Name _____ Date _____ Class _____

SECTION 5A

Ready To Go On? Skills Intervention

5-1 Using Transformations to Graph Quadratic Functions

Find these vocabulary words in Lesson 5-1 and the Multilingual Glossary.

Vocabulary			
quadratic function	parabola	vertex of a parabola	vertex form

Translating Quadratic Functions

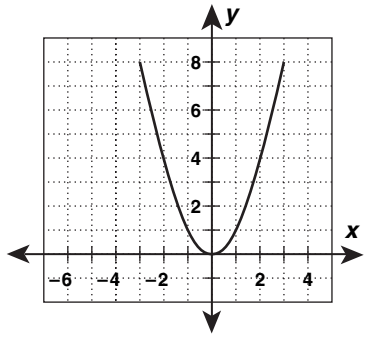
Using the graph of $f(x)^2$ as a guide, describe the transformations, and then graph the function. $g(x) = (x + 3)^2 - 1$

$f(x - h) = (x - h)^2$ represents the general form for a horizontal shift. If $h < 0$ the graph moves left and if $h > 0$ the graph moves _____.

$f(x) + k = x^2 + k$ represents the general form for a vertical shift. If k is negative the graph is shifted down and if k is positive the graph is shifted _____.

$g(x) = (x + 3)^2 - 1$

$= (x - (-3))^2 - 1$ Rewrite to identify h and k.



Because $h =$ _____, the graph is translated 3 units left and since $k = 1$, the graph is translated _____ unit up.
Complete the table of values and graph.

x	$f(x) = (x + 3)^2 - 1$	$(x, f(x))$
-5	$f(-5) = (-5 + 3)^2 - 1 = 3$	$(-5, 3)$
-4	$f(-4) = (-4 + 3)^2 - 1 =$ ____	$(-4,$ ____$)$
-3	$f(-3) = (-3 + 3)^2 - 1 =$ ____	$(-3,$ ____$)$
-2	$f(-2) = ($____ $+ 3)^2 - 1 =$ ____	$(-2,$ ____$)$
-1	$f(-1) = ($____ $+ 3)^2 - 1 =$ ____	$(-1,$ ____$)$

Writing Transformed Quadratic Functions

Use the description to write the quadratic function in vertex form:
$f(x)^2$ is vertically stretched by a factor of 3 and translated 4 units left.

The _____ form of a quadratic function is $f(x) = a(x - h)^2 + k$.

The a indicates a _____ across the x-axis and/or a vertical _____ or compression. The h represents a _____ translation and ____ indicates a vertical translation. Vertical stretch by 3: means ____ = 3. Translated 4 units left means $h = -$____.
Substitute to write the transformed function. $g(x) = a(x - h)^2 + k$

$g(x) =$ ____$(x -$____$)^2 + 0$

$g(x) =$ ____$(x +$____$)^2$

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SECTION 5A

Ready To Go On? Skills Intervention

5-2 Properties of Quadratic Functions in Standard Form

Find these vocabulary words in Lesson 5-2 and the Multilingual Glossary.

Vocabulary			
axis of symmetry	standard form	minimum value	maximum value

Graphing Quadratic Functions in Standard Form

For the function $g(x) = -x^2 - 2x + 3$, (a) determine whether the graph opens upward or downward, (b) find the axis of symmetry, (c) find the vertex, (d) find the *y*-intercept, and (e) graph the function.

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

a. What is the standard form for a quadratic equation? $f(x) =$ ____$x^2 +$ ____$x + c$.

The parabola opens _____ if $a > 0$ and downward if $a < 0$.

Since a equals -1 in the given function, the graph will open _____.

b. The axis of symmetry is given by $x = -\frac{\square}{2a}$.

What does b equal in the function $g(x) = -x^2 - 2x + 3$? ____

Substitute to find x. $x = -\frac{b}{2a} = -\frac{\square}{2(-1)} = \frac{\square}{-2} = -1$

The axis of symmetry is the line $x =$ ____.

c. The vertex lies on the axis of symmetry, so the x-coordinate is ____.

The _____ is the value of the function at this x-value, or $f(-1)$.

$f(-1) = -\square^2 - 2\square + 3$

$= -1 + \square + 3$

$= \square$

The vertex is at (____, ____).

d. The *y*-intercept is the c value of the function. In the function, $g(x) = -x^2 - 2x + 3$

$c =$ ____ therefore, the *y*-intercept is _____.

e. Graph the function.

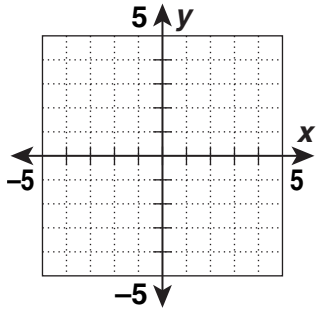
Step 1 Plot the axis of symmetry. $x =$ ____

Step 2 Plot the vertex. (____, ____)

Step 3 Plot the *y*-intercept. (____, ____).

Step 4 Use the axis of symmetry to find another point on the parabola.

Step 5 Connect the points in a smooth curve.



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SECTION 5A

Ready To Go On? Problem Solving Intervention

5-2 Properties of Quadratic Functions in Standard Form

When a parabola opens upward, the *y*-value of the vertex is a minimum value.
When a parabola opens downward, the *y*-value of the vertex is the maximum value.

In a science experiment a ball is rolled up a ramp and allowed to roll back down. The equation that models the distance between the ball and the top of the ramp is $h(x) = 0.332x^2 - 0.828x + 1$. Find the minimum distance between the ball and the top of the ramp.

Understand the Problem

1. What does the equation model? _____

2. What is the given equation? _____

3. What are you asked to find? _____

_____

Make a Plan

4. Where is the minimum distance located in a parabola? _____

5. What is the equation that models the distance? _____

6. To find the *x*-value of the vertex, use the formula $x = -\frac{\square}{2a}$.

Solve

7. What is the *a* value in the equation $h(x) = 0.332x^2 - 0.828x + 1$? _____

8. What is the *b* value in the equation $h(x) = 0.332x^2 - 0.828x + 1$? _____

9. Substitute into the formula: $x = -\frac{b}{2a} = -\frac{\square}{2(\square)} = 1.25$

10. Find the *y*-value of the vertex, $h(1.25) = 0.332(1.25)^2 - 0.828(\square) + 1$

$h(1.25) =$ _____

11. The minimum distance between the ball and the top of the ramp is _____ in.

Look Back

12. Graph $h(x) = 0.332x^2 - 0.828x + 1$ on a graphing calculator.

13. Locate the minimum value of the parabola. Does your answer check? _____

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SECTION 5A

Ready To Go On? Skills Intervention

5-3 Solving Quadratic Equations by Graphing and Factoring

Find these vocabulary words in Lesson 5-3 and the Multilingual Glossary.

Vocabulary			
zero of a function	root of an equation	binomial	trinomial

Finding Zeros by Factoring

Find the roots of each equation by factoring.

A. $x^2 - 3x = 10$

Set the function equal to 0. $x^2 - 3x - \_\_\_\_ = 0$

What are two factors of -10 whose sum equal -3? ____ and ____

Write the equation in factored form: $(x - \_\_\_\_)(x + \_\_\_\_) = 0$

Apply the Zero Product Property: $x - \_\_\_\_ = 0$ or $x + 2 = 0$

Solve each equation: $x - 5 = 0$ or $x + 2 = 0$

$x = \_\_\_\_$ $x = \_\_\_\_$

Check by substituting each value of x into the original equation.

$x^2 - 3x = 10$ $x^2 - 3x = 10$

$5^2 - 3(\_\_\_\_) = 10$ $(-2)^2 - 3(\_\_\_\_) = 10$

$25 - \_\_\_\_ = 10$ $4 + \_\_\_\_ = 10$

$10 = 10$ ✓ $10 = 10$ ✓

B. $6x^2 + 18x = 0$

First, find the Greatest Common Factor of $6x^2$ and $18x$. ____

Factor the equation: $6x(\_\_\_\_ + \_\_\_\_) = 0$

Apply the Zero Product Property: $\_\_\_\_ = 0$ or $x + 3 = 0$

Solve each equation: $6x = 0$ or $x + 3 = 0$

$x = \_\_\_\_$ $x = \_\_\_\_$

Check by substituting each value into the original equation.

$6x^2 + 18x = 0$ $6x^2 + 18x = 0$

$6(\_\_\_\_)^2 + 18(0) = 0$ $6(\_\_\_\_)^2 + 18(-3) = 0$

$\_\_\_\_ + 0 = 0$ $\_\_\_\_ - 54 = 0$

$0 = 0$ ✓ $0 = 0$ ✓

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SECTION 5A

Ready To Go On? Skills Intervention

5-4 Completing the Square

Find this vocabulary word in Lesson 5-4 and the Multilingual Glossary.

Vocabulary
completing the square

Solving a Quadratic Equation by Completing the Square

Solve the equation $x^2 + 8x = -11$, by completing the square.

$x^2 + 8x + \square = -11 + \square$ Set up to complete the square.

What is the value of b in the equation? ____ What is $\left(\frac{b}{2}\right)^2$? ____

$x^2 + 8x + \square = -11 + \square$ Add $\left(\frac{b}{2}\right)^2$ to both sides.

$x^2 + 8x + \square = \square$ Simplify.

$(x + \_\_\_\_)^2 = 5$ Factor.

$x + 4 = \pm\sqrt{\_\_\_\_}$ Take the square root of both sides.

$x + 4 =$ ____ or $x + 4 =$ _____ Solve for x.

$x =$ $-4 +$ ____ or $x = -4 -$ _____

The solutions of the equation are _____.

Writing a Quadratic Function in Vertex Form

Write the function $f(x) = 2x^2 - 8x + 5$, in vertex form, and identify its vertex.

$f(x) = \square(x^2 - \_\_\_\_x) + 5$ Factor so the coefficient of the x^2-term is 1.

$f(x) = 2(x^2 - \_\_\_\_x + \square) + 5 + \square$ Set up to complete the square.

What is $\left(\frac{b}{2}\right)^2$? ____ What term did you factor so the leading coefficient was 1? ____

You must subtract $2\left(\frac{b}{2}\right)^2$ from 5.

$f(x) = 2\left(x^2 - 4x + \left(\frac{-\square}{2}\right)^2\right) + 5 - 2\left(\frac{-\square}{2}\right)^2$

$f(x) = 2(x^2 - 4x + \square) + 5 - 8$ Simplify.

$f(x) = 2(x^2 - 4x + \square) + \square$ Simplify.

$f(x) = 2(x - 2)^2 + \square$ Factor.

The vertex form of a quadratic function is $f(x) = a(x - h)^2 + k$.

So, what is the value of h? ____ What is the value of k? ____

The vertex of the function is at (____, ____).

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SECTION 5A

Ready To Go On? Skills Intervention

5-5 Complex Numbers and Roots

Find these vocabulary words in Lesson 5-5 and the Multilingual Glossary.

Vocabulary			
imaginary unit	imaginary number	complex number	real part
imaginary part	complex conjugate		

Solving a Quadratic Equation with Imaginary Solutions

Solve each equation.

A. $5x^2 = -125$

$\frac{5x^2}{\square} = \frac{-125}{\square}$ To isolate x^2 divide both sides of the equation by ____.

$x^2 = -\square$ Simplify.

The opposite of squaring a number is taking the _____ of the number.

$x = \pm\sqrt{-\_\_\_\_}$ Take the square root of both sides.

The square root of a negative number is an _____ number.

$x = \pm\square i$ Express in terms of i.

Check $5x^2 = -125$

$\square(\pm 5i)^2 = -125$ Substitute the answer back into the original equation.

$5(25)\square^2 = -125$ Simplify.

$125(\square) = -125$ Substitute $i^2 = -1$.

$-125 = -125$ ✓

B. $m^2 + 6m = -12$

$m^2 + 6m + \blacksquare = -12 + \blacksquare$ Set up to complete the square.

What is the value of b? ____ What is $\left(\frac{b}{2}\right)^2$? ____

$m^2 + 6m + \square = -12 + \square$ Add $\left(\frac{b}{2}\right)^2$ to both sides.

$m^2 + 6m + 9 = -\square$ Simplify.

$(m + \square)^2 = -\square$ Factor.

$m + 3 = \pm\sqrt{\square}$ Take the square root of both sides.

$m = -3 \pm i\square$ Simplify, by subtracting ____ from both sides.

The two solutions are _____ and _____.

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SECTION 5A

Ready To Go On? Skills Intervention

5-6 The Quadratic Formula

Find this vocabulary word in Lesson 5-6 and the Multilingual Glossary.

Vocabulary
discriminant

Quadratic Functions with Complex Zeros

Find the zeros of the function $y = x^2 - 5x + 20$ by using the Quadratic Formula.

What is the general form for a quadratic equation? $y =$ _____

What is the quadratic formula? $x =$ _____

In the equation $y = x^2 - 5x + 20$ what are a, b, and c? $a =$ ____ $b =$ ____ and $c =$ ____.

Substitute for a, b, and c in the quadratic formula.

$$x = \frac{-\square \pm \sqrt{\square^2 - 4(1)\square}}{2(1)}$$ Simplify.

$$x = \frac{-\square \pm \sqrt{\square - 80}}{2(1)}$$ Simplify.

$$x = \frac{-\square \pm \sqrt{-\square}}{2}$$

$$x = \frac{5 \pm \sqrt{-\square}}{2}$$ What is the square root of a negative number? _____

$$x = \frac{5 \pm i\sqrt{\square}}{2}$$ Now, write in terms of i.

$$x = \frac{\square}{2} \pm i\frac{\square}{2}$$

Analyzing Quadratic Equations by Using the Discriminant

Find the type and number of solutions for the equation $4x^2 - 28x + 49 = 0$.

The _____ is part of the quadratic formula that can be used to determine the number of real roots of a quadratic equation.

If $b^2 - 4ac > 0$, there are two distinct _____ solutions.

If $b^2 - 4ac = 0$, then there is _____ distinct real solution.

If $b^2 - 4ac < 0$, then there are two distinct nonreal _____ solutions.

What are a, b, and c in the given equation? $a =$ ____, $b =$ _____, $c =$ ____

The discriminant is $b^2 - 4ac$. Substitute a, b, and c.

$(-28)^2 - 4(\_\_\_\_)(\_\_\_\_) = 784 -$ _____ $=$ ____

Since $b^2 - 4ac$ ____ 0, the equation has _____ distinct real solution.

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SECTION 5A

Ready To Go On? Quiz

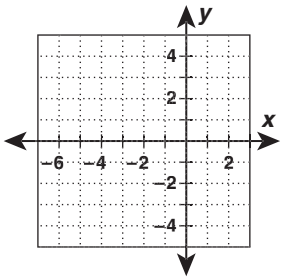
5-1 Using Transformations to Graph Quadratic Functions

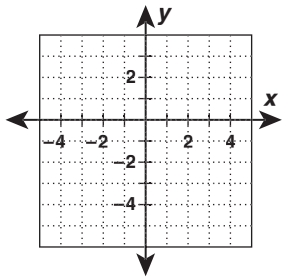
Using the graph of $f(x)^2$ as a guide, describe the transformations, and then graph each function.

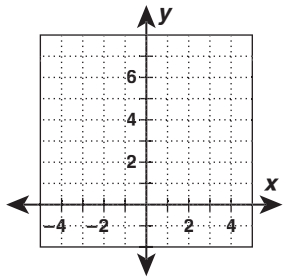
1. $g(x) = (x + 3)^2 - 3$

2. $g(x) = -3(x - 2)^2$

3. $g(x) = \frac{1}{4}x^2 + 1$







Use the description to write each quadratic function in vertex form.

4. $f(x)^2$ is vertically stretched by a factor of 4 and translated 4 units left to create $g(x)$.

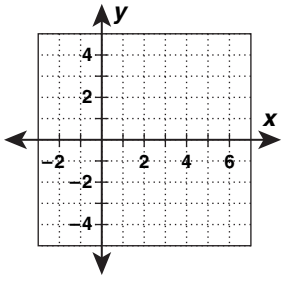
5. $f(x)^2$ is reflected across the x-axis and translated 3 units up to create $g(x)$.

5-2 Properties of Quadratic Functions in Standard Form.

For each function, (a) determine whether the graph opens upward or downward, (b) find the axis of symmetry, (c) find the vertex, (d) find the y-intercept, and (e) graph the function.

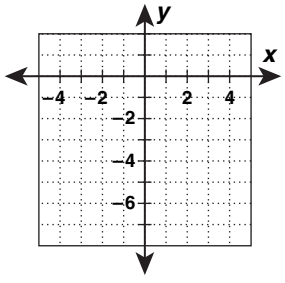
6. $f(x) = x^2 - 6x + 5$

a) _____
b) _____
c) _____
d) _____
e)



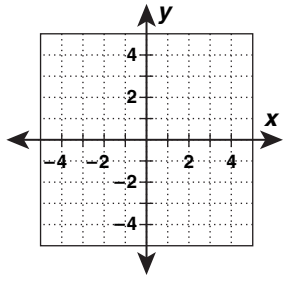
7. $g(x) = -x^2 - 2x - 3$

a) _____
b) _____
c) _____
d) _____
e)



8. $h(x) = x^2 - 4x$

a) _____
b) _____
c) _____
d) _____
e)



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SECTION 5A

Ready To Go On? Quiz continued

9. A soccer ball is kicked and modeled by the function $h(x) = -0.0085x^2 + 0.25x + 6$, where h is the height of the ball in feet and x is the horizontal distance in feet that the ball travels. Find the maximum height of the ball to the nearest foot.

_____

5-3 Solving Quadratic Equations by Graphing and Factoring

Find the roots of each equation by factoring.

10. $x^2 - 144 = 0$ **11.** $x^2 + 3x = 28$ **12.** $5x^2 + 15x = 0$

_____ _____ _____

5-4 Completing the Square

Solve each equation by completing the square.

13. $x^2 + 6x = 7$ **14.** $x^2 + 6x = 5$ **15.** $x^2 - 8x = 7$

_____ _____ _____

Write each function in vertex form, and identify its vertex.

16. $f(x) = x^2 + 18x + 77$ **17.** $g(x) = x^2 - 6x + 13$ **18.** $h(x) = 3x^2 - 6x - 6$

_____ _____ _____

_____ _____ _____

5-5 Complex Numbers and Roots

Solve each equation.

19. $3x^2 = -75$ **20.** $x^2 - 4x = -13$ **21.** $x^2 - 4x = -9$

_____ _____ _____

5-6 The Quadratic Formula

Find the zeros of each function by using the Quadratic Formula.

22. $f(x) = (x + 8)^2 + 3$ **23.** $g(x) = x^2 - 3x + 7$ **24.** $h(x) = 3x^2 - 8x + 5$

_____ _____ _____

Find the type and number of solutions for each equation.

25. $x^2 + 4x = 21$ **26.** $9x^2 - 12x = -4$ **27.** $x^2 + 5x + 8 = 0$

_____ _____ _____

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SECTION 5A

Ready To Go On? Enrichment

Equations Quadratic in Form

Certain equations that are not quadratic can be thought of in such a way that they can be solved as quadratic. For example, because the square of x^2 is x^4, the equation $x^4 - 9x^2 + 8 = 0$ is said to be "quadratic in x^2."

$x^4 - 9x^2 + 8 = 0$

$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow$

$(x^2)^2 - 9(x^2) + 8 = 0$ Think of x^4 as $(x^2)^2$.

$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow$

$u^2 - 9u + 8 = 0$ Substitute u for x^2.

The equation $u^2 - 9u + 8 = 0$ can be solved by factoring or by the quadratic formula.

$u^2 - 9u + 8 = 0$

$(u - 8)(u - 1) = 0$

$u - 8 = 0$ or $u - 1 = 0$

$u = 8$ or $u = 1$

Replace u with x^2 and solve these equations:

$x^2 = 8$ $\quad$ $x^2 = 1$

$x = \sqrt{8}$ $\quad$ $x = \sqrt{1}$

$x = \pm 2\sqrt{2}$ $\quad$ $x = \pm 1$

The solutions are -1, 1, $2\sqrt{2}$ and $-2\sqrt{2}$.

Solve.

1. $x^4 - 6x^2 + 9 = 0$

_____

2. $x^4 - 7x^2 + 12 = 0$

_____

3. $6x^4 - 19x^2 + 15 = 0$

_____

4. $6x^4 - 17x^2 + 5 = 0$

_____

5. $x^4 - 13x^2 + 36 = 0$

_____

6. $x^6 - 28x^3 + 27 = 0$

_____

Name _____ Date _____ Class _____

SECTION 5B

Ready To Go On? Skills Intervention

5-7 Solving Quadratic Inequalities

Find this vocabulary word in Lesson 5-7 and the Multilingual Glossary.

Vocabulary

quadratic inequalities in two variables

Solving Quadratic Inequalities by Using Algebra

Solve the inequality $x^2 + 3x - 8 > 2$.

$x^2 + 3x - 8 \square 2$ — Write the related equation by replacing the inequality symbol with the _____ sign.

$x^2 + 3x - 8 - \square = 2 - \square$ — Write the equation in standard form, by subtracting ____ from both sides.

$x^2 + 3x - \square = 0$ — Simplify. This is now the equation in standard form.

Factor the equation.

What are the factors of 10 that have a sum of 3? ____ and ____

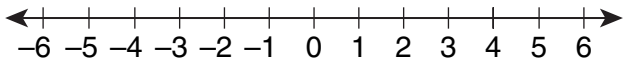
Write the equation in factored form.

$(x + \square)(x - 2) = 0$ — Write the factors.

$x + \square = 0$ or $x - 2 = 0$ — Apply the Zero Product Property.

$x = \square$ or $x = 2$ — Solve each equation for x.

Plot the two solutions on a number line.



The critical values divide the number line into ____ intervals.

The intervals are $x <$ ____, ____ $< x < 2$, and $x > 2$.

Determine if the test values make the original inequality, $x^2 + 3x - 8 > 2$, true or false.

Try $x = -6$. $(-6)^2 + 3(-6) - 8 > 2$ ____ > 2 True or False? _____

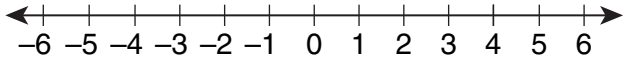
Try $x = 0$. $(0)^2 + 3(0) - 8 > 2$ ____ > 2 True or False? _____

Try $x = 4$. $(4)^2 + 3(4) - 8 > 2$ ____ > 2 True or False? _____

Should the circle drawn on -5 be solid or empty? _____

Should the circle drawn on 2 be solid or empty? _____

Shade the solutions on the number line, where the test points made the inequality true.



The solution is $x <$ $\square$ or $x > 2$.

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SECTION 5B

Ready To Go On? Problem Solving Intervention

5-7 Solving Quadratic Inequalities

A profit is made when the revenue from items sold is more than the cost to produce the items. A loss occurs when cost is more than the revenue.

A business makes and sells cabinets. The profit that the company earns for x number of cabinets can be modeled by $P(x) = -30x^2 + 750x - 2000$. How many cabinets are needed for a profit of at least \$2000?

Understand the Problem

1. How much must the profit be? _____

2. Which symbol is needed to represent at least? _____

Make a Plan

3. Write the inequality to represent this situation. $-30x^2 + 750x - 2000 \square 2000$

Look Back

4. Find the critical values by solving the related equation.

$-30x^2 + 750x - 2000 = 2000$ Write as an equation.

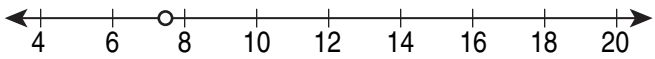
$-30x^2 + 750x - \square = 0$ Write the equation in standard form.

$-10(\square x^2 - \square x + 400) = 0$ Factor out -10 to simplify.

Substitute $a =$ ___, $b =$ _____, $c =$ _____ into the quadratic formula and solve.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-(-75) \pm \sqrt{(\square)^2 - 4(\square)(400)}}{2\square} = \frac{75 \pm \sqrt{\square}}{6} = x \approx \square \text{ or } \square$$

5. Plot the x-values on the number line and test an x-value in each of the three regions formed by the critical x-values.



Try 6.

$-30(6)^2 + 750(6) - 4000 \geq 0$

$-580 \geq 0$

True or False? _____

Try 12.

$-30\square^2 + 750\square - 4000 \geq 0$

$\square \geq 0$

True or False? _____

Try 18.

$-30\square^2 + 750\square - 4000 \geq 0$

$\square \geq 0$

True or False? _____

6. For a profit of at least \$2000, from _____ to _____ cabinets must be sold.

Look Back

7. Enter $y = -30x^2 + 750x - 2000$ into a graphing calculator, and create a table of values. Does the table show that integer values of x between 8 and 17 inclusive results in y-values greater than or equal to 2000? _____

Name _____ Date _____ Class _____

SECTION 5B

Ready To Go On? Skills Intervention

5-8 Curve Fitting with Quadratic Models

Find these vocabulary words in Lesson 5-8 and the Multilingual Glossary.

Vocabulary	
quadratic model	quadratic regression

Writing a Quadratic Function from Data

Write a quadratic function that fits the points (0, −12), (2, −4), and (3, 3).

Use each point to write a system of equations to find a, b, and c in $f(x) = ax^2 + bx + c$. Substitute x and y into the general form of a quadratic function.

(x, y)	$f(x) = ax^2 + bx + c$	System in a, b, c	Equation
$(0, -12)$	$-12 = a(0)^2 + b(0) + c$	$c =$ ☐	**1**
$(2, -4)$	$-4 = a(2)^2 + b(2) + c$	$4a +$ ☐ $+ c = -4$	**2**
$(3, 3)$	$3 = a(3)^2 + b(3) + c$	☐ $+ 3b + c = 3$	**3**

Substitute $c = -12$ from **Equation 1** into both **Equations 2** and **3.**

$4a + 2b + c = -4$ **Equation 2**

$4a + 2b +$ ☐ $= -4$

$4a + 2b + (-12) + 12 = -4 +$ ☐ Add 12.

$4a + 2b =$ ☐ **Equation 4**

$9a + 3b + c = 3$ **Equation 3**

$9a + 3b +$ ☐ $= 3$

$9a + 3b + (-12) + 12 = 3 +$ ☐ Add 12.

$9a + 3b =$ ☐ **Equation 5**

Next solve **Equation 4** and **Equation 5** for a and b using elimination.

Equation 4 $4a + 2b = 8$ Multiply by 3. $4a(3) + 2b(3) = 8(3)$ $12a +$ ☐ $b =$ ☐

Equation 5 $9a + 3b = 15$ Multiply by -2. $9a(-2) + 3b(-2) = 15(-2)$ ☐ $a - 6b = -30$

$-6a = -6$

$a =$ ____

Substitute the solution for a into **Equation 4** to find b.

$4($☐$) + 2b = 8$

$2b = 4$ Subtract 4 from both sides.

$b =$ ☐ Divide by 2.

The function is: $f(x) = ax^2 + bx + c$

$= x^2 +$ ☐$x -$ ☐

Name _____ Date _____ Class _____

SECTION 5B

Ready To Go On? Problem Solving Intervention

5-8 Curve Fitting with Quadratic Models

A quadratic model is a quadratic function that represents a set of real data. Models are helpful for making estimates. A graphing calculator can help to make predictions from a set of data.

Claire is participating in a running club and keeps record of how many miles she runs. The table shows the distances that Claire has run after so many days. Find the quadratic model for the number of miles ran in the amount of days given. Use the model to estimate the number of miles that Claire ran in 25 days. Predict the number of miles she will have run after 55 days.

Claire's Running Record	
Days	**Miles**
10	12.5
20	36.0
30	69.5
40	114.0
50	169.5

Understand the Problem

1. What does the data in the first column represent? _____

2. What does the data in the second column represent? _____

3. In 30 days, how many miles has Claire ran? _____

4. According to the chart, in 25 days she should have ran between 36 and _____ miles.

Make a Plan

5. On your calculator, which data will you enter for List 1? 10, ____, ____, ____, ____

6. On your calculator, which data will you enter for List 2? 12.5, ____, _____, _____, _____

Solve

7. Using the quadratic regression feature on your calculator, $a = 0.06$, $b =$ _____, and $c = 0.2$.

8. The quadratic model is $y \approx 0.06x^2 + \square x + 0.2$.

9. Using the table feature, when $x = 25$, $y =$ _____. (To the nearest hundredth.)

10. Using the table feature, when $x = 55$, $y =$ _____. (To the nearest hundredth.)

Look Back

11. Graph the function model from Exercise 8 on a graphing calculator. Does the model appear to fit the data? _____

Name _____ Date _____ Class _____

SECTION 5B

Ready To Go On? Skills Intervention

5-9 Operations with Complex Numbers

Find these vocabulary words in Lesson 5-9 and the Multilingual Glossary.

Vocabulary	
complex plane	absolute value of a complex number

Adding and Subtracting Complex Numbers

Add or subtract. Write the result in the form *a* + *bi*.

A. $(6 + 7i) + (5 + 3i)$

$(6 + \square) + (7i + \square)$ Group the real parts and the imaginary parts.

$11 + \square\, i$ Add. Then, write the result in $a + bi$ form.

B. $(7 - 4i) - (5 - 3i)$

$7 - 4i - \square + \square\, i$ Distribute the negative sign.

$(7 - 5) + (\square + 3i)$ Group the real parts and the imaginary parts.

$\square - i$ Add. Then, write the result in $a + bi$ form.

Multiplying Complex Numbers

Multiply. Write the result in the form *a* + *bi*.

A. $-7i(3 - 4i)$

$\square + 28i^2$ Distribute.

$\square + 28(\square)$ Use $i^2 = -1$.

$-21i - \square$ Multiply.

$-28 - \square$ Write in $a + bi$ form.

B. $(7 - 2i)(2 - 6i)$

$14 - \square - 4i + \square\, i^2$ Multiply.

$14 - \square + \square\, i^2$ Combine like terms.

$14 - \square + 12(\square)$ Use $i^2 = -1$.

$14 - \square - \square$ Simplify.

$2 - \square\, i$ Write in $a + bi$ form.

Evaluate Powers of *i*.

Simplify $7i^{17}$.

$7i \cdot i^{\square}$ Rewrite as an even power.

$7i \cdot (i^2)^{\square}$ Rewrite as a power of i^2.

A negative number raised to an even power has a _____ solution.

$7i \cdot (\square)^{\square}$ Simplify $i^2 = -1$.

$\square\, i$ Simplify.

Name _____ Date _____ Class _____

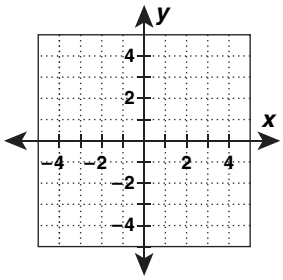
SECTION 5B

Ready To Go On? Quiz

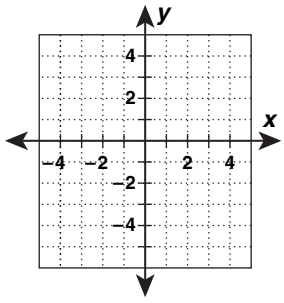
5-7 Solving Quadratic Inequalities

Graph each inequality.

1. $y > -x^2 + 3x$



2. $y < -x^2 + 5x - 6$



Solve each inequality by using tables or graphs.

3. $x^2 - 4x - 4 > 8$

_____

4. $2x^2 + 12x + 8 \leq -2$

_____

Solve each inequality by algebra.

5. $x^2 + 3x - 15 > 3$

_____

6. $x^2 - 2x < 0$

_____

7. The function $P(x) = -15x^2 + 600x - 1800$ models the monthly profit P of a small business, where x is the price of an item. For what price of items does the store earn a monthly profit of at least \$1950?

_____

5-8 Curve Fitting with Quadratic Models

Determine whether each data set could represent a quadratic function. Explain.

8.

x	6	7	8	9	10
y	11	9	5	−1	−9

_____

_____

_____

9.

x	−6	−3	0	1	3
y	8	6	2	6	8

_____

_____

_____

Name _____ Date _____ Class _____

SECTION 5B

Ready To Go On? Quiz continued

Write a quadratic function that fits each set of points.

10. (0, 10), (2, 0), and (3, −2)

11. (1, 5), (2, 6), and (4, 2)

For Exercises 12–14, use the table of number of recliners produced and the profit made over three months.

Month	Number of Recliners Produced	Profit
1	50	$5100
2	100	$5600
3	150	$1100

12. Use the data to find a quadratic function that describes the profit as a function of number of recliners produced.

13. Use your function to predict the level of production that will maximize the profit.

14. Use your function to predict the maximum profit, assuming that all business situations stay the same.

5-9 Operations with Complex Numbers

Find each absolute value.

15. $|-4i|$

16. $|12 - 5i|$

17. $|2 + 3i|$

Perform each indicated operation, and write the result in the form *a* + *bi*.

18. $(4 + 5i) - (6 - 3i)$

19. $(8 + 6i) + (3 + 2i)$

20. $-4i(3 - 5i)$

21. $(-5 - i)(-2 + 2i)$

22. $(1 + i)(1 - i)$

23. $4i^{35}$

24. $\frac{6i + 3}{3i}$

25. $\frac{3 - 2i}{4 + 3i}$

Name _____ Date _____ Class _____

SECTION 5B

Ready To Go On? Enrichment

Solving Quadratic Systems of Inequalities

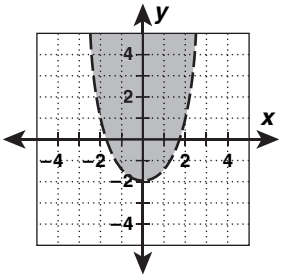
Graphical techniques can be used to solve systems of quadratic inequalities. When graphing two parabolas, the solution set includes all the points (x, y) in both shaded regions. For example, consider this quadratic inequality system:

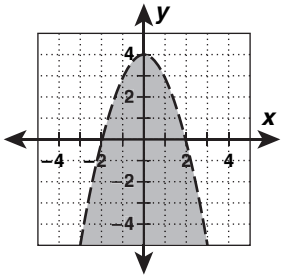
$$\begin{cases} y > x^2 - 2 \\ y < 4 - x^2 \end{cases}$$

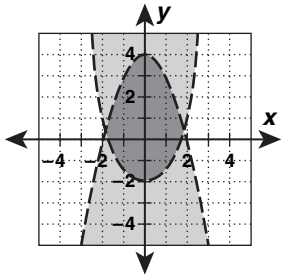
The graph of $y > x^2 - 2$ is a parabola opening upward.

The graph of $y < 4 - x^2$ is a parabola opening downward.

The intersection of the shaded regions shows the solutions.

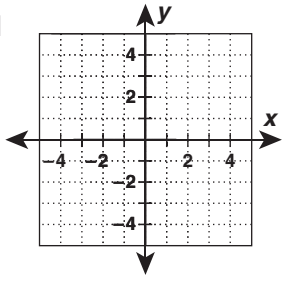




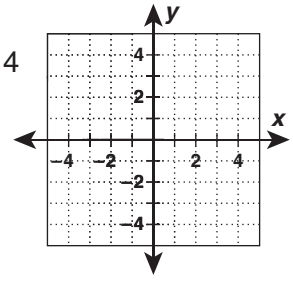


Solve.

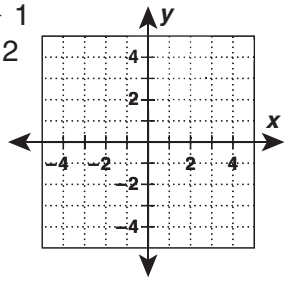
1. $y > x^2 + 3x - 1$
$y < 3 - 2x^2$



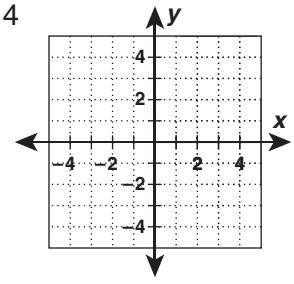
2. $y > (x + 3)^2$
$y < -2(x + 1)^2 + 4$



3. $y < 2x^2 + 3x + 1$
$y < (x - 1)^2 + 2$



4. $y > 3(x - 3)^2 - 4$
$x > y^2$



SECTION 4B Ready To Go On? Quiz

4-4 Determinants and Cramer's Rule

Find the determinant of each matrix.

1. $\begin{bmatrix} 4 & -2 \\ -2 & 4 \end{bmatrix}$ 12

2. $\begin{bmatrix} \frac{1}{3} & 6 \\ 0 & \frac{3}{4} \end{bmatrix}$ $\frac{1}{4}$

3. $\begin{bmatrix} 0.25 & 1.5 \\ -2.5 & 8.0 \end{bmatrix}$ 5.75

4. $\begin{bmatrix} -1 & 3 & 2 \\ 2 & -1 & 0 \\ 1 & 2 & -3 \end{bmatrix}$ 25

Use Cramer's rule to solve.

5. $\begin{cases} y = 2x + 1 \\ 2x - 4y = 1 \end{cases}$ $\left(\frac{-5}{6}, \frac{-2}{3}\right)$

6. $\begin{cases} 2x - 2y = 2 \\ y - x - 1 = 0 \end{cases}$ No solution

7. $\begin{cases} 2x + 3y = 6 \\ y = 1 - x \end{cases}$ $(-3, 4)$

8. $\begin{cases} 2x - 2y + z = -5 \\ x + 2y = 3z + 3 \\ z = 2x + 1 \end{cases}$ $(0, 3, 1)$

4-5 Matrix Inverses and Solving Systems

Find the inverse of each matrix, if it is defined.

9. $\begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix}$ $\begin{bmatrix} \frac{4}{5} & -\frac{3}{5} \\ -\frac{1}{5} & \frac{2}{5} \end{bmatrix}$

10. $\begin{bmatrix} 0.5 & 1.5 \\ -2 & 4 \end{bmatrix}$ $\begin{bmatrix} 0.8 & -0.3 \\ 0.4 & 0.1 \end{bmatrix}$

11. $\begin{bmatrix} -2 & 1 \\ -\frac{1}{2} & \frac{1}{4} \end{bmatrix}$ Not defined

12. $\begin{bmatrix} 0 & -1 & 2 \\ 1 & 1 & -1 \\ 2 & 0 & 3 \end{bmatrix}$ $\begin{bmatrix} 3 & 3 & -1 \\ -5 & -4 & 2 \\ -2 & -2 & 1 \end{bmatrix}$

Write the matrix equation for the system, and solve, if possible.

13. $\begin{cases} y = 2x - 4.5 \\ 5y - x = 0 \end{cases}$ $\begin{bmatrix} -2 & 1 \\ -1 & 5 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} -4.5 \\ 0 \end{bmatrix}$ $(2.5, 0.5)$

14. $\begin{cases} 3x - 4y = 5 \\ 2(x + y) + 6 = 0 \end{cases}$ $\begin{bmatrix} 3 & -4 \\ 2 & 2 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 5 \\ -6 \end{bmatrix}$ $(-1, -2)$

15. $\begin{cases} 5x + 4y = 19 \\ 10x + 8y = 12 \end{cases}$ No solution

16. $\begin{cases} 4x + 5y = 2z + 5 \\ 3x + 4y = z + 3 \\ x + 3y = 5z + 12 \end{cases}$ $[-1, 1, -2]$

SECTION 4B Ready To Go On? Quiz continued

17. You are starting a business renting bouncy houses for children's parties. You are deciding which equipment to purchase. Use x as the price of a bouncy slide, y as the price of a bouncy castle, and z as the price of a bouncy maze. What is the price of each type of equipment?

$\begin{cases} 2x + y + 3z = 8000 \\ x + 3y + 2z = 7250 \\ 3x + 2y + z = 7250 \end{cases}$

slide = $1250

castle = $1000

maze = $1500

4-6 Row Operations and Augmented Matrices

Write the augmented matrix, and use row reduction to solve, if possible.

18. $\begin{cases} 2x + 3y = 1 \\ x = y + 3 \end{cases}$ $\left[\begin{array}{ccc} 2 & 3 & 1 \\ 1 & -1 & 3 \end{array}\right]$; $(2, -1)$

19. $\begin{cases} 3x + y = 8 \\ 10x - y = 5 \end{cases}$ $\left[\begin{array}{ccc} 3 & 1 & 8 \\ 10 & -1 & 5 \end{array}\right]$; $(1, 5)$

20. $\begin{cases} 6x - 2y = 16 \\ 3x = 8 + y \end{cases}$ The system is dependent.

21. $\begin{cases} 4x + 2y - 5 = 0 \\ x - y = \frac{1}{2} \end{cases}$ $\left(1, \frac{1}{2}\right)$

22. The system of equations represents the cost of bakery bouquets. Use a to represent the cost of cookie flowers, b the cost of cupcake flowers, and c the cost of chocolate flowers. Find the cost of each type of flower.

$\begin{cases} 2a + b + 2c + 2.10 = 12.60 \\ 3a + 2b + c + 2.10 = 16.35 \\ 4a + 3b + 3c + 2.10 = 24.60 \end{cases}$

cookie flower = $2.25

cupcake flower = $3.00

chocolate flower = $1.50

SECTION 4B Ready To Go On? Enrichment

Inverse Matrices

Use the information provided to decode the three-word message made up of three-letter words encrypted in the matrices below.

$\begin{bmatrix} 161 \\ 145 \\ 062 \end{bmatrix}$ $\begin{bmatrix} 170 \\ 150 \\ 061 \end{bmatrix}$ $\begin{bmatrix} 113 \\ 109 \\ 045 \end{bmatrix}$

The words are encrypted by first assigning each letter of the alphabet a number. $A = 1$, $B = 2$, $C = 3$, and so on.

The three-letter words are multiplied by the matrix $M = \begin{bmatrix} 6 & 5 & 2 \\ 5 & 5 & 2 \\ 2 & 2 & 1 \end{bmatrix}$.

The message can be decoded by multiplying the coded message by the inverse of the encoding matrix.

What is the inverse matrix? $M^{-1} = \begin{bmatrix} 1 & -1 & 0 \\ -1 & 2 & -2 \\ 0 & -2 & 5 \end{bmatrix}$

What word is coded by $\begin{bmatrix} 161 \\ 145 \\ 062 \end{bmatrix}$? $\begin{bmatrix} 1 & -1 & 0 \\ -1 & 2 & -2 \\ 0 & -2 & 5 \end{bmatrix}\begin{bmatrix} 161 \\ 145 \\ 062 \end{bmatrix} = \begin{bmatrix} 16 \\ 5 \\ 20 \end{bmatrix} = \begin{bmatrix} P \\ E \\ T \end{bmatrix}$

What word is coded by $\begin{bmatrix} 170 \\ 150 \\ 061 \end{bmatrix}$? $\begin{bmatrix} 1 & -1 & 0 \\ -1 & 2 & -2 \\ 0 & -2 & 5 \end{bmatrix}\begin{bmatrix} 170 \\ 150 \\ 061 \end{bmatrix} = \begin{bmatrix} 20 \\ 8 \\ 5 \end{bmatrix} = \begin{bmatrix} T \\ H \\ E \end{bmatrix}$

What word is coded by $\begin{bmatrix} 113 \\ 109 \\ 045 \end{bmatrix}$? $\begin{bmatrix} 1 & -1 & 0 \\ -1 & 2 & -2 \\ 0 & -2 & 5 \end{bmatrix}\begin{bmatrix} 113 \\ 109 \\ 045 \end{bmatrix} = \begin{bmatrix} 4 \\ 15 \\ 7 \end{bmatrix} = \begin{bmatrix} D \\ O \\ G \end{bmatrix}$

The message is:

P E T T H E D O G.

SECTION 5A Ready To Go On? Skills Intervention

5-1 Using Transformations to Graph Quadratic Functions

Find these vocabulary words in Lesson 5-1 and the Multilingual Glossary.

Vocabulary			
quadratic function	parabola	vertex of a parabola	vertex form

Translating Quadratic Functions

Using the graph of $f(x)^2$ as a guide, describe the transformations, and then graph the function. $g(x) = (x + 3)^2 - 1$

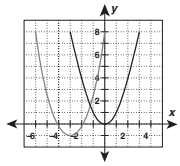
$f(x - h) = (x - h)^2$ represents the general form for a horizontal shift. If $h < 0$ the graph moves left and if $h > 0$ the graph moves right.

$f(x) + k = x^2 + k$ represents the general form for a vertical shift. If k is negative the graph is shifted down and if k is positive the graph is shifted up.

$g(x) = (x + 3)^2 - 1$

$= (x - (-3))^2 - 1$ Rewrite to identify h and k.

Because $h =$ −3, the graph is translated 3 units left and since $k = 1$, the graph is translated 1 unit up. Complete the table of values and graph.



x	$f(x) = (x + 3)^2 - 1$	$(x, f(x))$
−5	$f(-5) = (-5 + 3)^2 - 1 = 3$	(−5, 3)
−4	$f(-4) = (-4 + 3)^2 - 1 =$ 0	(−4, 0)
−3	$f(-3) = (-3 + 3)^2 - 1 =$ −1	(−3, −1)
−2	$f(-2) = (-2 + 3)^2 - 1 =$ 0	(−2, 0)
−1	$f(-1) = (-1 + 3)^2 - 1 =$ 3	(−1, 3)

Writing Transformed Quadratic Functions

Use the description to write the quadratic function in vertex form: $f(x)^2$ is vertically stretched by a factor of 3 and translated 4 units left.

The vertex form of a quadratic function is $f(x) = a(x - h)^2 + k$.

The a indicates a reflection across the x-axis and/or a vertical stretch or compression. The h represents a horizontal translation and k indicates a vertical translation. Vertical stretch by 3: means $a = 3$. Translated 4 units left means $h =$ −4.

Substitute to write the transformed function. $g(x) = a(x - h)^2 + k$

$g(x) = 3(x - (-4))^2 + 0$

$g(x) = 3(x + 4)^2$

SECTION 5A Ready To Go On? Skills Intervention

5-2 Properties of Quadratic Functions in Standard Form

Find these vocabulary words in Lesson 5-2 and the Multilingual Glossary.

Vocabulary			
axis of symmetry	standard form	minimum value	maximum value

Graphing Quadratic Functions in Standard Form

For the function $g(x) = -x^2 - 2x + 3$, (a) determine whether the graph opens upward or downward, (b) find the axis of symmetry, (c) find the vertex, (d) find the *y*-intercept, and (e) graph the function.

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

a. What is the standard form for a quadratic equation? $f(x) =$ ___a___ $x^2 +$ ___b___ $x + c$.

The parabola opens ___upward___ if $a > 0$ and downward if $a < 0$.

Since a equals -1 in the given function, the graph will open ___downward___.

b. The axis of symmetry is given by $x = -\frac{b}{2a}$.

What does b equal in the function $g(x) = -x^2 - 2x + 3$? ___−2___

Substitute to find x. $x = -\frac{b}{2a} = -\frac{-2}{2(-1)} = \frac{2}{-2} = -1$

The axis of symmetry is the line $x =$ ___−1___.

c. The vertex lies on the axis of symmetry, so the x-coordinate is ___−1___.

The ___y-coordinate___ is the value of the function at this x-value, or $f(-1)$.

$f(-1) = -(-1)^2 - 2(-1) + 3$

$= -1 + 2 + 3$

$=$ ___4___

The vertex is at (___−1___, ___4___).

d. The y-intercept is the c value of the function. In the function, $g(x) = -x^2 - 2x + 3$

$c =$ ___3___ therefore, the y-intercept is ___(0, 3)___.

e. Graph the function.

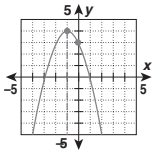
Step 1 Plot the axis of symmetry. $x =$ ___−1___

Step 2 Plot the vertex. (___−1___, ___4___)

Step 3 Plot the y-intercept. (___0___, ___3___).

Step 4 Use the axis of symmetry to find another point on the parabola.

Step 5 Connect the points in a smooth curve.



SECTION 5A Ready To Go On? Problem Solving Intervention

5-2 Properties of Quadratic Functions in Standard Form

When a parabola opens upward, the y-value of the vertex is a minimum value.
When a parabola opens downward, the y-value of the vertex is the maximum value.

In a science experiment a ball is rolled up a ramp and allowed to roll back down. The equation that models the distance between the ball and the top of the ramp is $h(x) = 0.332x^2 - 0.828x + 1$. Find the minimum distance between the ball and the top of the ramp.

Understand the Problem

1. What does the equation model? ___The distance between the ball and the top of the ramp.___

2. What is the given equation? ___$h(x) = 0.332x^2 - 0.828x + 1$___

3. What are you asked to find? ___The minimum distance between the ball and the top of the ramp.___

Make a Plan

4. Where is the minimum distance located in a parabola? ___Vertex___

5. What is the equation that models the distance? ___$h(x) = 0.332x^2 - 0.828x + 1$___

6. To find the x-value of the vertex, use the formula $x = -\frac{b}{2a}$.

Solve

7. What is the a value in the equation $h(x) = 0.332x^2 - 0.828x + 1$? ___0.332___

8. What is the b value in the equation $h(x) = 0.332x^2 - 0.828x + 1$? ___−0.828___

9. Substitute into the formula: $x = -\frac{b}{2a} = -\frac{-0.828}{2(0.332)} = 1.25$

10. Find the y-value of the vertex, $h(1.25) = 0.332(1.25)^2 - 0.828(1.25) + 1$

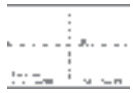
$h(1.25) =$ ___0.484___

11. The minimum distance between the ball and the top of the ramp is ___0.484___ in.

Look Back

12. Graph $h(x) = 0.332x^2 - 0.828x + 1$ on a graphing calculator.

13. Locate the minimum value of the parabola. Does your answer check? ___Yes___



SECTION 5A Ready To Go On? Skills Intervention

5-3 Solving Quadratic Equations by Graphing and Factoring

Find these vocabulary words in Lesson 5-3 and the Multilingual Glossary.

Vocabulary			
zero of a function	root of an equation	binomial	trinomial

Finding Zeros by Factoring

Find the roots of each equation by factoring.

A. $x^2 - 3x = 10$

Set the function equal to 0. $x^2 - 3x -$ ___10___ $= 0$

What are two factors of -10 whose sum equal -3? ___−5___ and ___2___

Write the equation in factored form: $(x -$ ___5___$)(x +$ ___2___$) = 0$

Apply the Zero Product Property: $x -$ ___5___ $= 0$ or $x + 2 = 0$

Solve each equation: $x - 5 = 0$ or $x + 2 = 0$

$x =$ ___5___ $x =$ ___−2___

Check by substituting each value of x into the original equation.

$x^2 - 3x = 10$ $x^2 - 3x = 10$

$5^2 - 3($___5___$) = 10$ $(-2)^2 - 3($___−2___$) = 10$

$25 -$ ___15___ $= 10$ $4 +$ ___6___ $= 10$

$10 = 10$ ✓ $10 = 10$ ✓

B. $6x^2 + 18x = 0$

First, find the Greatest Common Factor of $6x^2$ and $18x$. ___6x___

Factor the equation: $6x($___x___ $+$ ___3___$) = 0$

Apply the Zero Product Property: ___6x___ $= 0$ or $x + 3 = 0$

Solve each equation: $6x = 0$ or $x + 3 = 0$

$x =$ ___0___ $x =$ ___−3___

Check by substituting each value into the original equation.

$6x^2 + 18x = 0$ $6x^2 + 18x = 0$

$6($___0___$)^2 + 18(0) = 0$ $6($___−3___$)^2 + 18(-3) = 0$

___0___ $+ 0 = 0$ ___54___ $- 54 = 0$

$0 = 0$ ✓ $0 = 0$ ✓

SECTION 5A Ready To Go On? Skills Intervention

5-4 Completing the Square

Find this vocabulary word in Lesson 5-4 and the Multilingual Glossary.

Vocabulary
completing the square

Solving a Quadratic Equation by Completing the Square

Solve the equation $x^2 + 8x = -11$, by completing the square.

$x^2 + 8x +$ ☐ $= -11 +$ ☐ Set up to complete the square.

What is the value of b in the equation? ___8___ What is $\left(\frac{b}{2}\right)^2$? ___16___

$x^2 + 8x +$ ___16___ $= -11 +$ ___16___ Add $\left(\frac{b}{2}\right)^2$ to both sides.

$x^2 + 8x +$ ___16___ $=$ ___5___ Simplify.

$(x +$ ___4___$)^2 = 5$ Factor.

$x + 4 = \pm\sqrt{}$ ___5___ Take the square root of both sides.

$x + 4 =$ ___$\sqrt{5}$___ or $x + 4 =$ ___$-\sqrt{5}$___ Solve for x.

$x = -4 +$ ___$\sqrt{5}$___ or $x = -4 -$ ___$\sqrt{5}$___

The solutions of the equation are ___$-4 \pm \sqrt{5}$___.

Writing a Quadratic Function in Vertex Form

Write the function $f(x) = 2x^2 - 8x + 5$, in vertex form, and identify its vertex.

$f(x) =$ ___2___$(x^2 -$ ___4___$x) + 5$ Factor so the coefficient of the x^2-term is 1.

$f(x) = 2(x^2 -$ ___4___$x +$ ☐$) + 5 +$ ☐ Set up to complete the square.

What is $\left(\frac{b}{2}\right)^2$? ___4___ What term did you factor so the leading coefficient was 1? ___2___

You must subtract $2\left(\frac{b}{2}\right)^2$ from 5.

$f(x) = 2\left(x^2 - 4x + \left(-\frac{4}{2}\right)^2\right) + 5 - 2\left(-\frac{4}{2}\right)^2$

$f(x) = 2(x^2 - 4x +$ ___4___$) + 5 - 8$ Simplify.

$f(x) = 2(x^2 - 4x +$ ___4___$) +$ ___−3___ Simplify.

$f(x) = 2(x - 2)^2 +$ ___−3___ Factor.

The vertex form of a quadratic function is $f(x) = a(x - h)^2 + k$.

So, what is the value of h? ___2___ What is the value of k? ___−3___

The vertex of the function is at (___2___, ___−3___).

SECTION 5A

Ready To Go On? Skills Intervention

5-5 Complex Numbers and Roots

Find these vocabulary words in Lesson 5-5 and the Multilingual Glossary.

Vocabulary			
imaginary unit	imaginary number	complex number	real part
imaginary part	complex conjugate		

Solving a Quadratic Equation with Imaginary Solutions
Solve each equation.

A. $5x^2 = -125$

$\frac{5x^2}{5} = \frac{-125}{5}$ To isolate x^2 divide both sides of the equation by 5.

$x^2 = -25$ Simplify.

The opposite of squaring a number is taking the square root of the number.

$x = \pm\sqrt{-25}$ Take the square root of both sides.

The square root of a negative number is an imaginary number.

$x = \pm 5i$ Express in terms of i.

Check $5x^2 = -125$

$5(\pm 5i)^2 = -125$ Substitute the answer back into the original equation.

$5(25)i^2 = -125$ Simplify.

$125(-1) = -125$ Substitute $i^2 = -1$.

$-125 = -125$ ✓

B. $m^2 + 6m = -12$

$m^2 + 6m + \square = -12 + \square$ Set up to complete the square.

What is the value of b? 6 What is $\left(\frac{b}{2}\right)^2$? 9

$m^2 + 6m + 9 = -12 + 9$ Add $\left(\frac{b}{2}\right)^2$ to both sides.

$m^2 + 6m + 9 = -3$ Simplify.

$(m + 3)^2 = -3$ Factor.

$m + 3 = \pm\sqrt{-3}$ Take the square root of both sides.

$m = -3 \pm i\sqrt{3}$ Simplify, by subtracting 3 from both sides.

The two solutions are $-3 + i\sqrt{3}$ and $-3 - i\sqrt{3}$.

SECTION 5A

Ready To Go On? Skills Intervention

5-6 The Quadratic Formula

Find this vocabulary word in Lesson 5-6 and the Multilingual Glossary.

Vocabulary
discriminant

Quadratic Functions with Complex Zeros
Find the zeros of the function $y = x^2 - 5x + 20$ by using the Quadratic Formula.

What is the general form for a quadratic equation? $y = ax^2 + bx + c$

What is the quadratic formula? $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

In the equation $y = x^2 - 5x + 20$ what are a, b, and c? $a = 1$ $b = -5$ and $c = 20$.

Substitute for a, b, and c in the quadratic formula.

$x = \frac{-(-5) \pm \sqrt{(-5)^2 - 4(1)(20)}}{2(1)}$ Simplify.

$x = \frac{-(-5) \pm \sqrt{25 - 80}}{2(1)}$ Simplify.

$x = \frac{-(-5) \pm \sqrt{-55}}{2}$

$x = \frac{5 \pm \sqrt{-55}}{2}$ What is the square root of a negative number? Imaginary

$x = \frac{5 \pm i\sqrt{55}}{2}$ Now, write in terms of i.

$x = \frac{5}{2} \pm i\frac{\sqrt{55}}{2}$

Analyzing Quadratic Equations by Using the Discriminant
Find the type and number of solutions for the equation $4x^2 - 28x + 49 = 0$.

The discriminant is part of the quadratic formula that can be used to determine the number of real roots of a quadratic equation.

If $b^2 - 4ac > 0$, there are two distinct real solutions.

If $b^2 - 4ac = 0$, then there is one distinct real solution.

If $b^2 - 4ac < 0$, then there are two distinct nonreal complex solutions.

What are a, b, and c in the given equation? $a = 4$, $b = -28$, $c = 49$

The discriminant is $b^2 - 4ac$. Substitute a, b, and c.

$(-28)^2 - 4(4)(49) = 784 - 784 = 0$

Since $b^2 - 4ac = 0$, the equation has one distinct real solution.

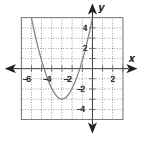
SECTION 5A

Ready To Go On? Quiz

5-1 Using Transformations to Graph Quadratic Functions
Using the graph of $f(x)^2$ as a guide, describe the transformations, and then graph each function.

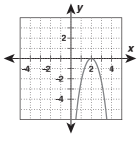
1. $g(x) = (x + 3)^2 - 3$

Translated 3 units down and 3 units left



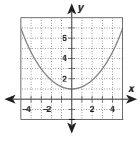
2. $g(x) = -3(x - 2)^2$

Vertically stretched by a factor of 3, reflected across the x-axis and translated 2 units right



3. $g(x) = \frac{1}{4}x^2 + 1$

Vertically compressed by a factor of $\frac{1}{4}$ and translated 1 unit up



Use the description to write each quadratic function in vertex form.

4. $f(x)^2$ is vertically stretched by a factor of 4 and translated 4 units left to create $g(x)$.

$g(x) = 4(x + 4)^2$

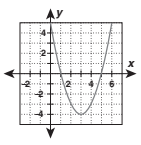
5. $f(x)^2$ is reflected across the x-axis and translated 3 units up to create $g(x)$.

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

5-2 Properties of Quadratic Functions in Standard Form.
For each function, (a) determine whether the graph opens upward or downward, (b) find the axis of symmetry, (c) find the vertex, (d) find the y-intercept, and (e) graph the function.

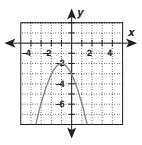
6. $f(x) = x^2 - 6x + 5$

a) Up
b) $x = 3$
c) $(3, -4)$
d) $(0, 5)$
e)



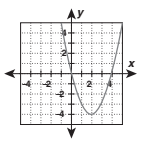
7. $g(x) = -x^2 - 2x - 3$

a) Down
b) $x = -1$
c) $(-1, -2)$
d) $(0, -3)$
e)



8. $h(x) = x^2 - 4x$

a) Up
b) $x = 2$
c) $(2, -4)$
d) $(0, 0)$
e)



SECTION 5A

Ready To Go On? Quiz continued

9. A soccer ball is kicked and modeled by the function $h(x) = -0.0085x^2 + 0.25x + 6$, where h is the height of the ball in feet and x is the horizontal distance in feet that the ball travels. Find the maximum height of the ball to the nearest foot.

8 feet

5-3 Solving Quadratic Equations by Graphing and Factoring
Find the roots of each equation by factoring.

10. $x^2 - 144 = 0$ $x = 12, -12$

11. $x^2 + 3x = 28$ $x = 4, -7$

12. $5x^2 + 15x = 0$ $x = 0, -3$

5-4 Completing the Square
Solve each equation by completing the square.

13. $x^2 + 6x = 7$ $x = -7, 1$

14. $x^2 + 6x = 5$ $x = -3 \pm \sqrt{14}$

15. $x^2 - 8x = 7$ $x = 4 \pm \sqrt{23}$

Write each function in vertex form, and identify its vertex.

16. $f(x) = x^2 + 18x + 77$ $f(x) = (x + 9)^2 - 4$ Vertex: $(-9, -4)$

17. $g(x) = x^2 - 6x + 13$ $g(x) = (x - 3)^2 + 4$ Vertex: $(3, 4)$

18. $h(x) = 3x^2 - 6x - 6$ $h(x) = 3(x - 1)^2 - 9$ Vertex: $(1, -9)$

5-5 Complex Numbers and Roots
Solve each equation.

19. $3x^2 = -75$ $x = \pm 5i$

20. $x^2 - 4x = -13$ $x = 2 \pm 3i$

21. $x^2 - 4x = -9$ $x = 2 \pm i\sqrt{5}$

5-6 The Quadratic Formula
Find the zeros of each function by using the Quadratic Formula.

22. $f(x) = (x + 8)^2 + 3$ $x = -8 \pm i\sqrt{3}$

23. $g(x) = x^2 - 3x + 7$ $x = \frac{3}{2} \pm i\frac{\sqrt{19}}{2}$

24. $h(x) = 3x^2 - 8x + 5$ $x = 1, \frac{5}{3}$

Find the type and number of solutions for each equation.

25. $x^2 + 4x = 21$ 2 distinct real solutions

26. $9x^2 - 12x = -4$ 1 distinct real solution

27. $x^2 + 5x + 8 = 0$ 2 distinct nonreal complex solutions

SECTION 5A

Ready To Go On? Enrichment

Equations Quadratic in Form

Certain equations that are not quadratic can be thought of in such a way that they can be solved as quadratic. For example, because the square of x^2 is x^4, the equation $x^4 - 9x^2 + 8 = 0$ is said to be "quadratic in x^2."

$x^4 - 9x^2 + 8 = 0$

$(x^2)^2 - 9(x^2) + 8 = 0$ Think of x^4 as $(x^2)^2$.

$u^2 - 9u + 8 = 0$ Substitute u for x^2.

The equation $u^2 - 9u + 8 = 0$ can be solved by factoring or by the quadratic formula.

$u^2 - 9u + 8 = 0$

$(u - 8)(u - 1) = 0$

$u - 8 = 0$ or $u - 1 = 0$

$u = 8$ or $u = 1$

Replace u with x^2 and solve these equations:

$x^2 = 8$ $x^2 = 1$

$x = \sqrt{8}$ $x = \sqrt{1}$

$x = \pm 2\sqrt{2}$ $x = \pm 1$

The solutions are -1, 1, $2\sqrt{2}$ and $-2\sqrt{2}$.

Solve.

1. $x^4 - 6x^2 + 9 = 0$

   $x = \pm\sqrt{3}$

2. $x^4 - 7x^2 + 12 = 0$

   $x = \pm\sqrt{3}, \pm 2$

3. $6x^4 - 19x^2 + 15 = 0$

   $x = \pm\frac{\sqrt{15}}{3}, \pm\frac{\sqrt{6}}{2}$

4. $6x^4 - 17x^2 + 5 = 0$

   $x = \pm\frac{\sqrt{3}}{3}, \pm\frac{\sqrt{10}}{2}$

5. $x^4 - 13x^2 + 36 = 0$

   $x = \pm 2, \pm 3$

6. $x^6 - 28x^3 + 27 = 0$

   $x = 1, 3$

SECTION 5B

Ready To Go On? Skills Intervention

5-7 Solving Quadratic Inequalities

Find this vocabulary word in Lesson 5-7 and the Multilingual Glossary.

Vocabulary
quadratic inequalities in two variables

Solving Quadratic Inequalities by Using Algebra

Solve the inequality $x^2 + 3x - 8 > 2$.

$x^2 + 3x - 8$ [=] 2 — Write the related equation by replacing the inequality symbol with the equal sign.

$x^2 + 3x - 8$ [2] $= 2 -$ [2] — Write the equation in standard form, by subtracting 2 from both sides.

$x^2 + 3x -$ [10] $= 0$ — Simplify. This is now the equation in standard form.

Factor the equation.

What are the factors of 10 that have a sum of 3? 5 and -2

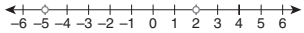
Write the equation in factored form.

$(x +$ [5] $)(x - 2) = 0$ Write the factors.

$x +$ [5] $= 0$ or $x - 2 = 0$ Apply the Zero Product Property.

$x =$ [-5] or $x = 2$ Solve each equation for x.

Plot the two solutions on a number line.



The critical values divide the number line into 3 intervals.

The intervals are $x <$ -5, $-5 < x < 2$, and $x > 2$.

Determine if the test values make the original inequality, $x^2 + 3x - 8 > 2$, true or false.

Try $x = -6$. $(-6)^2 + 3(-6) - 8 > 2$ 10 > 2 True or False? True

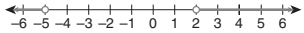
Try $x = 0$. $(0)^2 + 3(0) - 8 > 2$ $-8 > 2$ True or False? False

Try $x = 4$. $(4)^2 + 3(4) - 8 > 2$ 20 > 2 True or False? True

Should the circle drawn on -5 be solid or empty? Empty

Should the circle drawn on 2 be solid or empty? Empty

Shade the solutions on the number line, where the test points made the inequality true.



The solution is $x <$ [-5] or $x > 2$.

SECTION 5B

Ready To Go On? Problem Solving Intervention

5-7 Solving Quadratic Inequalities

A profit is made when the revenue from items sold is more than the cost to produce the items. A loss occurs when cost is more than the revenue.

A business makes and sells cabinets. The profit that the company earns for x number of cabinets can be modeled by $P(x) = -30x^2 + 750x - 2000$. How many cabinets are needed for a profit of at least \$2000?

Understand the Problem

1. How much must the profit be? At least \$2000
2. Which symbol is needed to represent at least? $\geq$

Make a Plan

3. Write the inequality to represent this situation. $-30x^2 + 750x - 2000$ [$\geq$] 2000

Look Back

4. Find the critical values by solving the related equation.

   $-30x^2 + 750x - 2000 = 2000$ Write as an equation.

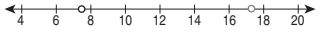
   $-30x^2 + 750x -$ [4000] $= 0$ Write the equation in standard form.

   $-10($[3]$x^2 -$ [75]$x + 400) = 0$ Factor out -10 to simplify.

Substitute $a =$ 3, $b =$ -75, $c =$ 400 into the quadratic formula and solve.

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-(-75) \pm \sqrt{(-75)^2 - 4(3)(400)}}{2(3)} = \frac{75 \pm \sqrt{825}}{6} = x \approx$ [7.7] or [17.3]

5. Plot the x-values on the number line and test an x-value in each of the three regions formed by the critical x-values.



Try 6. $-30(6)^2 + 750(6) - 4000 \geq 0$; $-580 \geq 0$. True or False? False

Try 12. $-30($[12]$)^2 + 750($[12]$) - 4000 \geq 0$; [680] ≥ 0. True or False? True

Try 18. $-30($[18]$)^2 + 750($[18]$) - 4000 \geq 0$; [-220] ≥ 0. True or False? False

6. For a profit of at least \$2000, from 8 to 17 cabinets must be sold.

Look Back

7. Enter $y = -30x^2 + 750x - 2000$ into a graphing calculator, and create a table of values. Does the table show that integer values of x between 8 and 17 inclusive results in y-values greater than or equal to 2000? Yes

SECTION 5B

Ready To Go On? Skills Intervention

5-8 Curve Fitting with Quadratic Models

Find these vocabulary words in Lesson 5-8 and the Multilingual Glossary.

Vocabulary	
quadratic model	quadratic regression

Writing a Quadratic Function from Data

Write a quadratic function that fits the points (0, −12), (2, −4), and (3, 3).

Use each point to write a system of equations to find a, b, and c in $f(x) = ax^2 + bx + c$. Substitute x and y into the general form of a quadratic function.

(x, y)	$f(x) = ax^2 + bx + c$	System in a, b, c	Equation
(0, −12)	$-12 = a(0)^2 + b(0) + c$	$c =$ [-12]	1
(2, −4)	$-4 = a(2)^2 + b(2) + c$	$4a +$ [$2b$] $+ c = -4$	2
(3, 3)	$3 = a(3)^2 + b(3) + c$	[$9a$] $+ 3b + c = 3$	3

Substitute $c = -12$ from **Equation 1** into both **Equations 2** and **3.**

$4a + 2b + c = -4$ **Equation 2**

$4a + 2b +$ [-12] $= -4$

$4a + 2b + (-12) + 12 = -4 +$ [12] Add 12.

$4a + 2b =$ [8] **Equation 4**

$9a + 3b + c = 3$ **Equation 3**

$9a + 3b +$ [-12] $= 3$

$9a + 3b + (-12) + 12 = 3 +$ [12] Add 12.

$9a + 3b =$ [15] **Equation 5**

Next solve **Equation 4** and **Equation 5** for a and b using elimination.

Equation 4 $4a + 2b = 8$ Multiply by 3. $4a(3) + 2b(3) = 8(3)$ $12a +$ [6] $b =$ [24]

Equation 5 $9a + 3b = 15$ Multiply by -2. $9a(-2) + 3b(-2) = 15(-2)$ [-18] $a - 6b = -30$

$-6a = -6$

$a =$ 1

Substitute the solution for a into **Equation 4** to find b.

$4($[1]$) + 2b = 8$

$2b = 4$ Subtract 4 from both sides.

$b =$ [2] Divide by 2.

The function is: $f(x) = ax^2 + bx + c$

$= x^2 +$ [2]$x -$ [12]

SECTION 5B Ready To Go On? Problem Solving Intervention

5-8 Curve Fitting with Quadratic Models

A quadratic model is a quadratic function that represents a set of real data. Models are helpful for making estimates. A graphing calculator can help to make predictions from a set of data.

Claire is participating in a running club and keeps record of how many miles she runs. The table shows the distances that Claire has run after so many days. Find the quadratic model for the number of miles ran in the amount of days given. Use the model to estimate the number of miles that Claire ran in 25 days. Predict the number of miles she will have run after 55 days.

Claire's Running Record	
Days	**Miles**
10	12.5
20	36.0
30	69.5
40	114.0
50	169.5

Understand the Problem

1. What does the data in the first column represent? Days
2. What does the data in the second column represent? Miles
3. In 30 days, how many miles has Claire ran? 69.5 miles
4. According to the chart, in 25 days she should have ran between 36 and 69.5 miles.

Make a Plan

5. On your calculator, which data will you enter for List 1? 10, 20, 30, 40, 50
6. On your calculator, which data will you enter for List 2? 12.5, 36, 69.5, 114, 169.5

Solve

7. Using the quadratic regression feature on your calculator, $a = 0.06$, $b =$ 0.71, and $c = 0.2$.
8. The quadratic model is $y \approx 0.06x^2 +$ 0.71 $x + 0.2$.
9. Using the table feature, when $x = 25$, $y =$ 51.33. (To the nearest hundredth.)
10. Using the table feature, when $x = 55$, $y =$ 201.07. (To the nearest hundredth.)

Look Back

11. Graph the function model from Exercise 8 on a graphing calculator. Does the model appear to fit the data? Yes

SECTION 5B Ready To Go On? Skills Intervention

5-9 Operations with Complex Numbers

Find these vocabulary words in Lesson 5-9 and the Multilingual Glossary.

Vocabulary	
complex plane	absolute value of a complex number

Adding and Subtracting Complex Numbers
Add or subtract. Write the result in the form $a + bi$.

A. $(6 + 7i) + (5 + 3i)$

$(6 +$ 5 $) + (7i +$ 3i $)$ — Group the real parts and the imaginary parts.

$11 +$ 10 i — Add. Then, write the result in $a + bi$ form.

B. $(7 - 4i) - (5 - 3i)$

$7 - 4i -$ 5 $+$ 3 i — Distribute the negative sign.

$(7 - 5) + ($ $-4i$ $+ 3i)$ — Group the real parts and the imaginary parts.

2 $- i$ — Add. Then, write the result in $a + bi$ form.

Multiplying Complex Numbers
Multiply. Write the result in the form $a + bi$.

A. $-7i(3 - 4i)$

$-21i + 28i^2$ — Distribute.

$-21i +28($ -1 $)$ — Use $i^2 = -1$.

$-21i -$ 28 — Multiply.

$-28 -$ 21i — Write in $a + bi$ form.

B. $(7 - 2i)(2 - 6i)$

$14 -$ 42i $- 4i +$ 12 i^2 — Multiply.

$14 -$ 46i $+$ 12 i^2 — Combine like terms.

$14 -$ 46i $+ 12($ -1 $)$ — Use $i^2 = -1$.

$14 -$ 46i $-$ 12 — Simplify.

$2 -$ 46 i — Write in $a + bi$ form.

Evaluate Powers of i.
Simplify $7i^{17}$.

$7i \cdot i^{16}$ — Rewrite as an even power.

$7i \cdot (i^2)^{8}$ — Rewrite as a power of i^2.

A negative number raised to an even power has a positive solution.

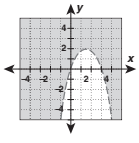
$7i \cdot ($ -1 $)^{8}$ — Simplify $i^2 = -1$.

7 i — Simplify.

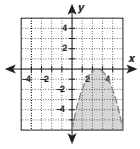
SECTION 5B Ready To Go On? Quiz

5-7 Solving Quadratic Inequalities
Graph each inequality.

1. $y > -x^2 + 3x$



2. $y < -x^2 + 5x - 6$



Solve each inequality by using tables or graphs.

3. $x^2 - 4x - 4 > 8$

$x < -2$ or $x > 6$

4. $2x^2 + 12x + 8 \leq -2$

$-5 \leq x \leq -1$

Solve each inequality by algebra.

5. $x^2 + 3x - 15 > 3$

$x < -6$ or $x > 3$

6. $x^2 - 2x < 0$

$0 < x < 2$

7. The function $P(x) = -15x^2 + 600x - 1800$ models the monthly profit P of a small business, where x is the price of an item. For what price of items does the store earn a monthly profit of at least \$1950?

$x \approx$ \$32.25; \$7.75

5-8 Curve Fitting with Quadratic Models
Determine whether each data set could represent a quadratic function. Explain.

8.

x	6	7	8	9	10
y	11	9	5	−1	−9

Yes; second differences are constant for equally spaced x-values.

9.

x	−6	−3	0	1	3
y	8	6	2	6	8

No; second differences are not constant for equally spaced x-values.

SECTION 5B Ready To Go On? Quiz continued

Write a quadratic function that fits each set of points.

10. (0, 10), (2, 0), and (3, −2)

$y = x^2 - 7x + 10$

11. (1, 5), (2, 6), and (4, 2)

$y = -x^2 + 4x + 2$

For Exercises 12-14, use the table of number of recliners produced and the profit made over three months.

Month	Number of Recliners Produced	Profit
1	50	\$5100
2	100	\$5600
3	150	\$1100

12. Use the data to find a quadratic function that describes the profit as a function of number of recliners produced.

$P(x) = -x^2 + 160x - 400$

13. Use your function to predict the level of production that will maximize the profit.

80 recliners

14. Use your function to predict the maximum profit, assuming that all business situations stay the same.

\$6000

5-9 Operations with Complex Numbers
Find each absolute value.

15. $|-4i|$

4

16. $|12 - 5i|$

13

17. $|2 + 3i|$

$\sqrt{13}$

Perform each indicated operation, and write the result in the form $a + bi$.

18. $(4 + 5i) - (6 - 3i)$

$-2 + 8i$

19. $(8 + 6i) + (3 + 2i)$

$11 + 8i$

20. $-4i(3 - 5i)$

$-20 - 12i$

21. $(-5 - i)(-2 + 2i)$

$12 - 8i$

22. $(1 + i)(1 - i)$

2

23. $4i^{35}$

$-4i$

24. $\frac{6i + 3}{3i}$

$2 + i$

25. $\frac{3 - 2i}{4 + 3i}$

$\frac{6}{25} - \frac{17}{25}i$

SECTION 5B

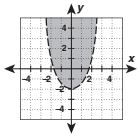
Ready To Go On? Enrichment

Solving Quadratic Systems of Inequalities

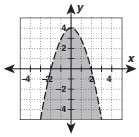
Graphical techniques can be used to solve systems of quadratic inequalities. When graphing two parabolas, the solution set includes all the points (x, y) in both shaded regions. For example, consider this quadratic inequality system:

$$\begin{cases} y > x^2 - 2 \\ y < 4 - x^2 \end{cases}$$

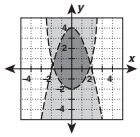
The graph of $y > x^2 - 2$ is a parabola opening upward.



The graph of $y < 4 - x^2$ is a parabola opening downward.

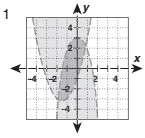


The intersection of the shaded regions shows the solutions.

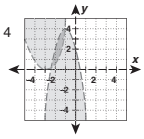


Solve.

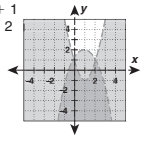
1. $y > x^2 + 3x - 1$
   $y < 3 - 2x^2$



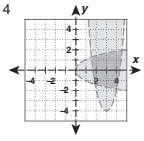
2. $y > (x + 3)^2$
   $y < -2(x + 1)^2 + 4$



3. $y < 2x^2 + 3x + 1$
   $y < (x - 1)^2 + 2$



4. $y > 3(x - 3)^2 - 4$
   $x > y^2$



SECTION 6A

Ready To Go On? Skills Intervention

6-1 Polynomials

Find these vocabulary words in Lesson 6-1 and the Multilingual Glossary.

Vocabulary			
monomial	polynomial	degree of a monomial	degree of a polynomial
leading coefficient	binomial	trinomial	polynomial function

Classifying Polynomials

Rewrite the polynomial $4 + 7x^3 + 2x^2 - 9x$ in standard form. Then identify the leading coefficient, degree, and number of terms. Name the polynomial.

A polynomial is written in standard form when its terms are written in descending order by degree.

leading coefficient

$7x^3 + 2x^2 - 9x + 4$ Write the given polynomial in standard form.

degree of polynomial

Identify the leading coefficient. 7 Identify the degree of the leading coefficient. 3

A term is separated by addition or subtraction signs. How many terms are there? 4

A polynomial is named by its largest degree. Is the polynomial quadratic or cubic? Cubic

Adding and Subtracting Polynomials

Add or subtract. Write your answer in standard form.

A. $(9x^2 + x^3 + 4) + (3x^3 + 6x^2 - 3x)$

To add vertically, write each polynomial in standard form and align like terms.

$x^3 + 9x^2 + 4$ First polynomial

$+ 3x^3 + 6x^2 - 3x$ Second polynomial

$4x^3 + 15x^2 - 3x + 4$ Add.

B. $(10x^3 - 5x^2) - (3x^3 + x^2 + 5)$

To subtract horizontally, you add the opposite.

$(10x^3 - 5x^2) + (-3x^3 - x^2 - 5)$ Change the sign and distribute the negative.

$(10x^3 - 3x^3) + (-5x^2 - x^2) - 5$ Rearrange so like terms are together.

$7x^3 - 6x^2 - 5$ Add.

SECTION 6A

Ready To Go On? Skills Intervention

6-2 Multiplying Polynomials

Multiplying Polynomials

Find each product.

To multiply any two polynomials, use the Distributive Property to multiply each term in the second polynomial by each term in the first polynomial.

A. Multiply horizontally. $(2x - 1)(x^3 - 2x^2 + 6x + 1)$

Distribute $2x$, and then -1.

$2x(x^3) - 2x(2x^2) + 2x(6x) + 2x(1) - 1(x^3) - (-1)(2x^2) - 1(6x)x - 1(1)$

$2x^4 - 4x^3 + 12x^2 + 2x - x^3 + 2x^2 - 6x - 1$ When you multiply, you add exponents.

$2x^4 + (-4x^3 - x^3) + (12x^2 + 2x^2) + (2x - 6x) - 1$ Combine like terms.

$2x^4 - 5x^3 + 14x^2 - 4x - 1$ Simplify.

B. Multiply vertically. $(x^2 + 6x - 5)(x - 4)$

$x^2 + 6x - 5$

$x - 4$

$-4x^2 - 24x + 20$ Multiply $x^2 + 6x - 5$ by -4.

$x^3 + 6x^2 - 5x$ Multiply $x^2 + 6x - 5$ by x.

$x^3 + 2x^2 - 29x + 20$ Combine like terms.

Using Pascal's Triangle to Expand Binomial Expressions

Expand the expression $(3x - 4)^3$.

Each row of Pascal's triangle gives the coefficients of the corresponding binomial expansion.

Using Pascal's Triangle, what are the coefficients for $n = 3$ (row 4)? 1 3 3 1

The exponents on the first term increase and the exponents on the second term decrease.

What is the first term in the expression $(3x - 4)^3$? $3x$ second term? -4

Complete the expansion.

$[1(3x)^3(-4)^0] + [3(3x)^2(-4)^1] + [3(3x)^1(-4)^2] + [1(3x)^0(-4)^3]$

$[27x^3(1)] + [3(9)x^2(-4)] + [9x(16)] + [1(1)(-64)]$ Simplify.

$27x^3 - 108x^2 + 144x - 64$ Simplify.

Pascal's Triangle

1

1 1

1 2 1

1 3 3 1

1 4 6 4 1

SECTION 6A

Ready To Go On? Skills Intervention

6-3 Dividing Polynomials

Find this vocabulary word in Lesson 6-3 and the Multilingual Glossary.

Vocabulary
synthetic division

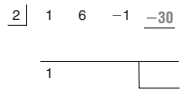
Using Synthetic Division to Divide by a Linear Binomial

Divide. $(x^3 + 6x^2 - x - 30) \div (x - 2)$

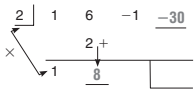
What are the coefficients of the dividend? 1, 6, −1, −30

The divisor is written in the form $x - a$. What is the value of a? 2

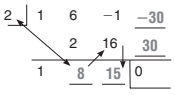
Write the coefficients of the dividend and the value for a in the upper left corner.



Bring down the first coefficient (1) and write it below the horizontal bar.



Multiply 2 by 1 to get 2. Write the product under the next coefficient and add.



Repeat the steps (multiply, write the product under the next coefficient and add) with the remaining numbers.

The answer is $x^2 + 8x + 15$.

Using Synthetic Substitution

Use synthetic substitution to evaluate $P(x) = x^4 + 2x^2 + 2x - 5$ for $x = 2$.

You can use synthetic division to evaluate polynomials. The process is exactly the same as synthetic division, but the final answer is interpreted differently.

If you are missing terms what do you do? Add a zero for the missing term.

What are the coefficients of the polynomial? 1, 0, 2, 2, −5

Write the coefficients.

2 | 1 0 2 2 −5 Bring down the first coefficient (1) and write it below the horizontal bar.

2 4 12 28

1 2 6 14 | 23 Complete the synthetic division by multiplying and adding.

Check: Substitute 2 for x in $P(x) = x^4 + 2x^2 + 2x - 5$. The answer should be your remainder.

$P(x) = 2^4 + 2(2)^2 + 2(2) - 5$

$= 16 + 8 + 4 - 5$

$= 23$ Does your answer check? Yes