Warm Up:

Consider the function $f(x) = 2x^2 + 6x - 7$.

1. Determine whether the graph opens upward or downward. Up
2. Find the axis of symmetry. $x = \frac{-b}{2a} = \frac{-6}{4} = -\frac{3}{2}$
3. Find the vertex. $(-3/2, -11.5)$
4. Identify the maximum or minimum value of the function. Min
5. Find the y-intercept. $(0, -7)$

Get out a half sheet of paper

Put numbers 18 and 25 on the half sheet

If you didn't do them or had questions I suggest writing other problems to prove that you completed your homework. Preferably problems later on in the set...

5-3 Solving Quadratic Equations by Graphing and Factoring

Objectives

Solve quadratic equations by graphing or factoring.

Determine a quadratic function from its roots.

5-3 Solving Quadratic Equations by Graphing and Factoring

Vocabulary

zero of a function

root of an equation

binomial

trinomial

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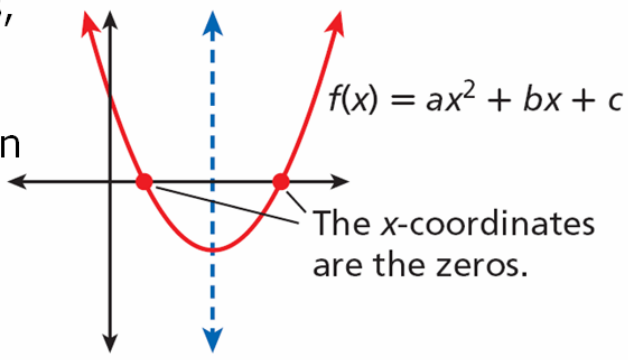
5-3 Solving Quadratic Equations by Graphing and Factoring

When a soccer ball is kicked into the air, how long will the ball take to hit the ground? The height h in feet of the ball after t seconds can be modeled by the quadratic function $h(t) = -16t^2 + 32t$. In this situation, the value of the function represents the height of the soccer ball. When the ball hits the ground, the value of the function is zero.

5-3 Solving Quadratic Equations by Graphing and Factoring

A **zero of a function** is a value of the input x that makes the output $f(x)$ equal zero. The zeros of a function are the x-intercepts.

Unlike linear functions, which have no more than one zero, quadratic functions can have two zeros, as shown at right. These zeros are always symmetric about the axis of symmetry.



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5-3 Solving Quadratic Equations by Graphing and Factoring

Helpful Hint

Recall that for the graph of a quadratic function, any pair of points with the same *y*-value are symmetric about the axis of symmetry.

It helps to find the vertex first, then you can work out from the vertex to find the zeros using a table.

Find the zeros of $f(x) = x^2 - 6x + 8$ by using a graph and table.

$\left(\frac{-b}{2a}, f\left(\frac{-b}{2a}\right)\right)$

$\frac{6}{2(1)} = 3 \quad 3^2 - 6(3) + 8$

$(3, -1)$

$4 - 12 + 8 = 0$

$16 - 24 + 8 = 0$

x	y
3	-1
2	0
4	0

Find the zeros of $f(x) = x^2 - 6x + 8$ by using a graph and table.

5-3 Solving Quadratic Equations by Graphing and Factoring

You can also find zeros by using algebra. For example, to find the zeros of $f(x) = x^2 + 2x - 3$, you can set the function equal to zero. The solutions to the related equation $x^2 + 2x - 3 = 0$ represent the zeros of the function.

The solution to a quadratic equation of the form $ax^2 + bx + c = 0$ are *roots*. The **roots of an equation** are the values of the variable that make the equation true.

5-3 Solving Quadratic Equations by Graphing and Factoring

You can find the roots of some quadratic equations by factoring and applying the Zero Product Property.

Reading Math

- Functions have *zeros* or *x-intercepts*.
- Equations have *solutions* or *roots*.

Zero Product Property

For all real numbers a and b,

WORDS	NUMBERS	ALGEBRA
If the product of two quantities equals zero, at least one of the quantities equals zero.	$3(0) = 0$ $0(4) = 0$	If $ab = 0$, then $a = 0$ or $b = 0$.

Factor each expression.

Because of the zero product property set each factor to zero and solve to find your zeros.

Before you factor be sure the equation is set to 0!

Find the zeros of the function by factoring.

$f(x) = x^2 - 4x - 12$

$x^2 - 4x - 12 = 0$

$(x+2)(x-6) = 0$

multiply to get c
add to get b

-12	
1	-12
-1	12
2	-6
-2	6
3	-4
-3	4

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

$x = -2, 6$

Find the zeros of the function by factoring.

$g(x) = 3x^2 + 18x$

$(3x)(x+6) = 0$

$3x = 0$

$x+6 = 0$

$x = 0, -6$

Find the zeros of the function by factoring.

$f(x) = x^2 - 5x - 6$

$x^2 - 5x - 6 = 0$

$(x-6)(x+1) = 0$

$x-6 = 0$

$x+1 = 0$

$x = 6, -1$

Find the zeros of the function by factoring.

$g(x) = x^2 - 8x$

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

$x = 0$

$x - 8 = 0$

$x = 0, 8$

5-3 Solving Quadratic Equations by Graphing and Factoring

Any object that is thrown or launched into the air, such as a baseball, basketball, or soccer ball, is a *projectile*. The general function that approximates the height h in feet of a projectile on Earth after t seconds is given.

$$h(t) = -16t^2 + v_0 t + h_0$$

Constant due to Earth's gravity in ft/s^2

Initial vertical velocity in ft/s (at $t = 0$)

Initial height in ft (at $t = 0$)

Note that this model has limitations because it does not account for air resistance, wind, and other real-world factors.

A golf ball is hit from ground level with an initial vertical velocity of 80 ft/s. After how many seconds will the ball hit the ground?

$h(t) = -16t^2 + 80t$

$-16t^2 + 80t = 0$

$(16t)(-t+5) = 0$

$16t = 0$

$-t+5 = 0 \quad t = 0, 5$

A football is kicked from ground level with an initial vertical velocity of 48 ft/s. How long is the ball in the air?

$-16t^2 + 48t = 0$

$2t(-8t+24) = 0$

$2t = 0$

$-8t+24 = 0$

$t = 0, 3$

5-3 Solving Quadratic Equations by Graphing and Factoring

Quadratic expressions can have one, two or three terms, such as $-16t^2$, $-16t^2 + 25t$, or $-16t^2 + 25t + 2$. Quadratic expressions with two terms are **binomials**. Quadratic expressions with three terms are **trinomials**. Some quadratic expressions with perfect squares have special factoring rules.

Special Products and Factors	
Difference of Two Squares	Perfect-Square Trinomial
$a^2 - b^2 = (a + b)(a - b)$	$a^2 - 2ab + b^2 = (a - b)^2$ $a^2 + 2ab + b^2 = (a + b)^2$

Find the roots of the equation by factoring.

$4x^2 = 25$

$4x^2 - 25 = 0$

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

Find the roots of the equation by factoring.

$18x^2 = 48x - 32$

Find the roots of the equation by factoring.

$x^2 - 4x = -4$

Find the roots of the equation by factoring.

$25x^2 = 9$

$25x^2 - 9 = 0$

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

If you know the zeros of a function, you can work backward to write a rule for the function

Be sure that if you plugged your zeros into the function you would get an output of zero.

Write a quadratic function in standard form with zeros 5 and –5.

$(x-5)(x+5)$

Write a quadratic function in standard form with zeros 4 and –7.

$(x-4)(x+7)$

Homework:

p. 338 #21-41(skip 22 and 26), 47, 67-69