

Section 3.1 Notes

$$y = -\frac{2}{3}x + \frac{2}{3}$$

$$y = \frac{3}{5}x - \frac{22}{5}$$

Use a graphing calculator to find the solution to the system of equations, if possible.

1. $2x + 3y = 2$	2. $2x + 3y = 6$	3. $2x - y = 1$
$3x - 5y = 22$	$2x + y = -2$	$6x - 3y = 12$
4. $2x + 3y = 16$	5. $3x + 2y = -3$	6. $2x - 5y = 8$
$6x + 9y = 18$	$x - 3y = 6$	$-x + 3y = -5$

Warm Up

Graph the function. Label the vertex and axis of symmetry.

1. $f(x) = (x + 4)^2$	2. $g(x) = (x - 2)^2 - 6$
3. $y = -5(x + 3)^2 - 3$	4. $f(x) = -x^2 + 4$

Cumulative Warm Up

**Essential Question**

How can you use the graph of a quadratic equation to determine the number of real solutions of the equation?

Essential Question

Use desmos and graphing calculator

\* discuss other ways to solve:

- Graphing
- Substitution
- Elimination

Skip for warm up.

What you will learn:

\* Solve quadratic equations by graphing

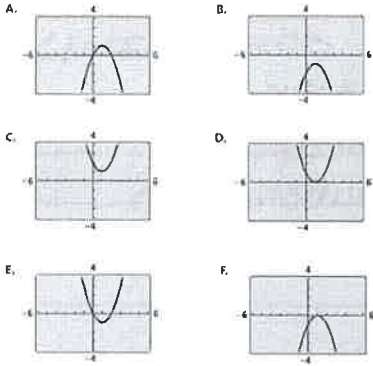
\* Solve quadratic equations algebraically

\* Solve real-life problems.

## Section 3.1 Notes

Work with a partner. Match each quadratic function with its graph. Explain your reasoning. Determine the number of  $x$ -intercepts of the graph.

- a.  $f(x) = x^2 - 2x$     b.  $f(x) = x^2 - 2x + 1$     c.  $f(x) = x^2 - 2x + 2$   
 d.  $f(x) = -x^2 + 2x$     e.  $f(x) = -x^2 + 2x - 1$     f.  $f(x) = -x^2 + 2x - 2$



Exploration 1

\* use graphing technology together

Work with a partner. Use the results of Exploration 1 to find the real solutions (if any) of each quadratic equation.

- a.  $x^2 - 2x = 0$     b.  $x^2 - 2x + 1 = 0$     c.  $x^2 - 2x + 2 = 0$   
 d.  $-x^2 + 2x = 0$     e.  $-x^2 + 2x - 1 = 0$     f.  $-x^2 + 2x - 2 = 0$

Exploration 2

\* besides graphing technology how else can we find the solutions

a)  $x^2 - 2x = 0$     b)  $x^2 - 2x + 1 = 0$   
 $x(x-2) = 0$      $(x-1)(x-1) = 0$   
 $x=0$      $x-2=0$      $(x-1)=0$      $x-1=0$   
 $x=2$      $x=1$      $x=1$

\* use factoring

### Core Concept

#### Solving Quadratic Equations

- By graphing** Find the  $x$ -intercepts of the related function  $y = ax^2 + bx + c$ .
- Using square roots** Write the equation in the form  $u^2 = d$ , where  $u$  is an algebraic expression, and solve by taking the square root of each side.
- By factoring** Write the polynomial equation  $ax^2 + bx + c = 0$  in factored form and solve using the Zero-Product Property.

Core Concept

Standard form:  $ax^2 + bx + c$

root of an equation: a solution of the equation

## Section 3.1 Notes

Solve each equation by graphing.

a.  $x^2 - x - 6 = 0$

$$y = x^2 - x - 6$$

$$y = (x+2)(x-3)$$

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

$$x+2=0 \quad x-3=0$$

$$x = -2 \quad x = 3$$

b.  $-2x^2 - 2 = 4x$

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

$$-1(2x^2 + 4x + 2) = 0$$

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

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

$$x+1=0$$

$$x = -1$$

Example 1

Solve the equation by graphing.

1.  $x^2 - 8x + 12 = 0$     2.  $4x^2 - 12x + 9 = 0$     3.  $\frac{1}{2}x^2 = 6x - 20$

Monitoring Progress 1-3

Solve each equation using square roots.

a.  $4x^2 - 31 = 49$

$$4x^2 = 80$$

$$\frac{4x^2}{4} = \frac{80}{4}$$

$$x^2 = 20$$

$$\sqrt{x^2} = \pm \sqrt{20}$$

$$x = \pm \sqrt{4} \cdot \sqrt{5}$$

$$x = \pm 2\sqrt{5}$$

b.  $3x^2 + 9 = 0$

$$-9 - 9$$

$$3x^2 = -9$$

$$\frac{3x^2}{3} = \frac{-9}{3}$$

$$x^2 = -3$$

$$\sqrt{x^2} = \pm \sqrt{-3}$$

$$x = \pm i\sqrt{3}$$

c.  $\frac{2}{5}(x+3)^2 = 5$

$$c.) \frac{2}{5}(x+3)^2 = 5$$

$$\frac{5 \cdot 2}{2 \cdot 5}(x+3)^2 = \frac{5 \cdot 5}{2}$$

$$(x+3)^2 = \frac{25}{2}$$

$$\sqrt{(x+3)^2} = \pm \sqrt{\frac{25}{2}}$$

$$x+3 = \pm \frac{\sqrt{25}}{\sqrt{2}} = \pm \frac{5(\sqrt{2})}{\sqrt{2}(\sqrt{2})}$$

$$x+3 = \pm \frac{5\sqrt{2}}{2}$$

$$-3 \quad -3$$

$$x = -3 \pm \frac{5\sqrt{2}}{2}$$

Example 2

no real solution

You can use factoring to solve a quadratic.

\* Make sure you are in standard form

- leading coefficient should be positive

- factor out a GCF if possible

\* set equal to zero

\* solve for x.

\* Student practice

Answers:

1.)  $x = 6$  and  $x = 2$

2.)  $x = 1.5$

3.) no real solutions

## Section 3.1 Notes

Solve the equation using square roots.

4.  $\frac{2}{3}x^2 + 14 = 20$

5.  $-2x^2 + 1 = -6$

6.  $2(x - 4)^2 = -5$

Monitoring Progress 4-6

### Core Concept

#### Zero-Product Property

**Words** If the product of two expressions is zero, then one or both of the expressions equal zero.

**Algebra** If  $A$  and  $B$  are expressions and  $AB = 0$ , then  $A = 0$  or  $B = 0$ .

Core Concept

Solve  $x^2 - 4x = 45$  by factoring.

$$x^2 - 4x - 45 = 0$$

$$(x - 9)(x + 5) = 0$$

$$x - 9 = 0 \quad x + 5 = 0$$

$$x = 9 \quad x = -5$$

$$\begin{array}{r} 45 \\ 1 \cdot 45 \\ 3 \cdot 15 \\ \boxed{5 \cdot 9} \end{array}$$

Example 3

\* Student practice

answers:

$$4.) x = \pm 3$$

$$5.) x = \pm \frac{\sqrt{14}}{2}$$

6.) no real solution

Any time you multiply and the answer is zero, at least one factor must be equal to zero

$$\text{example: } xy = 0$$

Any number times zero equals zero.

## Section 3.1 Notes

Find the zeros of  $f(x) = 2x^2 - 11x + 12$ .

$$0 = (2x^2 - 8x)(-3x + 12)$$

$$0 = 2x(x-4) \cdot 3(x-4)$$

$$0 = (x-4)(2x-3)$$

$$x-4=0$$

$$+4 \quad +4$$

$$x=4$$

$$2x-3=0$$

$$+3 \quad +3$$

$$2x=3$$

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

$$\begin{array}{r} 24 \\ -1 \quad -24 \\ -2 \quad -12 \\ \hline -3 \quad -8 \\ -4 \quad -6 \end{array}$$

Example 4

Solve the equation by factoring.

7.  $x^2 + 12x + 35 = 0$

8.  $3x^2 - 5x = 2$

Find the zero(s) of the function.

9.  $f(x) = x^2 - 8x$

10.  $f(x) = 4x^2 + 28x + 49$

Monitoring Progress 7-10

A monthly teen magazine has 48,000 subscribers when it charges \$20 per annual subscription. For each \$1 increase in price, the magazine loses about 2000 subscribers. How much should the magazine charge to maximize annual revenue? What is the maximum annual revenue?

Define variables:

$x$  = price increase      $R(x)$  = annual revenue

$$R(x) = (48000 - 2000x)(20 + x)$$

$$R(x) = -2000(x-24)(x+20)$$

Example 5

$$f(x) = y$$

Zeros of function =  
x-Intercepts

x-Intercepts are when the graph crosses the x-axis

$$y = 0$$

$$f(x) = y = 0$$

\* Student practice

Answers:

7.)  $x = -5$  and  $x = -7$

8.)  $x = 2$  and  $x = -\frac{1}{3}$

9.)  $x = 8$  and  $x = 0$

10.)  $x = -3.5$  or  $-3\frac{1}{2}$

## Section 3.1 Notes

11. WHAT IF? The magazine initially charges \$21 per annual subscription. How much should the magazine charge to maximize annual revenue? What is the maximum annual revenue?

Monitoring Progress 11

For a science competition, students must design a container that prevents an egg from breaking when dropped from a height of 50 feet.

- Write a function that gives the height  $h$  (in feet) of the container after  $t$  seconds. How long does the container take to hit the ground?
- Find and interpret  $h(1) - h(1.5)$ .

Example 6

12. WHAT IF? The egg container is dropped from a height of 80 feet. How does this change your answers in parts (a) and (b)?

Monitoring Progress 12

## Section 3.1 Notes

**Exit Ticket:** Explain what method you would use to solve each of the following quadratic equations.

a.  $x^2 - 84 = 0$

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

c.  $\frac{1}{5}x^2 - 2x + 6 = 0$

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Closure

