

11. Verbal Model:  $\boxed{\text{Difference}} = \boxed{\text{Actual expense}} - \boxed{\text{Budgeted amount}}$

Equation:  $x = 163,356 - 162,700$   
 $x = \$656$  which is more than \$500.

12. Verbal Model:  $\boxed{\text{Difference}} = \boxed{\text{Actual expense}} - \boxed{\text{Budgeted amount}}$

Equation:  $x = |42,335 - 42,640|$   
 $x = |-305| = \$305$  which is less than \$500.

## CHAPTER 2 Graphs and Functions

### SECTION 2.1 The Rectangular Coordinate System

- $3x = 7$  is a linear equation because it can be written in the form  $ax + b = 0$ . Since  $x^2 + 3x = 2$  cannot be written in the form  $ax + b = 0$ , it is not a linear equation.
- To check  $x = 3$  is a solution of the equation  $5x - 4 = 11$  substitute 3 for  $x$  in the equation. If the result is true,  $x = 3$  is a solution.
- $6x(2x^2) = (6 \cdot 2) \cdot (x \cdot x^2) = 12x^3$
- $3t^2 \cdot t^4 = 3t^{2+4} = 3t^6$
- $$\begin{aligned} -(-3x^2)^3(2x^4) &= (-1)(-3)^3(2)(x^2)^3(x^4) \\ &= (-1)(-27)(2)(x^6)(x^4) \\ &= 54x^{10} \end{aligned}$$
- $(4x^3y^2)(-2xy^3) = (4)(-2)(x^3)(x)(y^2)(y^3)$   
 $= -8x^4y^5$
- $4 - 3(2x + 1) = 4 - 6x - 3 = 1 - 6x$
- $5(x + 2) - 4(2x - 3) = 5x + 10 - 8x + 12$   
 $= -3x + 22$
- $24\left(\frac{y}{3} + \frac{y}{6}\right) = 8y + 4y = 12y$
- $0.12x + 0.05(2000 - 2x) = 0.12x + 100 - 0.1x$   
 $= 0.02x + 100$

11. Your rate =  $\frac{1}{4}$  job per hour  
 Friend's rate =  $\frac{1}{5}$  job per hour

Verbal model:  $\boxed{\text{Work done}} = \boxed{\text{Work done by you}} + \boxed{\text{Work done by friend}}$

Labels: Work done = 1  
 Your rate =  $\frac{1}{4}$   
 Friend's rate =  $\frac{1}{5}$   
 Time =  $t$

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## 11. —CONTINUED—

Equation:  $1 = \frac{1}{4}t + \frac{1}{5}t$

$$1 = \left(\frac{1}{4} + \frac{1}{5}\right)t$$

$$1 = \left(\frac{9}{20}\right)t$$

$$\frac{1}{\frac{9}{20}} = t$$

$$\frac{20}{9} = t \approx 2.2 \text{ hours}$$

## 12. Verbal model:

Distance	=	Rate	·	Time
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Labels:

Distance = 200 miles at 50 mph  
 200 miles at 42 mph  
 400 miles at  $x$  mph

Rate = 50, 42,  $x$ 

$$\text{Time} = \frac{200}{50} + \frac{200}{42} \text{ or } \frac{400}{x}$$

Equation:

$$\frac{200}{50} + \frac{200}{42} = \frac{400}{x}$$

$$4 + \frac{100}{21} = \frac{400}{x}$$

$$\frac{184}{21} = \frac{400}{x}$$

$$x = \frac{21(400)}{184} \approx 45.65 \text{ mph}$$

## SECTION 2.2 Graphs of Equations

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1. If  $t - 3 > 7$  and  $c$  is an algebraic expression, then  $t - 3 + c > 7 + c$ .

2. If  $t - 3 < 7$  and  $c < 0$ , then  $(t - 3)c > 7c$ .

3. Multiplicative Inverse Property:

$$y\left(\frac{1}{y}\right) = 1$$

4.  $u + v = v + u$  illustrates the Commutative Property of Addition.

5.  $2x + 3 \geq 5$

$2x + 3 - 3 \geq 5 - 3$

$2x \geq 2$

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

$x \geq 1$

6.  $5 - 3x > 14$

$5 - 5 - 3x > 14 - 5$

$-3x > 9$

$\frac{-3x}{-3} < \frac{9}{-3}$

$x < -3$

7.  $-4 < 10x + 1 < 6$

$-4 - 1 < 10x + 1 - 1 < 6 - 1$

$-5 < 10x < 5$

$\frac{-5}{10} < \frac{10x}{10} < \frac{5}{10}$

$\frac{-1}{2} < x < \frac{1}{2}$

8.  $-2 \leq 1 - 2x \leq 2$

$-2 - 1 \leq 1 - 1 - 2x \leq 2 - 1$

$-3 \leq -2x \leq 1$

$\frac{-3}{-2} \geq \frac{-2x}{-2} \geq \frac{1}{-2}$

$\frac{3}{2} \geq x \geq \frac{-1}{2}$

$\frac{-1}{2} \leq x \leq \frac{3}{2}$

9.  $-3 \leq -\frac{x}{2} \leq 3$

$2 \cdot -3 \leq 2 \cdot -\frac{x}{2} \leq 3 \cdot 2$

$-6 \leq -x \leq 6$

$\frac{-6}{-1} \geq \frac{-x}{-1} \geq \frac{6}{-1}$

$6 \geq x \geq -6$

$-6 \leq x \leq 6$

10.  $-5 < x - 25 < 5$

$-5 + 25 < x - 25 + 25 < 5 + 25$

$20 < x < 30$

11. Verbal model:

Compared number	=	Percent	·	Base number
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Labels:

Compared number =  $a$ Percent =  $p$ Base number =  $b$ 

Equation:

$a = pb$

$32,500 = 1.12b$

$\frac{32,500}{1.12} = b$

$\$29,018 \approx b$

12. Verbal model:

$$\boxed{\text{Compared number}} = \boxed{\text{Percent}} \cdot \boxed{\text{Base number}}$$

Labels:

Compared number =  $a$

Percent =  $p$

Base number =  $b$

Equation:

$a = pb$

$a = (0.035)(3100)$

$a = \$108.50$

## SECTION 2.3 Slope and Graphs of Linear Equations

1. Two equations having the same set of solutions are called equivalent.

2.  $12x - 5 = 13$

$12x = 13 + 5$

3.  $x + \frac{x}{2} = 4$

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

$2x + x = 8$

$3x = 8$

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

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

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

$3\left(\frac{1}{3}x + 1\right) = (10)3$

$x + 3 = 30$

$x = 27$

5.  $-4(x - 5) = 0$

$-4x + 20 = 0$

$-4x = -20$

$\frac{-4x}{-4} = \frac{-20}{-4}$

$x = 5$

6.  $\frac{3}{8}x + \frac{3}{4} = 2$

$8\left(\frac{3}{8}x + \frac{3}{4}\right) = (2)8$

$3x + 6 = 16$

$3x = 10$

$x = \frac{10}{3}$

7.  $8(x - 14) = 32$

$8x - 112 = 32$

$8x = 144$

$\frac{8x}{8} = \frac{144}{8}$

$x = 18$

8.  $12(3 - x) = 5 - 7(2x + 1)$

$36 - 12x = 5 - 14x - 7$

$36 - 12x = -14x - 2$

$36 + 2x = -2$

$2x = -38$

$x = -19$

$$9. -(2x + 8) + \frac{1}{3}(6x + 5) = 0$$

$$-2x - 8 + 2x + \frac{5}{3} = 0$$

$$\frac{-24}{3} + \frac{5}{3} = 0$$

$$\frac{-19}{3} \neq 0$$

No solution

$$10. (1 + r)500 = 550$$

$$1 + r = \frac{550}{500}$$

$$1 + r = 1.1$$

$$r = 1.1 - 1$$

$$r = 0.1$$

11. Verbal model:

$$\boxed{\text{Total cost}} = \boxed{\text{Cost of first minute}} + 0.45 \boxed{\text{Number of additional minutes}}$$

Labels:

Total cost = \$11

Cost of first minute = \$1.10

Number of additional minutes =  $x$

Inequality:

$$11 \geq 1.10 + 0.45t > 1.10$$

$$9.9 \geq 0.45t > 0$$

$$22 \geq t > 0$$

$$0 < t \leq 22$$

$$0 < t \leq 23 \text{ (with first minute)}$$

$$12. 0.65m + 4500 < 20,000$$

$$0.65m < 15,500$$

$$m < 23,846$$

## SECTION 2.4 Equations of Lines

1. The ratio of the real number  $a$  to the real number  $b$  is  $\frac{a}{b}$ .

2.  $\frac{4}{5} = \frac{12}{u}$  is a proportion.

3. Verbal model:

$$\boxed{\text{Compared number}} = \boxed{\text{Percent}} \cdot \boxed{\text{Base number}}$$

Labels:

Compared number =  $a$

Percent =  $p$

Base number =  $b$

Equation:

$$a = p \cdot b$$

$$a = 0.075 \cdot 25$$

$$a = 1.875$$

4. Verbal model:  $\boxed{\text{Compared number}} = \boxed{\text{Percent}} \cdot \boxed{\text{Base number}}$

Labels: Compared number =  $a$

Percent =  $p$

Base number =  $b$

Equation:  $a = pb$

$$a = 1.50(6000)$$

$$a = 9000$$

5. Verbal model:  $\boxed{\text{Compared number}} = \boxed{\text{Percent}} \cdot \boxed{\text{Base number}}$

Labels: Compared number =  $a$

Percent =  $p$

Base number =  $b$

Equation:  $a = p \cdot b$

$$225 = p \cdot 150$$

$$\frac{225}{150} = p$$

$$1.5 = p$$

$$150\% = p$$

6. Verbal model:  $\boxed{\text{Compared number}} = \boxed{\text{Percent}} \cdot \boxed{\text{Base number}}$

Labels: Compared number =  $a$

Percent =  $p$

Base number =  $b$

Equation:  $a = pb$

$$93 = p \cdot 600$$

$$\frac{93}{600} = p$$

$$0.155 = p$$

$$15.5\% = p$$

7. *Verbal model:*

Compared number
-----------------

 = 

Percent
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 · 

Base number
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*Labels:* Compared number =  $a$

Percent =  $p$

Base number =  $b$

*Equation:*  $a = p \cdot b$

$$160 = p \cdot 240$$

$$\frac{160}{240} = p$$

$$0.6\overline{6}\frac{2}{3} = p$$

$$66\frac{2}{3}\% = p$$

8. *Verbal model:*

Compared number
-----------------

 = 

Percent
---------

 · 

Base number
-------------

*Labels:* Compared number =  $a$

Percent =  $p$

Base number =  $b$

*Equation:*  $a = pb$

$$42 = 0.12b$$

$$\frac{42}{0.12} = b$$

$$350 = b$$

9. *Verbal model:*

Compared number
-----------------

 = 

Percent
---------

 · 

Base number
-------------

*Labels:* Compared number =  $a$

Percent =  $p$

Base number =  $b$

*Equation:*  $a = pb$

$$400 = 0.005b$$

$$\frac{400}{0.005} = b$$

$$80,000 = b$$

10. *Verbal model:*

Compared number
-----------------

 = 

Percent
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 · 

Base number
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*Labels:* Compared number =  $a$

Percent =  $p$

Base number =  $b$

*Equation:*  $a = pb$

$$132 = 0.48b$$

$$\frac{132}{0.48} = b$$

$$275 = b$$

11. Verbal model:

$$\frac{\text{Cement}}{\text{Sand}} = \frac{\text{Cement}}{\text{Sand}}$$

Proportion:

$$\frac{1}{4} = \frac{90 - x}{x}$$

$$4(90 - x) = x$$

$$360 - 4x = x$$

$$360 = 5x$$

$$72 = x \text{ pounds}$$

12.  $96 - 32t = 0$ 

$$96 = 32t$$

$$\frac{96}{32} = t$$

$$3 = t \text{ seconds}$$

## SECTION 2.5 Relations and Functions

1. If  $a < b$  and  $b < c$ , then  $a < c$  by the Transitive Property.

2.  $9x = 36$

$$9x = \frac{1}{9}(36)$$

$$x = 4$$

3. "y is no more than 45" translates into  $y \leq 45$ .4. "x is at least 15" can be expressed in inequality notation as  $x \geq 15$ .

$$\begin{aligned} 5. 6y - 3x + 3x - 10y &= (6y - 10y) + (-3x + 3x) \\ &= -4y \end{aligned}$$

$$\begin{aligned} 6. 8(x - 2) - 3(x - 2) &= 8x - 16 - 3x + 6 \\ &= 5x - 10 \\ &= 5(x - 2) \end{aligned}$$

$$\begin{aligned} 7. \frac{2}{3}t - \frac{5}{8} + \frac{5}{6}t &= \left(\frac{2}{3} + \frac{5}{6}\right)t - \frac{5}{8} \\ &= \left(\frac{4}{6} + \frac{5}{6}\right)t - \frac{5}{8} \\ &= \frac{9}{6}t - \frac{5}{8} \\ &= \frac{3}{2}t - \frac{5}{8} \end{aligned}$$

$$\begin{aligned} 8. \frac{3}{8}x - \frac{1}{12}x + 8 &= \left(\frac{3}{8} - \frac{1}{12}\right)x + 8 \\ &= \left(\frac{9}{24} - \frac{2}{24}\right)x + 8 \\ &= \frac{7}{24}x + 8 \end{aligned}$$

$$\begin{aligned} 9. 3x^2 - 5x + 3 + 28x - 33x^2 &= (3x^2 - 33x^2) + (-5x + 28x) + 3 \\ &= -30x^2 + 23x + 3 \end{aligned}$$

$$\begin{aligned} 10. 4x^3 - 3x^2y + 4xy^2 + 15x^2y + y^3 &= 4x^3 + (-3 + 15)(x^2y) + 4xy^2 + y^3 \\ &= 4x^3 + 12x^2y + 4xy^2 + y^3 \end{aligned}$$

11. *Verbal model:*

$$\boxed{\frac{\text{Cups flour}}{\text{Batches cookies}}} = \boxed{\frac{\text{Cups flour}}{\text{Batches cookies}}}$$

*Proportion:*

$$\frac{2\frac{1}{2}}{1} = \frac{x}{3\frac{1}{2}}$$

$$x = 2\frac{1}{2} \cdot 3\frac{1}{2}$$

$$x = \frac{5}{2} \cdot \frac{7}{2}$$

$$x = \frac{35}{4} = 8\frac{3}{4} \text{ cups}$$

12. *Verbal model:*

$$\boxed{\frac{\text{Gasoline}}{\text{Oil}}} = \boxed{\frac{\text{Gasoline}}{\text{Oil}}}$$

*Proportion:*

$$\frac{32}{1} = \frac{x}{\frac{1}{2}}$$

$$x = 32 \cdot \frac{1}{2}$$

$$x = 16 \text{ pints or 4 gallons}$$

## SECTION 2.6 Graphs of Functions

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1.  $8x \cdot \frac{1}{8x} = 1$  illustrates the Multiplicative Inverse Property.

2.  $3x + 0 = 3x$  illustrates the Additive Identity Property.

3.  $-4(x + 10) = -4 \cdot x + (-4)(10)$  illustrates the Distributive Property

4.  $5 + (-3 + x) = (5 - 3) + x$  illustrates the Associative Property of Addition.

5.  $5x^4(x^2) = 5x^{4+2} = 5x^6$

6.  $3(x + 1)^2(x + 1)^3 = 3(x + 1)^{2+3} = 3(x + 1)^5$

7.  $(-4t^3) = (-4)^3(t)^3 = -64t^3$

8.  $-(-2x)^4 = -(-2)^4x^4 = -(+16)x^4 = -16x^4$

9.  $(u^2v)^4 = (u^2)^4v^4 = u^8v^4$

10.  $(3a^2b)^2(2b^3) = 3^2(a^2)^2b^2(2)(b^3)$   
 $= (9 \cdot 2)(a^4)(b^{2+3})$   
 $= 18a^4b^5$

**11. Verbal model:**  $\boxed{\text{Discount}} = \boxed{\text{Discount rate}} \cdot \boxed{\text{List price}}$

*Labels:*  
 Discount =  $x$   
 Discount rate = 20%  
 List price = \$239.95

*Equation:*  
 $x = 0.20(239.95)$   
 $x = \$47.99$

*Verbal model:*  $\boxed{\text{Total cost}} = \boxed{\text{List price}} + \boxed{\text{Shipping}}$

*Labels:*  
 Total cost =  $x$   
 List price = \$188.95  
 Shipping = \$4.32

*Equation:*  
 $x = 188.95 + 4.32$   
 $x = \$193.27$

*Verbal model:*  $\boxed{\text{Sale price}} = \boxed{\text{List price}} - \boxed{\text{Discount}}$

*Labels:*  
 Sale price =  $x$   
 List price = \$239.95  
 Discount = \$47.99

*Equation:*  
 $x = 239.95 - 47.99$   
 $x = \$191.96$

The department store price is a better bargain.

**12. Verbal model:**  $\boxed{\text{Compared number}} = \boxed{\text{Percent}} \cdot \boxed{\text{Base number}}$

*Labels:*  
 Compared number =  $a$   
 Percent =  $p$   
 Base number =  $b$

*Equation:*  
 $a = pb$   
 $a = 1.30(739)$   
 $a = \$960.70$