

1. A student solves the system

$$5x - y = 15$$

$$7x + y = 21$$

and finds that $x=3$ is the correct value of x .

The student gives the solution set as $\{3\}$.

Is this correct? Explain

2. A student solves the system

$$x + y = 4$$

$$2x + 2y = 8$$

and obtains the equation $0=0$. The student gives the solution set as $\{(0,0)\}$.

Is this correct? Explain.

3. Given the system you were asked to solve the system by the method of substitution.

$$3x - y = 13$$

$$2x + 5y = 20$$

One student solves the problem by solving for y from the first equation first. Another student solves the system of equations by solving for x first, from the second equation. Both students get the correct solution $(5,2)$. Which student do you think had less work to do to solve the system.

4. When solving a system, how can we tell that a system has

(i) No solutions

(ii) Infinitely many solutions.

60. Line l_1 goes through $(1, 2)$ and $(1, -1)$. Line l_2 goes through $(4, 4)$ and $(3, 3)$.
61. Line l_1 goes through $(3, 5)$ and $(3, 6)$. Line l_2 goes through $(-2, 4)$ and $(-3, 4)$.
62. Line l_1 goes through $(-3, 7)$ and $(4, 7)$. Line l_2 goes through $(-5, 1)$ and $(-3, 1)$.

6 Applications

Solve each problem. See Examples 9 and 10.

63. **Super cost.** The average cost of a 30-second ad during the 1998 Super Bowl was \$1.3 million, and in 2006 it was \$2.8 million (www.adage.com).
- Find the slope of the line through $(1998, 1.3)$ and $(2006, 2.8)$ and interpret your result.
 - Use the slope to estimate the average cost of an ad in 2002. Is your estimate consistent with the accompanying graph?
 - Use the slope to predict the average cost in 2010.

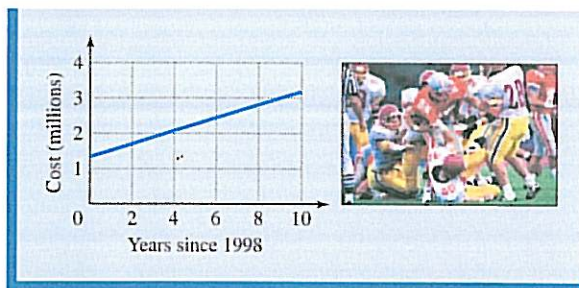


Figure for Exercise 63

64. **Retirement pay.** The annual Social Security benefit of a retiree depends on the age at the time of retirement. The accompanying graph gives the annual benefit for persons retiring at ages 62 through 70 in the year 2005 or later ([Social Security Administration, www.ssa.gov](http://www.ssa.gov)). What is the annual benefit for a person who retires at age 64? At what

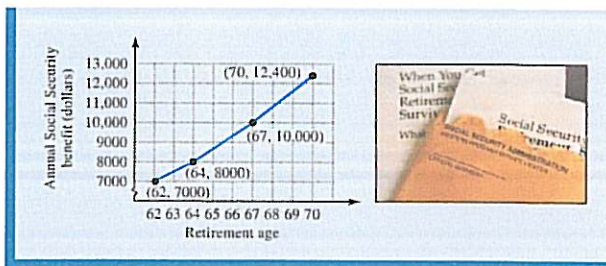


Figure for Exercise 64

retirement age does a person receive an annual benefit of \$11,600? Find the slope of each line segment on the graph, and interpret your results. Why do people who postpone retirement until 70 years of age get the highest benefit?

65. **Increasing training.** The accompanying graph shows the percentage of U.S. workers receiving training by their employers. The percentage went from 5% in 1982 to 29% in 2006 ([Department of Labor, www.dol.gov](http://www.dol.gov)). Find the slope of this line. Interpret your result.

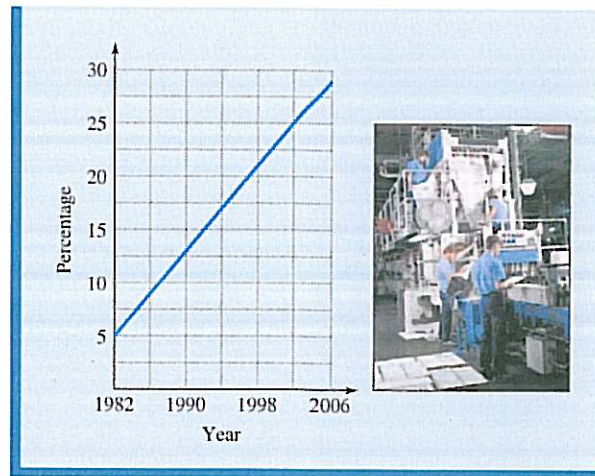


Figure for Exercise 65

66. **Saving for retirement.** Financial advisors at Fidelity Investments, Boston, use the accompanying table as a measure of whether a client is on the road to a comfortable retirement.

a) Graph these points and draw a line through them.

- What is the slope of the line?
- By what percentage of your salary should you be increasing your savings every year?

80. Direct deposit. The percentage of workers receiving direct deposit of their paychecks went from 32% in 1994 to 60% in 2004 (www.directdeposit.com). Let 1994 be year 0 and 2004 be year 10.

- Write the equation of the line through $(0, 32)$ and $(10, 60)$ to model the growth of direct deposit.
- Use the accompanying graph to predict the year in which 100% of all workers will receive direct deposit of their paychecks.
- Use the equation from part (a) to predict the year in which 100% of all workers will receive direct deposit.

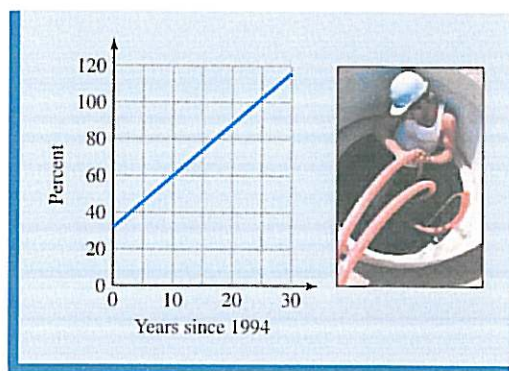


Figure for Exercise 80

81. Gross domestic product. The U.S. gross domestic product (GDP) per employed person increased from \$62.7 thousand in 1996 to \$71.6 thousand in 2002 (Bureau of Labor Statistics, www.bls.gov). Let 1996 be year 6 and 2002 be year 12.

- Find the equation of the line through $(6, 62.7)$ and $(12, 71.6)$ to model the gross domestic product.
- What do x and y represent in your equation?
- Use the equation to predict the GDP per employed person in 2010.
- Graph the equation.

82. Age at first marriage. The median age at first marriage for females increased from 24.5 years in 1995 to 25.1 years in 2000 (U.S. Census Bureau, www.census.gov). Let 1995 be year 5 and 2000 be year 10.

- Find the equation of the line through $(5, 24.5)$ and $(10, 25.1)$.
- What do x and y represent in your equation?
- Interpret the slope of this line.
- In what year will the median age be 30?
- Graph the equation.

83. Plumbing charges. Pete the plumber worked 2 hours at Millie's house and charged her \$70. He then worked 4 hours at Rosalee's house and charged her \$110. To determine the amount he charges, Pete uses a linear equation that gives the charge C in terms of the number of hours worked n . Find the equation and find the charge for 7 hours at Fred's house.

84. Interior angles. The sum of the measures of the interior angles of a triangle is 180° . The sum of the measures of the interior angles of a square is 360° . Let S represent the sum of the measures of the interior angles of a polygon and n represent the number of sides of the polygon. There is a linear equation that gives S in terms of n . Find the equation and find the sum of the measures of the interior angles of the stop sign shown in the accompanying figure.



Figure for Exercise 84

93. Enzyme concentration. The amount of light absorbed by a certain liquid depends on the concentration of an enzyme in the liquid. A concentration of 2 milligrams per milliliter (mg/ml) produces an absorption of 0.16 and a concentration of 5 mg/ml produces an absorption of 0.40. There is a linear equation that expresses the absorption a in terms of the concentration c .

- Find the equation.
- What is the absorption when the concentration is 3 mg/ml?
- Use the graph below to estimate the concentration when the absorption is 0.50.

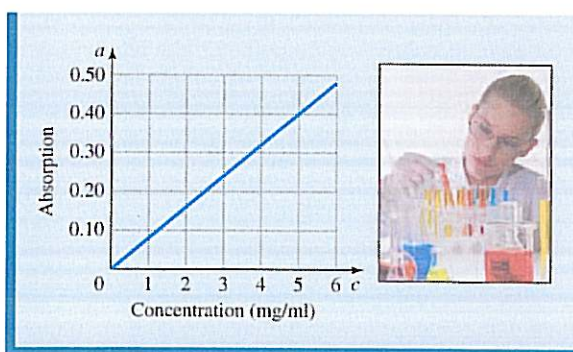


Figure for Exercise 93

94. Basal energy requirement. The basal energy requirement B is the number of calories that a person needs to maintain the life process. For a 28-year-old female with a height of 160 centimeters and a weight of 45 kilograms (kg), B is 1300 calories. If her weight increases to 50 kg, then B is 1365 calories. There is a linear equation that expresses B in terms of her weight w . Find the equation and find the basal energy requirement if her weight is 53.2 kg.

Getting More Involved

95. Exploration

Each linear equation in the following table is given in standard form $Ax + By = C$. In each case identify A , B , and the slope of the line.

Equation	A	B	Slope
$2x + 3y = 9$			
$4x - 5y = 6$			
$\frac{1}{2}x + 3y = 1$			
$2x - \frac{1}{3}y = 7$			

96. Exploration

Find a pattern in the table of Exercise 95 and write a formula for the slope of $Ax + By = C$, where $B \neq 0$.

Graphing Calculator Exercises

97. Graph each equation on a graphing calculator. Choose a viewing window that includes both the x - and y -intercepts. Use the calculator output to help you draw the graph on paper.

- $y = 20x - 300$
- $y = -30x + 500$
- $2x - 3y = 6000$

98. Graph $y = 2x + 1$ and $y = 1.99x - 1$ on a graphing calculator. Are these lines parallel? Explain your answer.

99. Graph $y = 0.5x + 0.8$ and $y = 0.5x + 0.7$ on a graphing calculator. Find a viewing window in which the two lines are separate.

100. Graph $y = 3x + 1$ and $y = -\frac{1}{3}x + 2$ on a graphing calculator. Do the lines look perpendicular? Explain.

7. The equations $y = 3x - 6$ and $y = 2x + 4$ are independent.
8. The equations $y = 2x + 7$ and $y = 2x + 8$ are inconsistent.
9. The graphs of dependent equations are the same.
10. The graphs of independent linear equations intersect at exactly one point.



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Exercises 7.1

Study Tips

- It is a good idea to work with others, but don't be misled. Working a problem with help is not the same as working a problem on your own.
- Math is personal. Make sure that you can do it.

Reading and Writing After reading this section, write out the answers to these questions. Use complete sentences.

1. How do we solve a system of linear equations by graphing?
2. How can you determine whether a system has no solution by graphing?
3. What is the major disadvantage to solving a system by graphing?
4. How do we solve systems by substitution?
5. How can you identify an inconsistent system when solving by substitution?
6. How can you identify a dependent system when solving by substitution?

$$\begin{aligned} 9. \quad & y = 2x - 1 \\ & 2y = x - 2 \end{aligned}$$



$$\begin{aligned} 11. \quad & y = x - 3 \\ & x - 2y = 4 \end{aligned}$$

$$\begin{aligned} 13. \quad & y = 2x + 4 \\ & 3x + y = -1 \end{aligned}$$

$$\begin{aligned} 15. \quad & y = -\frac{1}{2}x + 4 \\ & x + 2y = 8 \end{aligned}$$

$$\begin{aligned} 17. \quad & 2y - 2x = 2 \\ & 2y - 2x = 6 \end{aligned}$$

$$\begin{aligned} 19. \quad & y = -\frac{1}{4}x \\ & x + 4y = 8 \end{aligned}$$

$$\begin{aligned} 10. \quad & y = 2x + 1 \\ & x + y = -2 \end{aligned}$$

$$\begin{aligned} 12. \quad & y = -3x \\ & x + y = 2 \end{aligned}$$

$$\begin{aligned} 14. \quad & 3x - 2y = 6 \\ & 3x + 2y = 6 \end{aligned}$$

$$\begin{aligned} 16. \quad & 2x - 3y = 6 \\ & y = \frac{2}{3}x - 2 \end{aligned}$$

$$\begin{aligned} 18. \quad & 3y - 3x = 9 \\ & x - y = 1 \end{aligned}$$

$$\begin{aligned} 20. \quad & y = \frac{2}{3}x \\ & 2x + 3y = 5 \end{aligned}$$

1 Solving a System by Graphing

Solve each system by graphing. See Examples 1–3.

$$\begin{aligned} 7. \quad & y = 2x \\ & y = -x + 3 \end{aligned}$$

$$\begin{aligned} 8. \quad & y = x - 3 \\ & y = -x + 1 \end{aligned}$$

$$\begin{aligned} 21. \quad & 5x + 4y = 7 \\ & x - 3y = 9 \end{aligned}$$

$$\begin{aligned} 23. \quad & 4x - 5y = -2 \\ & 3y - x = -3 \end{aligned}$$

$$\begin{aligned} 22. \quad & 3x - 5y = -9 \\ & 5x - 6y = -8 \end{aligned}$$

$$\begin{aligned} 24. \quad & 4x + 5y = -2 \\ & 4y - x = 11 \end{aligned}$$

The graphs of the following systems are given in (a) through (d). Match each system with the correct graph.