

2.2 Exercises

Concept Check

Fill-in-the-Blank. Complete the sentences using information found in this section.

1. The first step in solving linear equations that simplify to the form $ax + b = c$ is to combine _____ terms on both sides of the equation.
2. When solving a linear equation that has been simplified to the form $ax + b = c$, use the _____ principle of equality and add the _____ of the constant b to both sides of the equation.
3. Once you have a variable term on one side of the equation and a constant term on the other, use the _____ principle of equality and multiply both sides of the equation by the reciprocal of the coefficient of the variable.
4. When you multiply both sides of the equation by the reciprocal of the coefficient of the variable, the coefficient of the variable will become _____.
5. Check your answer by _____ it in for the variable in the original equation.
6. Every linear equation is a/an _____ equation.

True/False. Determine whether each statement is true or false. If a statement is false, explain how it can be changed so the statement will be true. (**Note:** There may be more than one acceptable change.)

7. The first step in solving $2x + 3 = 9$ is to add 3 to both sides.
8. To solve an equation that has been simplified to $4x = 12$, you need to multiply both sides by $\frac{1}{4}$, or divide both sides by 4.
9. If an equation has no solution, it is called an identity.
10. The most general form of a linear equation is $ax + b = cx + d$.

Practice

Solve each equation.

- | | |
|-------------------|------------------------|
| 1. $3x + 11 = 2$ | 7. $-5x + 2.9 = 3.5$ |
| 2. $4y - 8 = -12$ | 8. $3x + 2.7 = -2.7$ |
| 3. $6x + 10 = 22$ | 9. $10 + 3x - 4 = 18$ |
| 4. $9x - 5 = 13$ | 10. $14 = 9x + 5 + 8$ |
| 5. $1 - 3y = 4$ | 11. $5y - 3y + 2 = 2$ |
| 6. $5 - 2x = 9$ | 12. $6y + 8y - 7 = -7$ |

13. $3y + 9y - 13 = 11$

14. $-20 = 5y + y + 16$

15. $4n - 10n + 35 = 1 - 2$

16. $-5n - 3n + 2 = 34$

17. $2n + 12 + n = 0$

18. $5.4x - 0.2x = 0$

19. $0 = 5.1x + 0.3x$

20. $\frac{1}{2}x + 7 = \frac{7}{2}$

21. $\frac{3}{5}x + 4 = \frac{9}{5}$

22. $\frac{3}{2} = \frac{1}{3}x + \frac{11}{3}$

23. $\frac{11}{8} = \frac{1}{5}x + \frac{4}{5}$

24. $\frac{7}{2} - 5 - \frac{5}{2}x = 9$

25. $\frac{8}{3} + 2 - \frac{7}{3}x = 6$

26. $\frac{5}{8}x - \frac{1}{4}x + \frac{1}{2} = \frac{3}{10}$

27. $\frac{1}{2}x + \frac{3}{4}x - \frac{5}{3} = \frac{5}{6}$

28. $\frac{7}{8} = \frac{3}{4}x - \frac{5}{8}$

29. $\frac{1}{10} = \frac{4}{5}x + \frac{3}{10}$

30. $\frac{y}{7} + \frac{y}{28} + \frac{1}{2} = \frac{3}{4}$

31. $\frac{5y}{6} - \frac{7y}{8} - \frac{1}{12} = \frac{1}{3}$

32. $x + 1.2x + 6.9 = -3.0$

33. $33 = y + 3 - 0.4y$

34. $2.5x + 0.5x - 3.5 = 2.5$

35. $4.7 - 0.5x - 0.3x = -0.1$

36. $6.4 + 1.2x + 0.3x = 0.4$

37. $3x + 2 = x - 8$

38. $5x + 1 = 2x - 5$

39. $4n - 3 = n + 6$

40. $2y + 5 = 8y + 10$

41. $3x + 11 = 8x - 4$

42. $14n = 3n$

43. $1.6x = 0.8x$

44. $6y - 2.1 = y - 2.1$

45. $2(z + 1) = 3z + 3$

46. $6x - 3 = 3(x + 2)$

47. $16y + 23y - 3 = 16y - 2y + 2$

48. $5x - 2x + 4 = 3x + x - 1$

49. $6.5 + 1.2x = 0.5 - 0.3x$

50. $x - 0.1x + 0.8 = 0.2x + 0.1$

51. $\frac{2}{3}x + 1 = \frac{1}{3}x - 6$

52. $\frac{4}{5}n + 2 = \frac{2}{5}n - 4$

53. $\frac{y}{5} + \frac{3}{4} = \frac{y}{2} + \frac{3}{4}$

54. $\frac{5n}{6} + \frac{1}{9} = \frac{3n}{2} + \frac{1}{9}$

55. $\frac{3}{8}\left(y - \frac{1}{2}\right) = \frac{1}{8}\left(y + \frac{1}{2}\right)$

56. $\frac{1}{2}\left(\frac{x}{2} + 1\right) = \frac{1}{3}\left(\frac{x}{2} - 1\right)$

57. $x + \frac{2}{3}x - 2x = \frac{x}{6} - \frac{1}{8}$

58. $3x + \frac{1}{2}x - \frac{2}{5}x = \frac{x}{10} + \frac{7}{20}$

59. $3(1 + 9x) = 6(2 - 4x)$

60. $4(5 - x) = 8(3x + 10)$

61. $5 - 3(2x + 1) = 4(x - 5) + 6$

62. $-2(y + 5) - 4 = 6(y - 2) + 2$

63. $0.2(x + 3) = 0.1(x - 5)$

64. $0.4(x + 3) = 0.3(x - 6)$

65. $\frac{1}{2}(4 - 8x) = \frac{1}{3}(4x + 7) - 3$

66. $3 + \frac{1}{4}(x - 4) = \frac{2}{5}(2 + 3x)$

67. $0.12n + 0.25n - 5.895 = 4.3n$

68. $0.15n + 32n - 21.0005 = 10.5n$

69. $0.7(x + 14.1) = 0.3(x + 32.9)$

70. $0.8(x - 6.21) = 0.2(x - 24.84)$

Determine whether each equation is a conditional equation, an identity, or a contradiction. See Examples 11 through 13.

71. $2(3x - 1) + 5 = 3$

72. $-2x + 13 = -2(x - 7)$

73. $5x + 13 = -2(x - 7) + 3$

74. $7(x - 1) = -3(3 - x) + 4x$

75. $3(x - 2) + 4x = 6(x - 1) + x$

76. $5(x + 1) = 3(x + 1) + 2(x + 1)$

77. $8x - 20 + x = -3(5 - 2x) + 3(x - 4)$


78. $5.2x + 3.4x = 0.2(x - 0.42)$

Applications

Solve.

79. The tickets for a concert featuring the new hit band, Flying Sailor, sold out in 2.5 hours. If there were 35,000 tickets sold, solve the equation $35,000 - 2.5x = 0$ to find the number of tickets sold per hour.
80. Salim is a student in a course on the modern British novel. He is given an assignment to read a 350 page novel in 7 days. He reads the first 38 pages of the novel on the day he receives his assignment and decides to finish the novel by reading the same amount of pages of each day until the assignment is due. Solve the equation $6x + 38 = 350$ to determine how many pages Salim should read each day.
81. All snacks (candy, popcorn, and soda) cost \$3.50 each at the local movie theater. Admission tickets cost \$7.50 each. After a long week, Carlos treats himself to a night at the movies. His movie night budget is \$25 and he spends all his movie money. Solve the equation $\$3.50x + \$7.50 = \$25.00$ to determine how many snacks Carlos can buy.
82. The Political Science Club at Homestate University is planning to host an election night party for members and guests. The club plans to serve cookies and estimates it will need a total of 1500 cookies in 6 varieties for the party. The club orders 300 chocolate chip cookies and an equal number of cookies in each of the remaining 5 varieties. Solve the equation $5x + 300 = 1500$ to determine how many cookies of each remaining variety will be ordered.

- 83.** All courses in the Homestate University graduate school are worth 3 credits. To earn a master's degree, a student must earn a total of 36 credits. The student's thesis work counts as 6 credits. Solve the equation $3x + 6 = 36$ to determine how many courses a student must take to earn a master's degree.
- 84.** Jeff, who lives in England, is reading a letter from his pen pal in the United States. His pen pal says that the temperature was 97.7° Fahrenheit that day, making it too hot to play soccer outside. Jeff doesn't know how hot this is, because he is used to temperatures in Celsius. Help Jeff solve the equation, $1.8C + 32 = 97.7$ to determine the temperature in degrees Celsius.
- 85.** The tallest man-made structure in the world is the Burj Khalifa in Dubai, which stands at 2717 feet tall. The tallest tree in the world is a Mendocino tree in California. If 7 of these trees were stacked on top of each other, they would still be 59.1 feet shorter than the Burj Khalifa. Solve the equation, $7x + 59.1 = 2717$ to determine the height of the tree.
- 86.** Starbucks sells cake pops individually and in packages of 4. At the beginning of the day, Starbucks had 114 cake pops in stock. They sold 34 individual cake pops and several packages of cake pops. At the end of the day, there were 8 cake pops left. This situation can be modeled by the equation $114 - 34 - 4x = 8$, where x is the number of packages of cake pops sold.
- Explain what each term in the equation $114 - 34 - 4x = 8$ represents in the situation.
 - Solve the equation to determine the value of x .
 - What does the answer to Part **b.** mean? Write a complete sentence.
- 87.** The lowest temperature of the night was reported to be 24°F . The weather report mentioned that the temperature has steadily risen 1.5 degrees per hour since the lowest temperature of the day and it is currently 30°F . This situation can be modeled by the equation $24 + 1.5x = 30$, where x is the time in hours since the lowest temperature was recorded.
- Explain what each term in the equation $24 + 1.5x = 30$ represents in the situation.
 - Solve the equation to determine the value of x .
 - What does the answer to Part **b.** mean? Write a complete sentence.
- 88.** Caitlyn and Steve are planning their wedding reception and must decide between two catering halls. The first site, A Wedding Space, rents for \$800 for one day and charges \$50 per person for dinner. The second venue, A Wedding Place, costs \$1000 to rent for one day and charges \$40 per person for the same dinner. Solve the equation $800 + 50x = 1000 + 40x$ to determine how many guests they can invite so that the cost they pay will be the same at both wedding catering halls.

89. The value of a new car depreciates at a rate of about \$250 per month. Suppose a car originally costs \$30,000. The car was bought with a \$1000 down payment and a loan with 0% financing for 60 months with payments of \$200 a month. Solve the equation $30,000 - 250t = 29,000 - 200t$ to determine how many months it will take for the value of the vehicle to equal the amount owed on the loan?
90.  Heidrick has won a chance to “Eat the Elite” at the Zombie Dash 7-mile race. He will receive a 2.2-mile head start. The elite runners run at a pace of 12.6 miles per hour and Heidrick runs at a pace of 6 miles per hour. Solve the equation $12.6t = 6t + 2.25$ to determine how many hours it will take the elite runners catch up to Heidrick? Enter your answer in hours rounded to the nearest hundredth.
91. A company has two packaging options for shipping quantities of a certain inventory item. Option A uses 20 boxes and there are 5 items unpacked. Option B requires more filler and uses 23 boxes, where each box holds 2 less items than Option A and there are only 3 items unpacked. This situation can be represented by $20x + 5 = 23(x - 2) + 3$, where x is the number of items that can fit in the box used for Option A.
- What does $20x + 5$ represent in the equation?
 - What does $x - 2$ represent?
 - Solve the equation for x .
 - Check the solution.
 - What does the answer from part c. mean? Write a complete sentence.
92. Two advertisement flyers have the same area. The first flyer has a length of 12 inches and a width of x inches. The second flyer has a length of 4 inches and a width that is 10 inches more than x . This situation can be represented by $12x = 4(10 + x)$, where x is the width of the first flyer.
- What does $12x$ represent in the equation?
 - What does $10 + x$ represent?
 - Solve the equation for x .
 - Check the solution.
 - What does the answer from part c. mean? Write a complete sentence.
93. The manager of a café wants to list a price for the weekly featured combo that includes tax. He wants to sell a medium house-blend coffee with a pastry for a total of \$5.45. He doesn't know which pastry to sell with the coffee to avoid losing money on the combo. The medium coffee costs \$2.75 and the tax is 9%. He uses the equation $1.09(2.75 + x) = 5.45$ to determine the price of the pastry, which is represented by the variable x .
- What does the sum $2.75 + x$ represent?
 - Solve the equation for x .

- c. Which of the following pastries would you choose to be a part of the combo? Explain why you made your choice.

cherry pie for \$2.50, coffee cake for \$2.25, bagel for \$2.00

94. A farmer is putting a shed on his property. He has two designs. One uses wood and would cost \$2 per square foot plus an extra \$8400 in materials. The other design is metal and would cost \$4 per square foot plus an additional \$8800. Both sheds are the same size, and the wood shed costs $\frac{3}{4}$ what the metal shed costs. Solve the equation $2x + 8400 = \frac{3}{4}(4x + 8800)$ to determine how many square feet the shed will be.
95. An ice cream shop is having a special “Ice Cream Sunday” event in which they are giving away giant mixed sundaes of 3 scoops of vanilla ice cream and 2 scoops of chocolate. If they have 24 gallons of chocolate and 36 gallons of vanilla to start with, solve the equation, $36 - \frac{1}{20}(3x) = 24 - \frac{1}{20}(2x)$ to determine how many sundaes they will have made when they run out of ice cream. (For this problem, we assume a gallon equals 20 scoops.)

Writing & Thinking

96. Answer each question.
- Simplify the expression $3(x + 5) + 2(x - 7)$.
 - Solve the equation $3(x + 5) + 2(x - 7) = 31$.
 - How are the methods you used to answer questions **a.** and **b.** similar? How are they different?
97. Write an equation to represent each situation, using x to represent Ryan’s current age. Determine whether each equation is a conditional equation, an identity, or a contradiction, and explain why that makes sense for the situation represented.
- In 6 years, Ryan will be 20 years old.
 - In 6 years, Ryan will be 8 years older than he is now.
 - In 6 years, Ryan will be 3 years older than he will be 3 years from now.