Shelby County Schools

Extended Learning Packet

Algebra I

NAME _____ DATE _____ PERIOD _____

9-1 Study Guide and Intervention

Graphing Quadratic Functions

Characteristics of Quadratic Functions

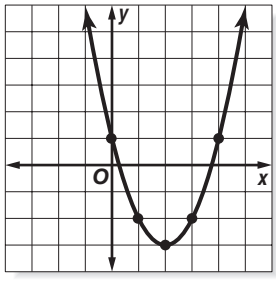
Quadratic Function	a function described by an equation of the form $f(x) = ax^2 + bx + c$, where $a \neq 0$	**Example:** $y = 2x^2 + 3x + 8$

The parent graph of the family of quadratic fuctions is $y = x^2$. Graphs of quadratic functions have a general shape called a **parabola**. A parabola opens upward and has a **minimum point** when the value of a is positive, and a parabola opens downward and has a **maximum point** when the value of a is negative.

Example 1

a. Use a table of values to graph $y = x^2 - 4x + 1$.

x	y
−1	6
0	1
1	−2
2	−3
3	−2
4	1



Graph the ordered pairs in the table and connect them with a smooth curve.

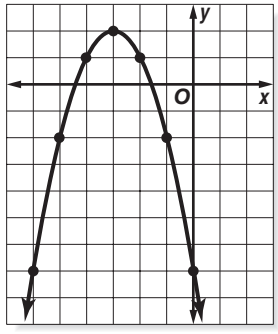
b. What is the domain and range of this function?

The domain (the x-values) is all real numbers. The range (the y-values) is all real numbers greater than or equal to −3, which is the minimum.

Example 2

a. Use a table of values to graph $y = -x^2 - 6x - 7$.

x	y
−6	−7
−5	−2
−4	1
−3	2
−2	1
−1	−2
0	−7



Graph the ordered pairs in the table and connect them with a smooth curve.

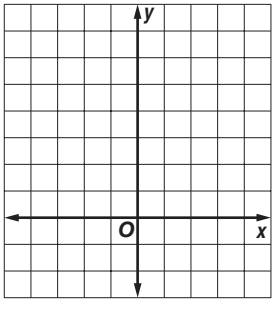
b. What is the domain and range of this function?

The domain (the x-values is all real numbers. The range (the y-values) is all real numbers less than or equal to 2, which is the maximum.

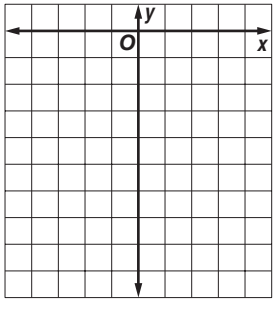
Exercises

Use a table of values to graph each function. Determine the domain and range.

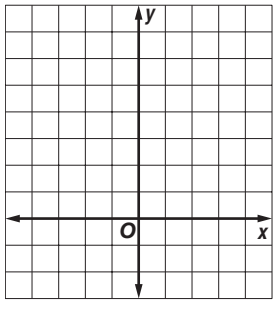
1. $y = x^2 + 2$



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



3. $y = x^2 - 3x + 2$



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9-1 Study Guide and Intervention *(continued)*

Graphing Quadratic Functions

Symmetry and Vertices Parabolas have a geometric property called **symmetry**. That is, if the figure is folded in half, each half will match the other half exactly. The vertical line containing the fold line is called the **axis of symmetry**. The axis of symmetry contains the minimum or maximum point of the parabola, the **vertex**.

Axis of Symmetry	For the parabola $y = ax^2 + bx + c$, where $a \neq 0$, the line $x = -\frac{b}{2a}$ is the axis of symmetry.	**Example:** The axis of symmetry of $y = x^2 + 2x + 5$ is the line $x = -1$.

Example **Consider the graph of $y = 2x^2 + 4x + 1$.**

a. Write the equation of the axis of symmetry.

In $y = 2x^2 + 4x + 1$, $a = 2$ and $b = 4$. Substitute these values into the equation of the axis of symmetry.

$$x = -\frac{b}{2a}$$

$$x = -\frac{4}{2(2)} = -1$$

The axis of symmetry is $x = -1$.

c. Identify the vertex as a maximum or a minimum.

Since the coefficient of the x^2-term is positive, the parabola opens upward, and the vertex is a minimum point.

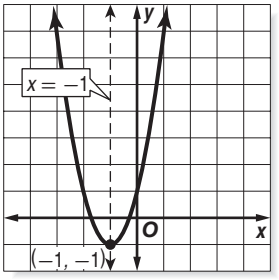
d. Graph the function.

b. Find the coordinates of the vertex.

Since the equation of the axis of symmetry is $x = -1$ and the vertex lies on the axis, the x-coordinate of the vertex is -1.

$y = 2x^2 + 4x + 1$ Original equation
$y = 2(-1)^2 + 4(-1) + 1$ Substitute.
$y = 2(1) - 4 + 1$ Simplify.
$y = -1$

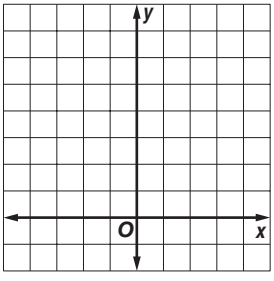
The vertex is at $(-1, -1)$.



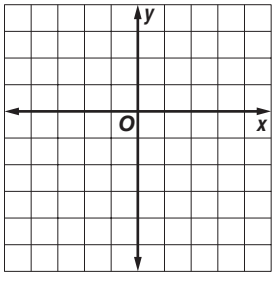
Exercises

Consider each equation. Determine whether the function has *maximum* or *minimum* value. State the maximum or minimum value. What are the domain and range of the function? Find the equation of the axis of symmetry. Graph the function.

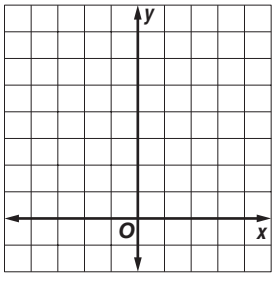
1. $y = x^2 + 3$



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



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



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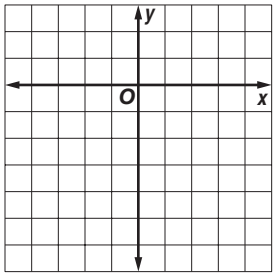
9-1 Practice

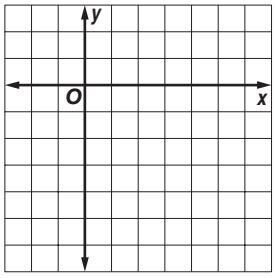
Graphing Quadratic Functions

Use a table of values to graph each function. Determine the domain and range.

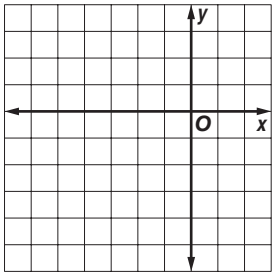
1. $y = -x^2 + 2$



2. $y = x^2 - 6x + 3$



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



Find the vertex, the equation of the axis of symmetry, and the *y*-intercept.

4. $y = x^2 - 9$

5. $y = -2x^2 + 8x - 5$

6. $4x^2 - 4x + 1$

Consider each equation. Determine whether the function has *maximum* or *minimum* value. State the maximum or minimum value. What are the domain and range of the function?

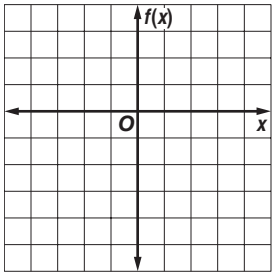
7. $y = 5x^2 - 2x + 2$

8. $y = -x^2 + 5x - 10$

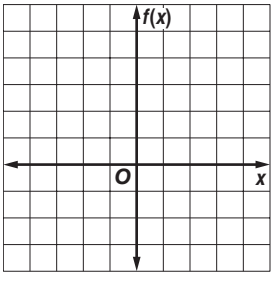
9. $y = \frac{3}{2}x^2 + 4x - 9$

Graph each function.

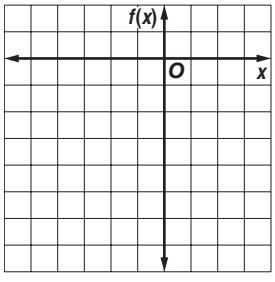
10. $f(x) = -x^2 + 3$



11. $f(x) = -2x^2 + 8x - 3$



12. $f(x) = 2x^2 + 8x + 1$



13. BASEBALL A player hits a baseball into the outfield. The equation $h = -0.005x^2 + x + 3$ gives the path of the ball, where h is the height and x is the horizontal distance the ball travels.

a. What is the equation of the axis of symmetry?

b. What is the maximum height reached by the baseball?

c. An outfielder catches the ball three feet above the ground. How far has the ball traveled horizontally when the outfielder catches it?

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9-2 Study Guide and Intervention

Solving Quadratic Equations by Graphing

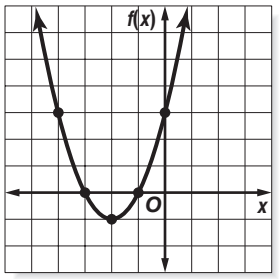
Solve by Graphing

Quadratic Equation	an equation of the form $ax^2 + bx + c = 0$, where $a \neq 0$

The solutions of a quadratic equation are called the **roots** of the equation. The roots of a quadratic equation can be found by graphing the related quadratic function $f(x) = ax^2 + bx + c$ and finding the x-intercepts or **zeros** of the function.

Example 1 **Solve $x^2 + 4x + 3 = 0$ by graphing.**

Graph the related function $f(x) = x^2 + 4x + 3$. The equation of the axis of symmetry is $x = -\frac{4}{2(1)}$ or -2. The vertex is at $(-2, -1)$. Graph the vertex and several other points on either side of the axis of symmetry.

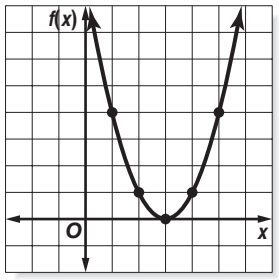


To solve $x^2 + 4x + 3 = 0$, you need to know where the value of $f(x) = 0$. This occurs at the x-intercepts, -3 and -1.

The solutions are -3 and -1.

Example 2 **Solve $x^2 - 6x + 9 = 0$ by graphing.**

Graph the related function $f(x) = x^2 - 6x + 9$. The equation of the axis of symmetry is $x = \frac{6}{2(1)}$ or 3. The vertex is at $(3, 0)$. Graph the vertex and several other points on either side of the axis of symmetry.

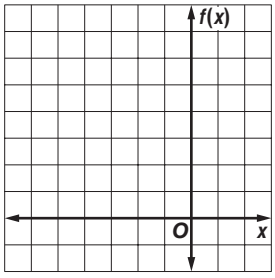


To solve $x^2 - 6x + 9 = 0$, you need to know where the value of $f(x) = 0$. The vertex of the parabola is the x-intercept. Thus, the only solution is 3.

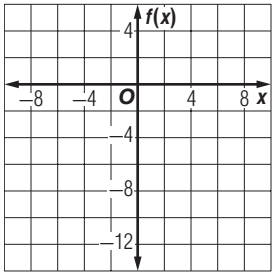
Exercises

Solve each equation by graphing.

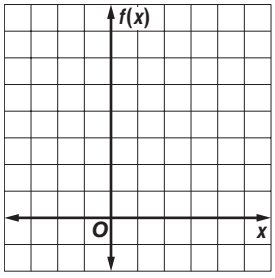
1. $x^2 + 7x + 12 = 0$



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



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



Lesson 9-2

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9-2 Study Guide and Intervention *(continued)*

Solving Quadratic Equations by Graphing

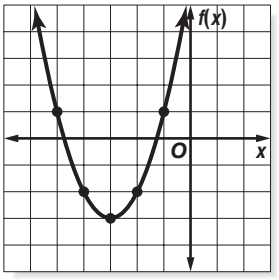
Estimate Solutions The roots of a quadratic equation may not be integers. If exact roots cannot be found, they can be estimated by finding the consecutive integers between which the roots lie.

Example **Solve $x^2 + 6x + 6 = 0$ by graphing. If integral roots cannot be found, estimate the roots by stating the consecutive integers between which the roots lie.**

Graph the related function $f(x) = x^2 + 6x + 6$.

x	$f(x)$
−5	1
−4	−2
−3	−3
−2	−2
−1	1

Notice that the value of the function changes from negative to positive between the x-values of −5 and −4 and between −2 and −1.

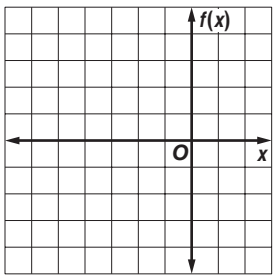


The x-intercepts of the graph are between −5 and −4 and between −2 and −1. So one root is between −5 and −4, and the other root is between −2 and −1.

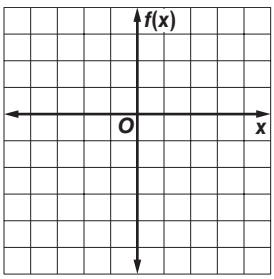
Exercises

Solve each equation by graphing. If integral roots cannot be found, estimate the roots to the nearest tenth.

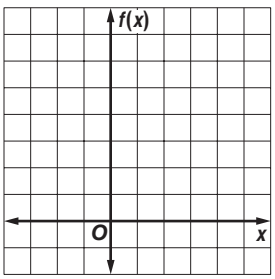
1. $x^2 + 7x + 9 = 0$



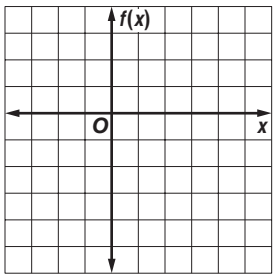
2. $x^2 - x - 4 = 0$



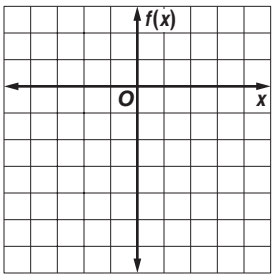
3. $x^2 - 4x + 6 = 0$



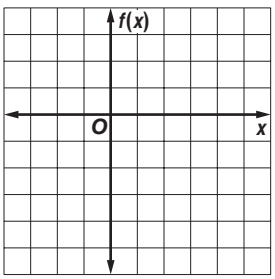
4. $x^2 - 4x - 1 = 0$



5. $4x^2 - 12x + 3 = 0$



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



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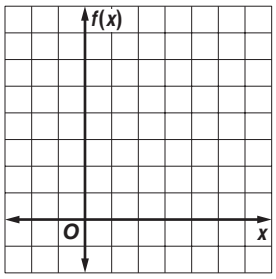
9-2 Practice

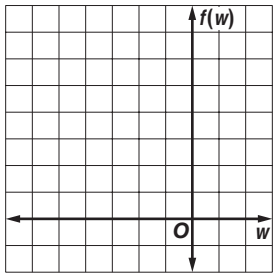
Solving Quadratic Equations by Graphing

Solve each equation by graphing.

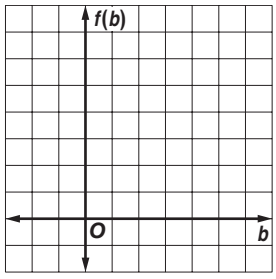
1. $x^2 - 5x + 6 = 0$



2. $w^2 + 6w + 9 = 0$

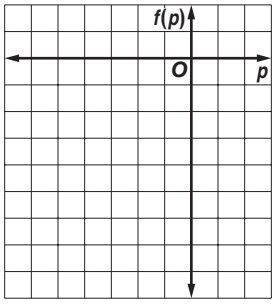


3. $b^2 - 3b + 4 = 0$

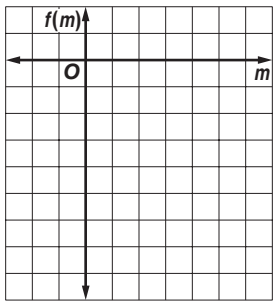


Solve each equation by graphing. If integral roots cannot be found, estimate the roots to the nearest tenth.

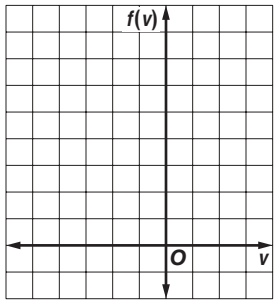
4. $p^2 + 4p = 3$



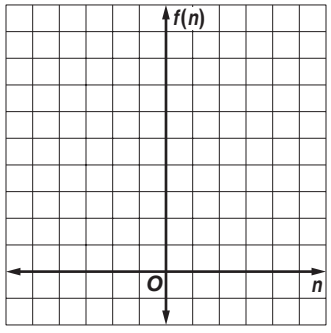
5. $2m^2 + 5 = 10m$



6. $2v^2 + 8v = -7$



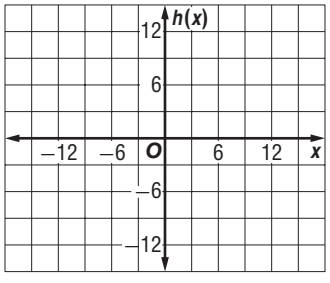
7. NUMBER THEORY Two numbers have a sum of 2 and a product of −8. The quadratic equation $-n^2 + 2n + 8 = 0$ can be used to determine the two numbers.



a. Graph the related function $f(n) = -n^2 + 2n + 8$ and determine its x-intercepts.

b. What are the two numbers?

8. DESIGN A footbridge is suspended from a parabolic support. The function $h(x) = -\frac{1}{25}x^2 + 9$ represents the height in feet of the support above the walkway, where $x = 0$ represents the midpoint of the bridge.



9. Graph the function and determine its x-intercepts.

10. What is the length of the walkway between the two supports?

Algebra I Educational Websites and Web Resources

Title of Resource	Web Address	Description	Student Access
eMathInstruction	https://www.emathinstruction.com Algebra I, Unit 8, Lessons 1-4; Unit 9, Lessons 4 & 5	Students will be able to view a video that corresponds to the worksheets provided.	Students will need to agree to the terms outlined by the website for free access
Khan Academy	https://www.khanacademy.org	Students will be able to get additional practice with skills in various subjects and test prep.	Students will need to sign up for a free account if they do not already have an account, however, the videos are accessible.