac{4}{3} \Rightarrow z = \frac{4}{24} \Rightarrow z = \frac{1}{6}$

(c) $0.6t + 0.4 = 2 \Rightarrow 0.6t + 0.4 - 0.4 = 2 - 0.4 \Rightarrow 0.6t = 1.6 \Rightarrow \frac{0.6t}{0.6} = \frac{1.6}{0.6} \Rightarrow t = 2.6$

(d) $5 - 2(x - 2) = 3(4 - x) \Rightarrow 5 - 2x + 4 = 12 - 3x \Rightarrow 9 - 2x = 12 - 3x \Rightarrow$

$9 - 2x + 3x = 12 - 3x + 3x \Rightarrow 9 + x = 12 \Rightarrow 9 - 9 + x = 12 - 9 \Rightarrow x = 3$

4. (a) $x-5=6x \Rightarrow x-x-5=6x-x \Rightarrow -5=5x \Rightarrow \frac{-5}{5}=\frac{5x}{5} \Rightarrow -1=x.$ Thus, the equation has one solution.

(b) $-2(x-5)=10-2x \Rightarrow -2x+10=10-2x \Rightarrow -2x+2x+10=10-2x+2x \Rightarrow 10=10$

Since $10 = 10$ is always true, the equation has infinitely many solutions.

(c) $-(x-1)=-x-1 \Rightarrow -x+1=-x-1 \Rightarrow -x+x+1=-x+x-1 \Rightarrow 1=-1$

Since this is never true, the equation has no solutions.

5. (a) Let D represent distance from home and x represent hours driven. Note that the driver is initially 300 miles from home and that each hour driven the driver gets closer to home by 75 miles. Thus, the formula is $D = 300 - 75x$.

(b) Since the distance from home, when the driver is home, is 0, use the formula and set D equal to 0. Thus, $0 = 300 - 75x$.

(c) $0=300-75x \Rightarrow 0+75x=300-75x+75x \Rightarrow 75x=300 \Rightarrow \frac{75x}{75}=\frac{300}{75} \Rightarrow x=4$ hours.

Section 2.3 Introduction to Problem Solving

1. Check your solution.
2. +
3. =
4. $n+1$ and $n+2$
5. $\frac{x}{100}$
6. 0.01
7. left
8. right
9. $\frac{B-A}{A} \cdot 100$

10. increase; decrease
11. rt
12. distance; time
13. Let t represent the number. $2+t=12 \Rightarrow 2-2+t=12-2 \Rightarrow t=10$
14. $2x+7=9 \Rightarrow 2x+7-7=9-7 \Rightarrow 2x=2 \Rightarrow \frac{2x}{2}=\frac{2}{2} \Rightarrow x=1$
15. $\frac{x}{5}=x-24 \Rightarrow \frac{x}{5} \cdot 5=5(x-24) \Rightarrow x=5x-120 \Rightarrow x-5x=5x-5x-120 \Rightarrow -4x=-120 \Rightarrow$ $\frac{-4x}{-4}=\frac{-120}{-4} \Rightarrow x=30$
16. $25x=125 \Rightarrow \frac{25x}{25}=\frac{125}{25} \Rightarrow x=5$
17. $\frac{x+5}{2}=7 \Rightarrow \frac{x+5}{2} \cdot 2=7 \cdot 2 \Rightarrow x+5=14 \Rightarrow x+5-5=14-5 \Rightarrow x=9$
18. $8-x=5 \Rightarrow 8-8-x=5-8 \Rightarrow -x=-3 \Rightarrow -1(-x)=-1(-3) \Rightarrow x=3$
19. $\frac{x}{2}=17 \Rightarrow \frac{x}{2} \cdot 2=17 \cdot 2 \Rightarrow x=34$
20. $5x=95 \Rightarrow \frac{5x}{5}=\frac{95}{5} \Rightarrow x=19$
21. Let the smallest natural number be represented by x. $x+(x+1)+(x+2)=96 \Rightarrow 3x+3=96 \Rightarrow$ $3x+3-3=96-3 \Rightarrow 3x=93 \Rightarrow \frac{3x}{3}=\frac{93}{3} \Rightarrow x=31$ Thus, the numbers are 31, 32 and 33.
22. Let x represent the smallest integer, $x+(x+1)+(x+2)=-123 \Rightarrow 3x+3=-123 \Rightarrow$

$$3x + 3 - 3 = -123 - 3 \Rightarrow 3x = -126 \Rightarrow \frac{3x}{} = \frac{-126}{} \Rightarrow x = -42$$

3 3

Thus, the numbers are −42, − 41 and − 40.

23. $3x = 102 \Rightarrow \frac{3x}{3} = \frac{102}{3} \Rightarrow x = 34$

24. $x + 18 = 2x \Rightarrow x - x + 18 = 2x - x \Rightarrow 18 = x \Rightarrow x = 18$

25. $5x = 2x + 24 \Rightarrow 5x - 2x = 2x - 2x + 24 \Rightarrow 3x = 24 \Rightarrow \frac{3x}{3} = \frac{24}{3} \Rightarrow x = 8$

26. $3x = x - 18 \Rightarrow 3x - x = x - x - 18 \Rightarrow 2x = -18 \Rightarrow \frac{2x}{2} = \frac{-18}{2} \Rightarrow x = -9$

27. $\frac{6x}{7} = 18 \Rightarrow \frac{6x}{7} \cdot 7 = 18 \cdot 7 \Rightarrow 6x = 126 \Rightarrow \frac{6x}{6} = \frac{126}{6} \Rightarrow x = 21$

28. $\frac{2x-2}{5} = 4 \Rightarrow \frac{2x-2}{5} \cdot 5 = 4 \cdot 5 \Rightarrow 2x-2 = 20 \Rightarrow 2x-2+2 = 20+2 \Rightarrow 2x = 22 \Rightarrow \frac{2x}{2} = \frac{22}{2} \Rightarrow x = 11$

29. Let x represent the child's current age.

$x + 10 = 2x + 3 \Rightarrow x - x + 10 = 2x - x + 3 \Rightarrow 10 = x + 3 \Rightarrow 10 - 3 = x + 3 - 3 \Rightarrow 7 = x \Rightarrow x = 7$

30. Let x be the age of the daughter then $2x + 15$ is the age of the mother.

The equation is $49 = 2x + 15$.

$49 = 2x + 15 \Rightarrow 49 - 15 = 2x + 15 - 15 \Rightarrow 34 = 2x \Rightarrow \frac{34}{2} = \frac{2}{2}x \Rightarrow x = 17$ and $2x + 15 = 49$

31. Let x be the previous weight of the individual.

$x - 30 = \frac{1}{3}x + 110 \Rightarrow 3(x-30) = 3\left(\frac{1}{3}x + 110\right) \Rightarrow 3x - 90 = x + 330 \Rightarrow 3x - x - 90 = x - x + 330 \Rightarrow$

$2x - 90 = 330 \Rightarrow 2x - 90 + 90 = 330 + 90 \Rightarrow 2x = 420 \Rightarrow \frac{2x}{2} = \frac{420}{2} \Rightarrow x = 210$ lb

32. Let x be the person's weight before gaining 25 pounds. The equation is $x + 25 = 2x - 115$.

$x - x + 25 = 2x - x - 115 \Rightarrow 25 = x - 115 \Rightarrow 25 + 115 = x - 115 + 115 \Rightarrow x = 140$ pounds

33. Let x be the number of waste sites in Washington.

$24 = 2x - 2 \Rightarrow 24 + 2 = 2x - 2 + 2 \Rightarrow 26 = 2x \Rightarrow \frac{26}{2} = \frac{2x}{2} \Rightarrow 13 = x \Rightarrow x = 13$

34. Let x be the number of unhealthy air quality days in San Diego.

$100 = 3x + 1 \Rightarrow 100 - 1 = 3x + 1 - 1 \Rightarrow 99 = 3x \Rightarrow \frac{99}{3} = \frac{3x}{3} \Rightarrow 33 = x \Rightarrow x = 33$

35. Let x be the number of reptiles on the endangered species list.

$92 = 2x + 12 \Rightarrow 92 - 12 = 2x - 12 + 12 \Rightarrow 80 = 2x \Rightarrow \frac{80}{2} = \frac{2x}{2} \Rightarrow 40 = x \Rightarrow x = 40$

36. $84 = 3x + x \Rightarrow 84 = 4x \Rightarrow \frac{84}{4} = \frac{4x}{4} \Rightarrow 21 = x \Rightarrow x = 21$ and $3x = 63$

There are 63,000 millionaires in Kentucky and 21,000 millionaires in Rhode Island.

37. $x - 1562 = 250 \Rightarrow x - 1562 + 1562 = 250 + 1562 \Rightarrow x = 1812$ million

38. $311 = 2x - 189 \Rightarrow 311 + 189 = 2x - 189 + 189 \Rightarrow 500 = 2x \Rightarrow \frac{500}{2} = \frac{2x}{2} \Rightarrow 250 = x \Rightarrow$

$x = 250$ billion kilowatt-hours

39. $2x - 4 = 70 \Rightarrow 2x - 4 + 4 = 70 + 4 \Rightarrow 2x = 74 \Rightarrow \frac{2x}{2} = \frac{74}{2} \Rightarrow x = 37$

There were 37,000 cosmetic surgeries performed on persons under age 18.

40. $368 = 13x - 22 \Rightarrow 368 + 22 = 13x - 22 + 22 \Rightarrow 390 = 13x \Rightarrow \frac{390}{13} = \frac{13x}{13} \Rightarrow 30 = x \Rightarrow x = 30$ thousand

41. $106 = 2(x + 5) + 2x \Rightarrow 106 = 2x + 10 + 2x \Rightarrow 106 = 4x + 10 \Rightarrow 106 - 10 = 4x + 10 - 10 \Rightarrow$
$96 = 4x \Rightarrow \frac{96}{4} = \frac{4x}{4} \Rightarrow 24 = x \Rightarrow x = 24$

Section 2.3: Introduction to Problem Solving 67

42. $24 = (x + 4) + (x + 2) + x \Rightarrow 24 = 3x + 6 \Rightarrow 24 - 6 = 3x + 6 - 6 \Rightarrow 18 = 3x \Rightarrow$
$\frac{18}{3} = \frac{3x}{3} \Rightarrow 6 = x \Rightarrow x = 6$

43. $62 = 2x + 2(x + 7) \Rightarrow 62 = 2x + 2x + 14 \Rightarrow 62 = 4x + 14 \Rightarrow 62 - 14 = 4x + 14 - 14 \Rightarrow$
$48 = 4x \Rightarrow \frac{48}{4} = \frac{4x}{4} \Rightarrow 12 = x \Rightarrow x = 12$ and $x + 7 = 19$

The length is 19 inches and the width is 12 inches.

44. $102 = x + (x - 15) + (x - 6) \Rightarrow 102 = 3x - 21 \Rightarrow 102 + 21 = 3x - 21 + 21 \Rightarrow$.
$123 = 3x \Rightarrow \frac{123}{3} = \frac{3x}{3} \Rightarrow 41 = x \Rightarrow x = 41$, $x - 6 = 35$, and $x - 15 = 26$

The measures are 26, 35, and 41 feet.

45. $170 = x + (2x - 10) \Rightarrow 170 = 3x - 10 \Rightarrow 170 + 10 = 3x - 10 + 10 \Rightarrow$
$180 = 3x \Rightarrow \frac{180}{3} = \frac{3x}{3} \Rightarrow 60 = x \Rightarrow x = 60$ and $2x - 10 = 110$

Therefore, Facebook had 60 million users and MySpace had 110 million users.

46. $x + 225 = 400 \Rightarrow x + 225 - 225 = 400 - 225 \Rightarrow x = 175$

There were 175 million Facebook users in February 2009.

47. $248,000 = x + (x - 52,000) \Rightarrow 248,000 = 2x - 52,000 \Rightarrow 248,000 + 52,000 = 2x \Rightarrow$
$300,000 = 2x \Rightarrow \frac{300,000}{2} = \frac{2x}{2} \Rightarrow 150,000 = x \Rightarrow x = 150,000$ and $x - 52,000 = 98,000$

In 2003 there were 150,000 troops and in 2010 there were 98,000 troops.

48. $64 = x + (x - 12) \Rightarrow 64 = 2x - 12 \Rightarrow 64 + 12 = 2x - 12 + 12 \Rightarrow$
$76 = 2x \Rightarrow \frac{76}{2} = \frac{2x}{2} \Rightarrow 38 = x \Rightarrow x - 38$ and $x - 12 = 26$

In 1980 there were 38 million acres and in 2009 there were 26 million acres.

49. $37\% = \frac{37}{100}$ $37\% = 37 \times 0.01 = 0.37$

50. $52\% = \frac{52}{100} = \frac{13 \cdot 4}{25 \cdot 4} = \frac{13}{25}$ $52\% = 52 \times 0.01 = 0.52$

51. $148\% = \frac{148}{100} = \frac{37 \cdot 4}{25 \cdot 4} = \frac{37}{25}$ $148\% = 148 \times 0.01 = 1.48$

52. $252\% = \frac{252}{100} = \frac{63 \cdot 4}{25 \cdot 4} = \frac{63}{25}$ $252\% = 252 \times 0.01 = 2.52$

6.9 6.9 10 69

53. $6.9\% = \frac{}{100} = \frac{}{100} \cdot \frac{}{10} = \frac{}{1000}$ $6.9\% = 6.9 \times 0.01 = 0.069$

54. $8.1\% = \frac{8.1}{100} = \frac{8.1}{100} \cdot \frac{10}{10} = \frac{81}{1000}$ $8.1\% = 8.1 \times 0.01 = 0.081$

55. $0.05\% = \frac{0.05}{100} = \frac{0.05}{100} \cdot \frac{100}{100} = \frac{5}{10,000} = \frac{1 \cdot 5}{2000 \cdot 5} = \frac{1}{2000}$

$0.05\% = 0.05 \times 0.01 = 0.0005$