# CHAPTER 3 Polynomials and Factoring

## SECTION 3.1 Adding and Subtracting Polynomials

**1.** If the product of two real numbers is $-96$ and one of the factors is 12, the other factor is negative.

**2.** The sum of the digits of $576 = 5 + 7 + 6 = 18$. 576 is divisible by 9 and 3.

**3.** $-6^2$ is positive is a false statement. $-6^2 = -1 \cdot 6^2 = -1 \cdot 36 = -36$

**4.** $(-6)^2$ is positive is a true statement. $(-6)^2 = (-6)(-6) = 36$

**5.**
$$\begin{aligned} 2x - 12 &\geq 0 \\ 2x - 12 + 12 &\geq 12 \\ 2x &\geq 12 \\ \frac{2x}{2} &\geq \frac{12}{2} \\ x &\geq 6 \end{aligned}$$

**6.**
$$\begin{aligned} 7 - 3x &< 4 - x \\ 7 - 3x + x &< 4 - x + x \\ 7 - 2x &< 4 \\ 7 - 7 - 2x &< 4 - 7 \\ -2x &< -3 \\ \frac{-2x}{2} &> \frac{-3}{-2} \\ x &> \frac{3}{2} \end{aligned}$$

**7.**
$$\begin{aligned} -2 < 4 - 2x &< 10 \\ -2 - 4 < 4 - 4 - 2x &< 10 - 4 \\ -6 < -2x &< 6 \\ \frac{-6}{-2} > \frac{-2x}{-2} &> \frac{6}{-2} \\ 3 > x &> -3 \\ -3 < x &< 3 \end{aligned}$$

**8.**
$$\begin{aligned} 4 \leq x + 5 &< 8 \\ 4 - 5 \leq x + 5 - 5 &< 8 - 5 \\ -1 \leq x &< 3 \end{aligned}$$

**9.**
$$\begin{aligned} |x - 3| &< 2 \\ -2 < x - 3 &< 2 \\ -2 + 3 < x - 3 + 3 &< 2 + 3 \\ 1 < x &< 5 \end{aligned}$$

**10.** $|x - 5| > 3$
$$\begin{aligned} x - 5 &> 3 \quad \text{or} \quad & x - 5 &< -3 \\ x - 5 + 5 &> 3 + 5 & x - 5 + 5 &< -3 + 5 \\ x &> 8 \quad \text{or} & x &< 2 \end{aligned}$$

**11.** *Verbal model:* $\boxed{\dfrac{\text{Tax}}{\text{Assessed Value}}} = \boxed{\dfrac{\text{Tax}}{\text{Assessed Value}}}$

*Proportion:* $\dfrac{2400}{145{,}000} = \dfrac{x}{90{,}000}$

$$x = \frac{(2400)(90{,}000)}{145{,}000}$$

$$x = \$1489.66$$

**12.** *Verbal model:* $\boxed{\dfrac{\text{Gallons}}{\text{Miles}}} = \boxed{\dfrac{\text{Gallons}}{\text{Miles}}}$

*Proportion:* $\dfrac{7}{200} = \dfrac{x}{325}$

$$x = \frac{7.325}{200}$$

$$x = 11.375 \text{ gallons or } 11\frac{3}{8} \text{ gallons}$$

## SECTION 3.2 Multiplying Polynomials

**1.** The point $(-2, 3)$ is 2 units to the left of the $y$-axis and 3 units above the $x$-axis.

**2.** Point 3 units from $x$-axis and 4 units from $y$-axis $(4, 3), (-4, 3), (-4, -3), (4, -3)$

**3.**
$$y = \frac{3}{5}x + 4$$
$(15, \quad)$
$$y = \frac{3}{5}(15) + 4$$
$$y = 9 + 4$$
$$y = 13$$

**4.**
$$y = 3 - \frac{5}{9}x$$
$(12, \quad)$
$$y = 3 - \frac{5}{9}(12)$$
$$y = 3 - \frac{20}{3}$$
$$y = \frac{9}{3} - \frac{20}{3}$$
$$y = -\frac{11}{3}$$

**5.**
$$y = 5.5 - 0.95x$$
$(\quad, -1)$
$$-1 = 5.5 - 0.95x$$
$$-6.5 = -0.95x$$
$$\frac{-6.5}{-0.95} = x$$
$$6.84 \approx x$$

**6.**
$$y = 3 + 0.2x$$
$(\quad, 4.4)$
$$4.4 = 3 + 0.2x$$
$$1.4 = 0.2x$$
$$\frac{1.4}{0.2} = x$$
$$7 = x$$

**7.** $f(x) = \frac{1}{3}x^2$

(a) $f(6) = \frac{1}{3}(6)^2 = \frac{1}{3} \cdot 36 = 12$

(b) $f\left(\frac{3}{4}\right) = \frac{1}{3}\left(\frac{3}{4}\right)^2 = \frac{1}{3} \cdot \frac{9}{16}$

$$= \frac{3}{16}$$

**8.** $f(x) = 3 - 2x$

(a) $f(5) = 3 - 2(5)$

$= 3 - 10$

$= -7$

(b) $f(x + 3) - f(3) = 3 - 2(x + 3) - [3 - 2(3)]$

$= 3 - 2x - 6 - 3 + 6$

$= -2x$

**9.** $g(x) = \dfrac{x}{x + 10}$

(a) $g(5) = \dfrac{5}{5 + 10} = \dfrac{5}{15} = \dfrac{1}{3}$

(b) $g(c - 6) = \dfrac{c - 6}{(c - 6) + 10} = \dfrac{c - 6}{c + 4}$

**10.** $h(x) = \sqrt{x - 4}$

(a) $h(16) = \sqrt{16 - 4}$

$= \sqrt{12}$

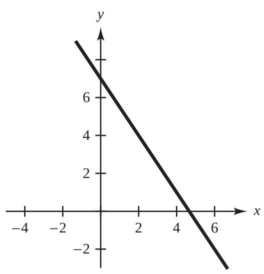
$= \sqrt{4 \cdot 3}$

$= 2\sqrt{3}$

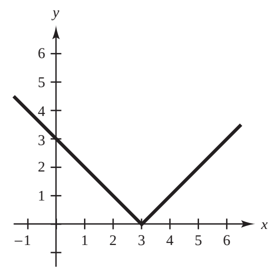
(b) $h(t + 3) = \sqrt{t + 3 - 4}$

$= \sqrt{t - 1}$

**11.** $g(x) = 7 - \dfrac{3}{2}x$




**12.** $h(x) = |3 - x|$



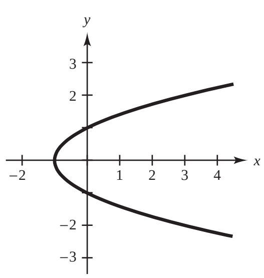

## SECTION 3.3 Factoring Polynomials

**1.** A function $f$ from a set A to a set B is a rule of correspondence that assigns to each element $x$ in the set A exactly one element $y$ in the set B.

**2.** The set A (see Exercise 1) is called the domain (or set of inputs) of the function $f$, and the set B (see Exercise 1) contains the range (or set of outputs) of the function $f$.

**3.** $y$ is not a function of $x$.

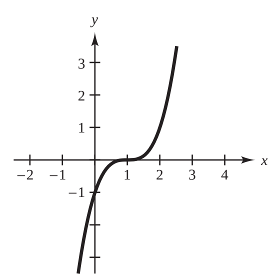
Answers will vary.



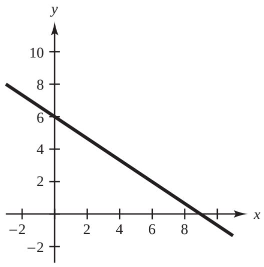

$x = y^2 - 1$

**4.** $y$ is a function of $x$.

Answers will vary.

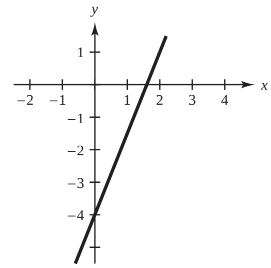


**5.** $y = 6 - \frac{2}{3}x$



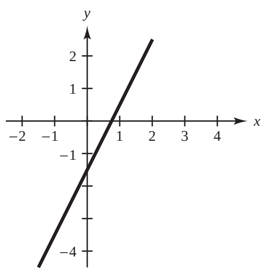

Function

**6.** $y = \frac{5}{2}x - 4$



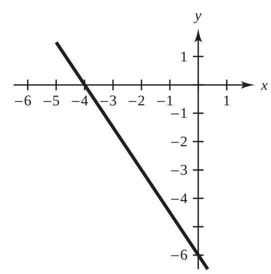

Function

**7.** $2y - 4x + 3 = 0$



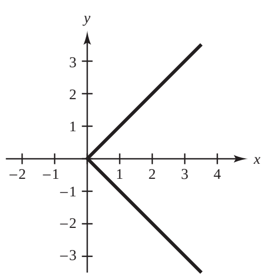

Function

**8.** $3x + 2y + 12 = 0$



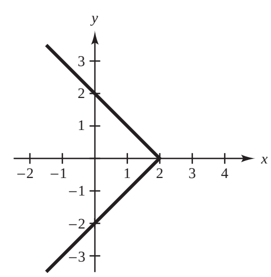

Function

**9.** $|y| - x = 0$



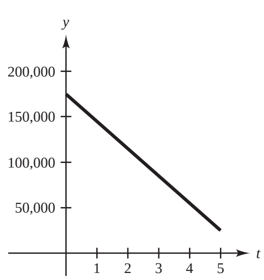

Not a function

**10.** $|y| = 2 - x$




Not a function

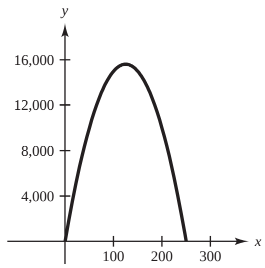
**11.**



**12.** (a) *Verbal model:* Area = Length · Width

*Function:* $A(x) = x \cdot (250 - x)$

(b)




# SECTION 3.4 Factoring Trinomials

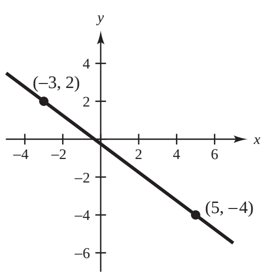
**1.** A function can have only one value of $y$ corresponding to $x = 0$.

**2.** Leading coefficient of $6t^3 + 3t^2 + 5t - 4$ is 6.

**3.** The set of all real numbers $x$ whose distance from 0 is less than 5 can be represented by $|x| < 5$.

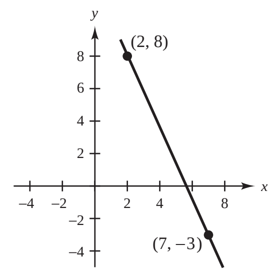
**4.** The set of all real numbers $x$ whose distance from 6 is more than 3 is represented by $|x - 6| > 3$.

**5.** $(-3, 2), (5, -4)$



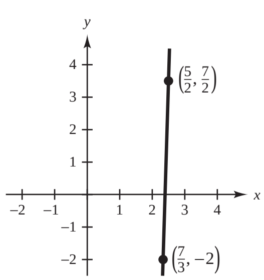

$$m = \frac{-4 - 2}{5 - (-3)} = \frac{-6}{8} = \frac{-3}{4}$$

**6.** $(2, 8), (7, -3)$



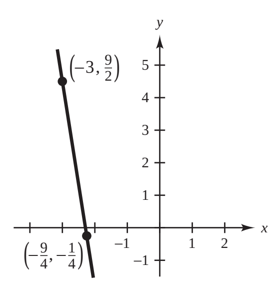

$$m = \frac{-3 - 8}{7 - 2} = \frac{-11}{5}$$

**7.** $\left(\frac{5}{2}, \frac{7}{2}\right), \left(\frac{7}{3}, -2\right)$



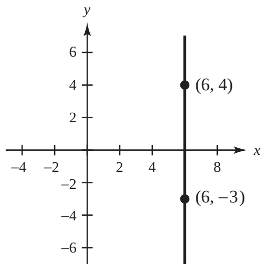
$$m = \frac{-2 - \frac{7}{2}}{\frac{7}{3} - \frac{5}{2}} \cdot \frac{6}{6} = \frac{-12 - 21}{14 - 15} = \frac{-33}{-1} = 33$$

**8.** $\left(-\frac{9}{4}, -\frac{1}{4}\right), \left(-3, \frac{9}{2}\right)$



$$m = \frac{\frac{9}{2} - \left(-\frac{1}{4}\right)}{-3 - \left(\frac{-9}{4}\right)} \cdot \frac{4}{4} = \frac{18 + 1}{-12 + 9} = \frac{19}{-3} = -\frac{19}{3}$$

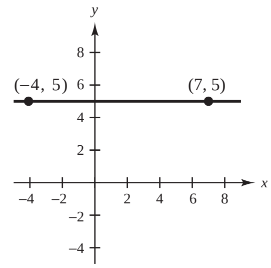
**9.** $(6, 4), (6, -3)$




$$m = \frac{-3 - 4}{6 - 6} = \frac{-7}{0}$$

$m$ is undefined

**10.** $(-4, 5), (7, 5)$




$$m = \frac{5 - 5}{7 - (-4)} = \frac{0}{11} = 0$$

**11.** *Verbal model:* [Interest] = [Principal] · [Rate] · [Time]

*Equation:* $i = 12{,}000 \cdot 0.12 \cdot \frac{1}{2}$

$i = \$720$

*Verbal model:* [Paymen] = [Principal] + [Interest]

*Equation:* $x = 12{,}000 + 720$

$x = \$12{,}720$

**12.** *Verbal model:* [Distance] = [Rate] · [Time]

[Time] = [Distance / Rate]

*Equation:* $$\frac{100}{54} + \frac{100}{45} = \frac{200}{x}$$

$$500x + 600x = 54000$$

$$1100x = 54000$$

$$x = \frac{54000}{1100}$$

$$x \approx 49.1 \text{ mph}$$

# SECTION 3.5 Solving Polynomial Equations

**1.** $3uv - 3uv = 0$ illustrates the Additive Inverse Property.

**2.** $5z \cdot 1 = 5z$ illustrates the Multiplicative Identity Property.

**3.** $2s(1 - s) = 2s - 2s^2$ illustrates the Distributive Property.

**4.** $(3x)y = 3(xy)$ illustrates the Associative Property of Multiplication.

**5.**
$$4 - \frac{1}{2}x = 6$$
$$4 - 4 - \frac{1}{2}x = 6 - 4$$
$$-\frac{1}{2}x = 2$$
$$(-2)\left(-\frac{1}{2}x\right) = (2)(-2)$$
$$x = -4$$

**6.**
$$500 - 0.75x = 235$$
$$500 - 500 - 0.75x = 235 - 500$$
$$-0.75x = -265$$
$$\frac{-0.75x}{-0.75} = \frac{-265}{-0.75}$$
$$x \approx 353.33$$

**7.**
$$4(x - 3) - (4x + 5) = 0$$
$$4x - 12 - 4x - 5 = 0$$
$$-17 \neq 0$$

No solution

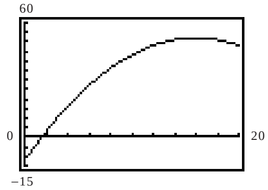
**8.**
$$12(3 - x) = 5 - 7(2x + 1)$$
$$36 - 12x = 5 - 14x - 7$$
$$36 - 12x = -2 - 14x$$
$$36 - 12x + 14x = -2 - 14x + 14x$$
$$36 + 2x = -2$$
$$36 - 36 + 2x = -2 - 36$$
$$2x = -38$$
$$\frac{2x}{2} = -\frac{38}{2}$$
$$x = -19$$

**9.**
$$\frac{12 + x}{4} = 13$$
$$4\left(\frac{12 + x}{4}\right) = (13)4$$
$$12 + x = 52$$
$$12 - 12 + x = 52 - 12$$
$$x = 40$$

**10.**
$$8(t - 24) = 0$$
$$t - 24 = 0$$
$$t = 24$$

**11.** (a) $P = R - C$
$$P = \left(16x - \frac{1}{4}x^2\right) - (12 + 8x)$$
$$= 16x - \tfrac{1}{4}x^2 - 12 - 8x$$
$$= -\tfrac{1}{4}x^2 + 8x - 12$$

(b)




*Keystrokes:*

[Y=] [(−)] 1 [÷] 4 [X,T,θ] [x²] [+] 8 [X,T,θ] [−] 12 [GRAPH]

(c)
$$P(16) = -\tfrac{1}{4}(16)^2 + 8(16) - 12$$
$$= -\tfrac{1}{4}(256) + 128 - 12$$
$$= -64 + 128 - 12$$
$$= 52$$

**12.**
$$-16t^2 + 576 = 0$$
$$-16t^2 + 576 - 576 = 0 - 576$$
$$-16t^2 = -576$$
$$\frac{-16t^2}{-16} = \frac{-576}{-16}$$
$$t^2 = 36$$
$$t = 6 \text{ seconds}$$