

Solve Quadratic Equations BY FACTORING

$$ax^2 + bx + c$$

We will solve quadratic equations by factoring.

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What are we going to learn?

Activate Prior Knowledge

Factor:

1. $x^2 - 10x + 16$

Factors of 16	Sum
-1 and -16	-17
-2 and -8	-10
-4 and -4	-8

$(x - 2)(x - 8)$

2. $x^2 + 12x + 35$

Factors of 35	Sum
1 and 35	36
5 and 7	12

$(x + 5)(x + 7)$

Make Connection

Students, you already know how to factor expressions. Now, we will solve quadratic equations by factoring.

A **quadratic equation** is a second-degree polynomial equation.

$$x^2 + 2x = 35 \quad x^2 - 8x = 9$$

Factoring is a method for solving a quadratic equation.

The **Zero Product Property** states that if the product of two unknown numbers equals zero, one or both of the numbers is equal to zero.

On your white boards, write a quadratic equation.
 If $(x-2)(x-3) = 0$, what do you know from the Zero Product Property?
 In your own words, what does the Zero Product Property state?
 "The Zero Product Property is _____."

Zero Product Property		
Rule	Example	Algebra example
If the product of two unknown numbers equals zero, one or both of the numbers equals zero.	$3(0) = 0$ $0(4) = 0$ $0(0) = 0$	For all real numbers a and b , if $ab = 0$, then $a = 0$ or $b = 0$.

Factoring:

Set the right-hand side of the equation equal to zero then factor the quadratic equation.

$$x^2 - 6x + 8 = 0$$

Factors of 8	Sum
-1 and -8	-9
-2 and -4	-6

$$(x - 2)(x - 4) = 0$$

Apply the Zero Product Property. (one or both must equal zero)

$$(x - 2) = 0 \quad (x - 4) = 0$$

Solve for x.

$$\begin{array}{r} x - 2 = 0 \\ +2 \quad +2 \\ \hline x = 2 \end{array} \quad \begin{array}{r} x - 4 = 0 \\ +4 \quad +4 \\ \hline x = 4 \end{array}$$

(The solutions make the equation true. Solutions are also known as the *roots* of the equation.)

Skill Development/Guided Practice

A **quadratic equation** is a second-degree polynomial equation.

The **Zero Product Property** states that if the product of two unknown numbers equals zero, one or both of the numbers is equal to zero.

Solve quadratic equations by factoring.

- 1 Set the right-hand side equal to zero, if necessary.
- 2 Factor the quadratic equation, if necessary.
- 3 Set up two equations using the Zero Product Property.
- 4 Solve each equation.
- 5 Read the answer. *The solutions to the quadratic equation are _____*

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- 1 How did I/you set the right-hand side equal to zero?
- 2 How did I/you factor the equations?
- 3 How did I/you set up two equations using the Zero Product Property?

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

$$\begin{array}{r} x - 3 = 0 \\ +3 \quad +3 \\ x = 3 \end{array} \quad \begin{array}{r} x + 7 = 0 \\ -7 \quad -7 \\ x = -7 \end{array}$$

The solutions to the quadratic equation are $x = 3$ and $x = -7$.

2. $(x - 2)(x + 1) = 0$

$$\begin{array}{r} x - 2 = 0 \\ +2 \quad +2 \\ x = 2 \end{array} \quad \begin{array}{r} x + 1 = 0 \\ -1 \quad -1 \\ x = -1 \end{array}$$

The solutions to the quadratic equation are $x = 2$ and $x = -1$.

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

$$\begin{array}{r} x = 0 \\ x - 5 = 0 \\ +5 \quad +5 \\ x = 5 \end{array}$$

The solutions to the quadratic equation are $x = 0$ and $x = 5$.

4. $(x)(x + 4) = 0$

$$\begin{array}{r} x = 0 \\ x + 4 = 0 \\ -4 \quad -4 \\ x = -4 \end{array}$$

The solutions to the quadratic equation are $x = 0$ and $x = -4$.

Skill Development/Guided Practice (continued)

A **quadratic equation** is a second-degree polynomial equation.

The **Zero Product Property** states that if the product of two unknown numbers equals zero, one or both of the numbers is equal to zero.

Solve quadratic equations by factoring.

- 1 Set the right-hand side equal to zero, if necessary.
- 2 Factor the quadratic equation, if necessary.
- 3 Set up two equations using the Zero Product Property.
- 4 Solve each equation.
- 5 Read the answer. *The solutions to the quadratic equation are _____*

CFU

- 1 How did I/you set the right-hand side equal to zero?
- 2 How did I/you factor the equations?
- 3 How did I/you set up two equations using the Zero Product Property?

$$5. x^2 + 7x + 10 = 0$$

$$(x + 5)(x + 2) = 0$$

$$x + 5 = 0 \quad x + 2 = 0$$

$$-5 \quad -5 \quad -2 \quad -2$$

$$x = -5 \quad x = -2$$

The solutions to the quadratic equation are $x = -5$ and $x = -2$.

$$6. x^2 + 9x + 20 = 0$$

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

$$x + 4 = 0 \quad x + 5 = 0$$

$$-4 \quad -4 \quad -5 \quad -5$$

$$x = -4 \quad x = -5$$

The solutions to the quadratic equation are $x = -4$ and $x = -5$.

$$7. x^2 + 2x = 8$$

$$(x + 4)(x - 2) = 0$$

$$x + 4 = 0 \quad x - 2 = 0$$

$$-4 \quad -4 \quad +2 \quad +2$$

$$x = -4 \quad x = 2$$

$$x^2 + 2x = 8$$

$$-8 \quad -8$$

$$x^2 + 2x - 8 = 0$$

The solutions to the quadratic equation are $x = -4$ and $x = 2$.

$$8. x^2 + 2x = 15$$

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

$$x + 5 = 0 \quad x - 3 = 0$$

$$-5 \quad -5 \quad +3 \quad +3$$

$$x = -5 \quad x = 3$$

$$x^2 + 2x = 15$$

$$-15 \quad -15$$

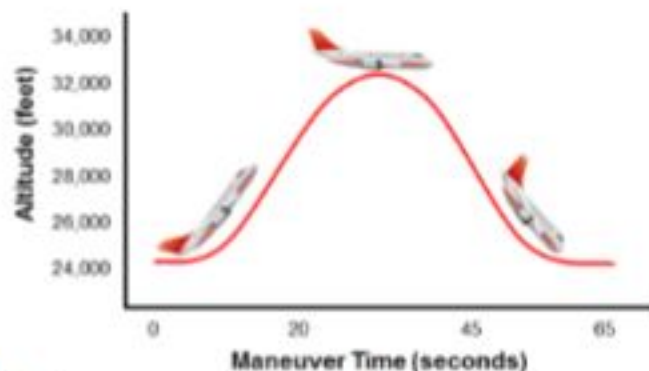
$$x^2 + 2x - 15 = 0$$

The solutions to the quadratic equation are $x = -5$ and $x = 3$.

The **Zero Product Property** states that if the product of two unknown numbers equals zero, one or both of the numbers is equal to zero.

1 *Solving quadratic equations by factoring will help you graph real-world quadratic equations.*

The “Weightless Wonder” is a plane used by NASA to train astronauts in zero-gravity situations. It accelerates upward and then descends fast enough for the effects of gravity to be negated, producing a feeling of weightlessness.



2 *Solving quadratic equations by factoring will help you do well on tests.*

Sample Test Question:

32. What is the solution to the following equation?

$$x^2 + 6x = 7$$

- A $x = -7$
- B $x = 1$
- C $x = -7$ and $x = -1$
- D $x = -7$ and $x = 1$

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Does anyone else have another reason why it is relevant to solve quadratic equations by factoring or completing the square? (Pair-Share) Why is it relevant to solve quadratic equations by factoring or completing the square? You may give one of my reasons or one of your own. Which reason is more relevant to you? Why?

A **quadratic equation** is a second-degree polynomial equation.

The **Zero Product Property** states that if the product of two unknown numbers equals zero, one or both of the numbers is equal to zero.

Skill Closure

Solve quadratic equations by factoring.

- 1 Set the right-hand side equal to zero, if necessary.
- 2 Factor the quadratic equation, if necessary.
- 3 Set up two equations using the Zero Product Property.
- 4 Solve each equation.
- 5 Read the answer. *The solutions to the quadratic equation are _____*

1. $(x + 1)(x - 2) = 0$

$$\begin{array}{cc} x + 1 = 0 & x - 2 = 0 \\ -1 & -1 & +2 & +2 \\ x = -1 & & & x = 2 \end{array}$$

The solutions to the quadratic equation are $x = -1$ and $x = 2$.

2. $x^2 + 6x = 7$

$$\begin{array}{l} x^2 + 6x = 7 \\ -7 \quad -7 \\ x^2 + 6x - 7 = 0 \\ (x + 7)(x - 1) = 0 \\ x + 7 = 0 \quad x - 1 = 0 \\ -7 \quad -7 \quad +1 \quad +1 \\ x = -7 \quad x = 1 \end{array}$$

The solutions to the quadratic equation are $x = -7$ and $x = 1$.

Word Bank

quadratic equation
polynomial
Zero Product Property

Summary Closure

What did you learn today about solving quadratic equations by factoring? (Pair-Share)

Use words from the word bank.

Independent Practice

A **quadratic equation** is a second-degree polynomial equation.

The **Zero Product Property** states that if the product of two unknown numbers equals zero, one or both of the numbers is equal to zero.

Solve quadratic equations by factoring.

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- 5 Read the answer. *The solutions to the quadratic equation are _____*

$$5. x^2 - 5x = 0$$

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

$$\begin{array}{l} x = 0 \quad x - 5 = 0 \\ \quad \quad +5 \quad +5 \\ \quad \quad \quad x = 5 \end{array}$$

The solutions to the quadratic equation are $x = 0$ and $x = 5$.

$$6. x^2 + 4x - 21 = 0$$

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

$$\begin{array}{l} x - 3 = 0 \quad x + 7 = 0 \\ +3 \quad +3 \quad -7 \quad -7 \\ \quad \quad x = 3 \quad x = -7 \end{array}$$

The solutions to the quadratic equation are $x = 3$ and $x = -7$.

$$7. x^2 - x = 2$$

$$\begin{array}{l} x^2 - x = 2 \\ -2 \quad -2 \end{array}$$

$$x^2 - x - 2 = 0$$

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

$$\begin{array}{l} x + 1 = 0 \quad x - 2 = 0 \\ -1 \quad -1 \quad +2 \quad +2 \\ \quad \quad x = -1 \quad x = 2 \end{array}$$

The solutions to the quadratic equation are $x = -1$ and $x = 2$.

$$8. x^2 + 2x = 3$$

$$\begin{array}{l} x^2 + 2x = 3 \\ -3 \quad -3 \end{array}$$

$$x^2 + 2x - 3 = 0$$

$$(x + 3)(x - 1) = 0$$

$$\begin{array}{l} x + 3 = 0 \quad x - 1 = 0 \\ -3 \quad -3 \quad +1 \quad +1 \\ \quad \quad x = -3 \quad x = 1 \end{array}$$

The solutions to the quadratic equation are $x = -3$ and $x = 1$.

A **quadratic equation** is a second-degree polynomial equation.

The **Zero Product Property** states that if the product of two unknown numbers equals zero, one or both of the numbers is equal to zero.

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- 4 Solve each equation.
- 5 Read the answer. *The solutions to the quadratic equation are _____*

$$5. x^2 - 5x + 4 = 0$$

$$(x - 1)(x - 4) = 0$$

$$x - 1 = 0 \quad x - 4 = 0$$

$$\quad \quad +4 \quad +4$$

$$x = 1 \quad x = 4$$

The solutions to the quadratic equation are $x = 1$ and $x = 4$.

$$6. x^2 + 2x - 35 = 0$$

$$(x - 5)(x + 7) = 0$$

$$x - 5 = 0 \quad x + 7 = 0$$

$$\quad +5 \quad +5 \quad \quad -7 \quad -7$$

$$x = 5 \quad x = -7$$

The solutions to the quadratic equation are $x = 5$ and $x = -7$.

$$7. x^2 + 7x = 8$$

$$x^2 + 7x = 8$$

$$\quad -8 \quad -8$$

$$x^2 + 7x - 8 = 0$$

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

$$x + 8 = 0 \quad x - 1 = 0$$

$$\quad -8 \quad -8 \quad \quad +1 \quad +1$$

$$x = -8 \quad x = 1$$

The solutions to the quadratic equation are $x = -8$ and $x = 1$.

$$8. x^2 + 8x = -16$$

$$x^2 + 8x = -16$$

$$\quad +16 \quad +16$$

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

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

$$x + 4 = 0 \quad x + 4 = 0$$

$$\quad -4 \quad -4 \quad \quad -4 \quad -4$$

$$x = -4 \quad x = -4$$

The solution to the quadratic equation is $x = -4$.

A **quadratic equation** is a second-degree polynomial equation.

The **Zero Product Property** states that if the product of two unknown numbers equals zero, one or both of the numbers is equal to zero.

Solve quadratic equations by factoring.

- 1 Set the right-hand side equal to zero, if necessary.
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- 3 Set up two equations using the Zero Product Property.
- 4 Solve each equation.
- 5 Read the answer. *The solutions to the quadratic equation are _____*

$$1. x^2 + 2x - 8 = 0$$

$$(x + 4)(x - 2) = 0$$

$$x + 4 = 0 \quad x - 2 = 0$$

$$\quad -4 \quad -4 \quad \quad +2 \quad +2$$

$$x = -4 \quad x = 2$$

The solutions to the quadratic equation are $x = -4$ and $x = 2$.

$$2. x^2 - x - 12 = 0$$

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

$$x - 4 = 0 \quad x + 3 = 0$$

$$\quad +4 \quad +4 \quad \quad -3 \quad -3$$

$$x = 4 \quad x = -3$$

The solutions to the quadratic equation are $x = 4$ and $x = -3$.

$$3. x^2 - 6x = 16$$

$$x^2 - 6x = 16$$

$$\quad -16 \quad -16$$

$$x^2 - 6x - 16 = 0$$

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

$$x + 2 = 0 \quad x - 8 = 0$$

$$\quad -2 \quad -2 \quad \quad +8 \quad +8$$

$$x = -2 \quad x = 8$$

The solutions to the quadratic equation are $x = -2$ and $x = 8$.

$$4. x^2 + x = 90$$

$$x^2 + x = 90$$

$$\quad -90 \quad -90$$

$$x^2 + x - 90 = 0$$

$$(x + 10)(x - 9) = 0$$

$$x + 10 = 0 \quad x - 9 = 0$$

$$\quad -10 \quad -10 \quad \quad +9 \quad +9$$

$$x = -10 \quad x = 9$$

The solutions to the quadratic equation are $x = -10$ and $x = 9$.

A **quadratic equation** is a second-degree polynomial equation.

The **Zero Product Property** states that if the product of two unknown numbers equals zero, one or both of the numbers is equal to zero.

Solve quadratic equations by factoring.

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- 5 Read the answer. *The solutions to the quadratic equation are _____*

<p>5. $x^2 + 2x - 15 = 0$ $(x + 5)(x - 3) = 0$</p> <p>$x + 5 = 0$ $x - 3 = 0$ $-5 \quad -5$ $+3 \quad +3$</p> <p>$x = -5$ $x = 3$</p> <p>The solutions to the quadratic equation are $x = -5$ and $x = 3$.</p>	<p>6. $x^2 - 4x - 12 = 0$ $(x - 6)(x + 2) = 0$</p> <p>$x - 6 = 0$ $x + 2 = 0$ $+6 \quad +6$ $-2 \quad -2$</p> <p>$x = 6$ $x = -2$</p> <p>The solutions to the quadratic equation are $x = 6$ and $x = -2$.</p>
<p>7. $x^2 - 10x = -25$ $x^2 - 10x = 25$ $-25 \quad -25$</p> <p>$x^2 - 10x - 25 = 0$ $(x - 5)(x - 5) = 0$</p> <p>$x - 5 = 0$ $x - 5 = 0$ $+5 \quad +5$ $+5 \quad +5$</p> <p>$x = 5$ $x = 5$</p> <p>The solution to the quadratic equation is $x = 5$.</p>	<p>8. $x^2 + x = 56$ $x^2 + x = 56$ $-56 \quad -56$</p> <p>$x^2 + x - 56 = 0$ $(x + 8)(x - 7) = 0$</p> <p>$x + 8 = 0$ $x - 7 = 0$ $-8 \quad -8$ $+7 \quad +7$</p> <p>$x = -8$ $x = 7$</p> <p>The solutions to the quadratic equation are $x = -8$ and $x = 7$.</p>

