

## Section 3.4

## 2 Solve Equations by Factoring

Solving quadratic equations by factoring is an application of the Zero Product Property.

### Key Concept Zero Product Property

**Words** For any real numbers  $a$  and  $b$ , if  $ab = 0$ , then either  $a = 0$ ,  $b = 0$ , or both  $a$  and  $b$  equal zero.

**Example** If  $(x + 3)(x - 5) = 0$ , then  $x + 3 = 0$  or  $x - 5 = 0$ .

### Example 2 Factor the GCF

Solve each equation.

a.  $16x^2 + 8x = 0$

$$8x(2x + 1) = 0$$

$$\frac{8}{8}x = \frac{0}{8} \quad 2x + 1 = 0$$

$$x = 0$$

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

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

$$16(0)^2 + 8(0) = 0$$

$$0 = 0$$

$$16\left(-\frac{1}{2}\right)^2 + 8\left(-\frac{1}{2}\right) = 0$$

$$16\left(\frac{1}{4}\right) - 4 = 0$$

$$4 - 4 = 0 \checkmark$$

b.  $21x^2 - 14x = 0$

$$7x(3x - 2) = 0$$

$$\frac{7}{7}x = \frac{0}{7}$$

$$x = 0$$

$$3x - 2 = 0$$

$$3x = 2$$

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

**Guided Practice**

2A.  $20x^2 + 15x = 0$

$$5x(4x+3) = 0$$

$$5x = 0$$

$$x = 0$$

$$4x+3 = 0$$

$$4x = -3$$

$$x = \frac{-3}{4}$$

2B.  $4y^2 + 16y = 0$

2C.  $6a^5 + 18a^4 = 0$

$$6a^4(a+3) = 0$$

$$6a^4 = 0$$

$$\sqrt[4]{a^4} = \sqrt[4]{0}$$

$$a = 0$$

$$a+3 = 0$$

$$a = -3$$

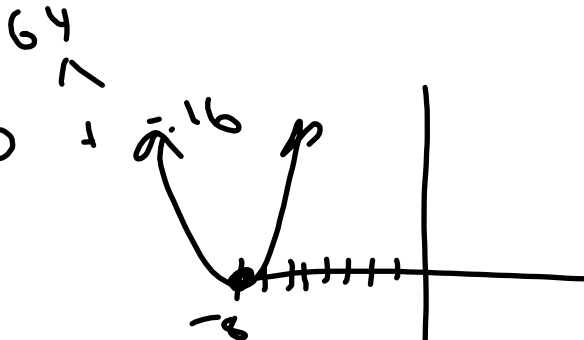
**Example 3** Perfect Squares and Differences of Squares

Solve each equation.

a.  $x^2 + 16x + 64 = 0$

$(x + 8)(x + 8) = 0$

$x + 8 = 0$   
 $x = -8$



b.  $x^2 = 64$

$\sqrt{x^2} = \pm\sqrt{64}$   
 $x = \pm 8$

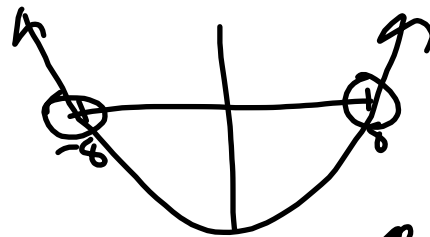
$\sqrt{x^2} - \sqrt{64} = 0$

a: x

$(x - 8)(x + 8) = 0$

$x - 8 = 0$      $x + 8 = 0$   
 $x = 8$        $x = -8$

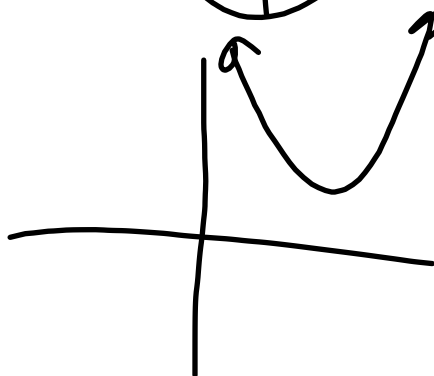
$a^2 - b^2 = (a - b)(a + b)$



c.  $x^2 + 225 = 0$

$\sqrt{x^2} = \pm\sqrt{-225}$

$x = \pm 15i$



$$3A. 4x^2 - 12x + 9 = 0$$

$$(4x^2 - 6x)(-6x + 9) = 0$$

$$2x(2x-3) - 3(2x-3) = 0$$

$$(2x-3)(2x-3) = 0$$

$$2x-3=0 \quad x = \frac{3}{2}$$

$$2x=3$$

36

^

$$-6 + -6 = -12$$

$$3B. 81x^2 - 9x = 0$$

$$9x(9x-1) = 0$$

$$9x = 0$$

$$x = 0$$

$$9x-1=0$$

$$\frac{9x}{9} = \frac{1}{9}$$

$$x = \frac{1}{9}$$

$$3C. a^2 + 9 = 0$$

$$\sqrt{a^2} = \pm \sqrt{-9}$$

$$a = \pm 3i$$

Solve each equation.

a.  $x^2 + 9x + 20 = 0$

b.  $6y^2 - 23y + 20 = 0$

$$\begin{aligned}
 (6y^2 - 8y)(-5y + 20) &= 0 \\
 2y(3y - 4) - 5(3y - 4) &= 0 \\
 (3y - 4)(2y - 5) &= 0 \\
 3y - 4 = 0 & \quad 2y - 5 = 0 \\
 3y = 4 & \quad 2y = 5 \\
 y = \frac{4}{3} & \quad y = \frac{5}{2}
 \end{aligned}$$

$$\begin{array}{c}
 120 \\
 \wedge \\
 -8 + -15 = -23
 \end{array}$$

4A.  $x^2 - 11x + 30 = 0$

$$4B. x^2 - 4x - 21 = 0$$

$$(x + 3)(x - 7) = 0$$

$$x = -3 \quad x = 7$$

$$4C. 15x^2 - 8x + 1 = 0$$

$$(15x^2 - 5x)(3x + 1) = 0$$

$$5x(3x - 1) - 1(3x - 1) = 0 \quad -5 \quad -3 \quad -8$$

$$3x - 1 = 0$$

$$3x = 1$$

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

$$5x - 1 = 0$$

$$5x = 1$$

$$x = \frac{1}{5}$$

15  
/