Graphing Quadratic Functions
§9.1

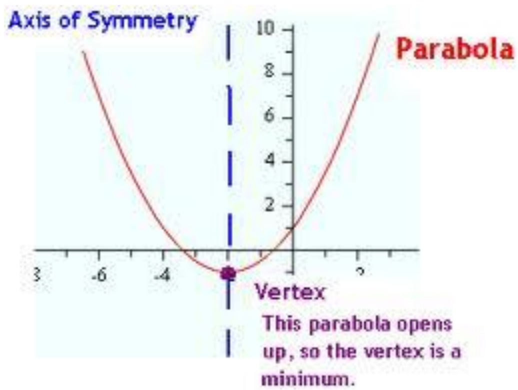
<u>Quadratic Functions</u> - $f(x) = ax^2 + bx + c$ (also called standard form).

The <u>graph</u> of <u>quadratic functions</u> is called a <u>parabola</u>.

<u>Axis of Symmetry</u> – a central line which makes the parabola symmetric.

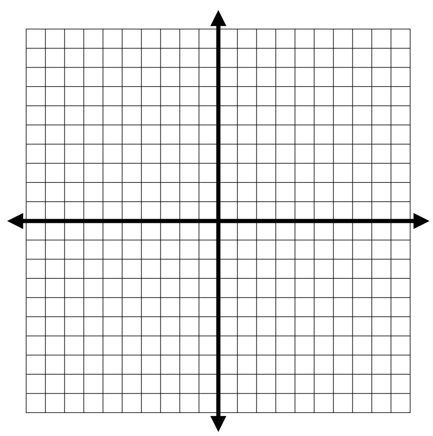
<u>Vertex</u> – the intersection of the parabola and the axis of symmetry.

Parent Function:	$f(x) = x^2$
Standard Form:	$f(x) = ax^2 + bx + c$
Type of Graph:	Parabola
Axis of Symmetry:	$x = \frac{-b}{2a}$
y-intercept:	c



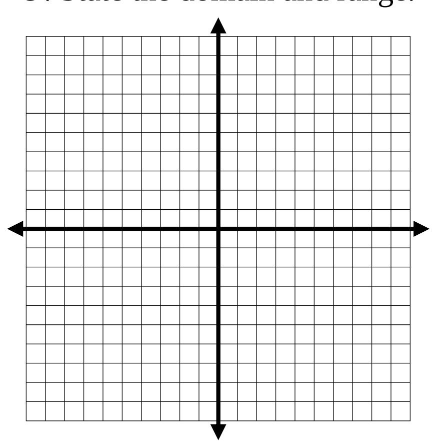
<u>Example 1</u>

Use a table of values to graph $y = 3x^2 + 6x - 4$. State the domain and range.



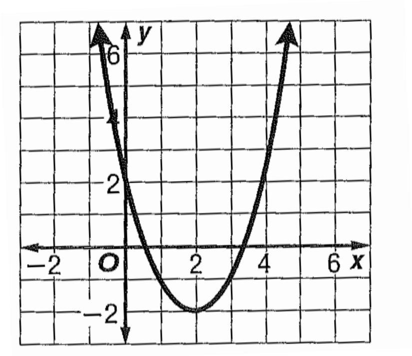
<u>Example 2</u>

Use a table of values to graph $y = x^2 + 6x + 8$. State the domain and range.

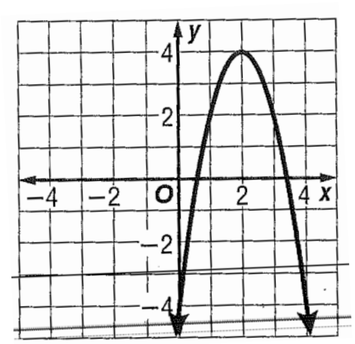


Find the vertex, the equation of the axis of symmetry, y-intercept, and determine if there is a minimum or maximum of each.

Example 3



Example 4



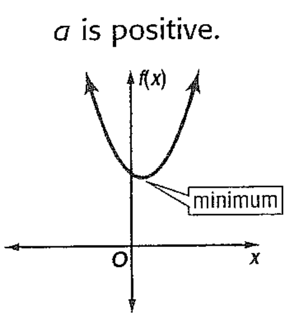
Find the vertex, the equation of the axis of symmetry, and y-intercept.

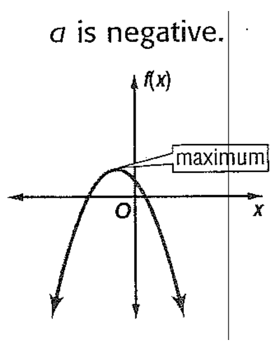
Example 5

$y = -2x^2 - 8x - 2$

Example 6

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





Determine if the function has a minimum or maximum value and state it. Find the domain and range of the function.

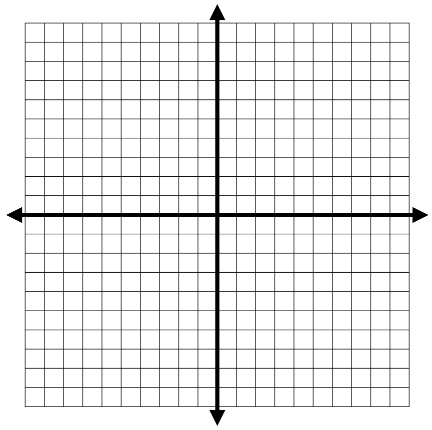
Example 7

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

Graph, find the vertex, the equation of the axis of symmetry, *y*-intercept, and determine if there is a minimum or maximum of each.

Example 8

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

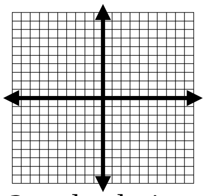


Pg 531,23-57 odds

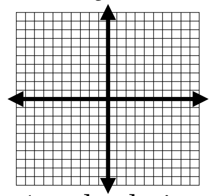
Solving Quadratic Equations by Graphing

§9.2

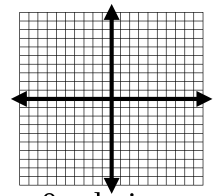
Solutions of Quadratic Equations



2 real solution



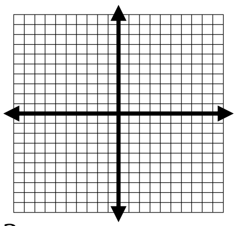
1 real solution



0 solutions

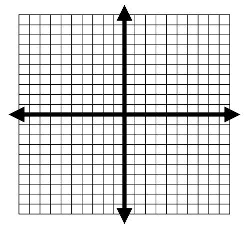
Example 1

Solve $x^2 - 3x - 10 = 0$ by graphing



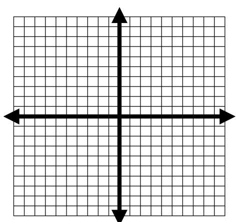
Example 2

Solve $x^2 + 8x = -16$ by graphing



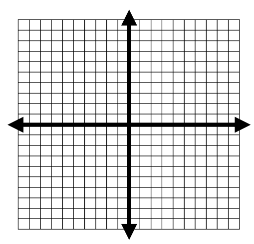
Example 3

Solve $x^2 + 2x + 3 = 0$ by graphing



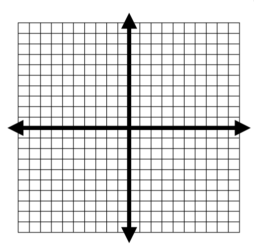
Example 4

Solve $x^2 - 4x + 2 = 0$ by graphing. If integral roots cannot be found, estimate the roots to the nearest tenth.



Example 5

Solve $x^2 + 5x - 2 = 0$ by graphing. If integral roots cannot be found, estimate the roots to the nearest tenth.



Pg 540,1-8,10-18,22-25,30,32

Transformations of Quadratic Functions
§9.3

Transformation – changes the position or size of the figure.
Translation (type of transformation) – moves the figure up, down, left, or right.

Vertical Transformations

$f(x) = x^2 + c$ c(+) : UP c(-): DOWN

Describe how the graph of each function is related to $f(x) = x^2$

Example 1

$f(x) = x^2 + 10$

Example 2

$f(x) = x^2 - 3$

Dilation (type of transformation) – makes the graph narrower (vertical stretch) or wider (vertical shrink) compared to the parent graph.

Describe how the graph of each function is related to $f(x) = x^2$

Example 3

$f(x) = \frac{1}{3}x^2$

Example 4

$f(x) = 3x^2 - 2$

Reflection – flips a figure over a line.

Describe how the graph of each function is related to $f(x) = x^2$

Example 5

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

Example 6

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

Example 7

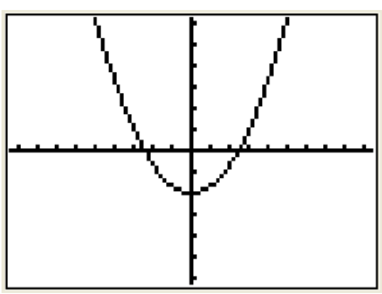
What is the equation for the function below?

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

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

C. $y = -\frac{1}{3}x^2 + 2$

D. $y = \frac{1}{3}x^2 - 2$



Pg 547,1-23

Solving Quadratic Equations by Completing the Square
§9.4

Completing the Square – a method used to make a quadratic expression into a ***perfect square trinomial***.

Steps
1. Find half of the coefficient of x.
2. Square the result from step 1.
3. Add the result from step 2 to the expression or both sides of equation.

Find the value of c that makes each a perfect square trinomial.

Example 1
$x^2 + 16x + c$

Example 2
$x^2 + 10x + c$

Example 3
$x^2 + 9x + c$

Solve each equation by completing the square.

Example 4
$x^2 + 6x + 5 = 12$

Example 5
$x^2 + 8x - 4 = 5$

Example 6
$-2x^2 + 36x - 10 = 24$

Example 7
$3x^2 + 5x - 10 = 0$

Example 8
$2x^2 - 11x + 5 = -7$

Pg 554,1-7,11-29 odds

Solving Quadratic Equations by Using the
Quadratic Formulas
§9.5

Quadratic Formula

The solutions of the quadratic equation $ax^2 + bx + c = 0$ can be found by the formula:

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Use the Quadratic Formula to solve.

Example 1

$x^2 - 2x = 35$

Example 2

$x^2 - 12x = -20$

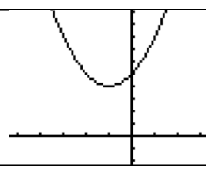
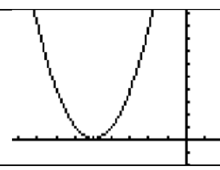
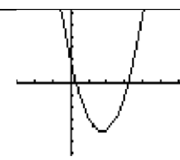
Example 3

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

Example 4

$2x^2 - 17x + 8 = 0$

Discriminant – part of the quadratic formula ($b^2 - 4ac$) used to determine the number of real solutions of a quadratic equation.

Equation	$x^2 + 2x + 5 = 0$	$x^2 + 10x + 25 = 0$	$2x^2 - 7x + 2 = 0$
Discriminant	$b^2 - 4ac$	$b^2 - 4ac$	$b^2 - 4ac$
Graph			
Real Solutions	0	1	2

State the value of the discriminant and determine the number of real solutions of the graph.

Example 5

$3x^2 + 10x = 12$

Example 6

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

Pg 562,1-35 odds

Exponential Functions
§9.6

Exponential Function – a function in the form $y = ab^x$

Graphing Calculator
1. window
   - x: -9.4 to 9.4
   - y: -6.2 to 6.2
2. y =
3. Graph
4. 2^{nd} Graph for t-chart

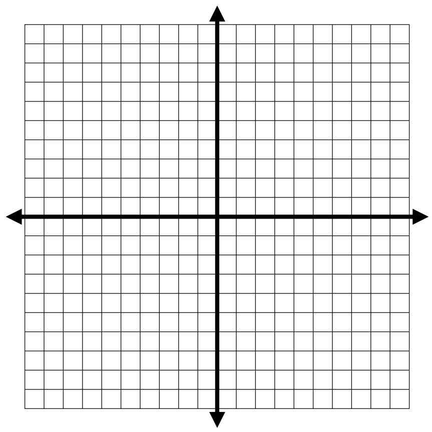
Graph each on the same coordinate plane. State the domain and range.

Example 1

$y = 3^x$

Example 2

$y = \left(\frac{1}{4}\right)^x$



Example 3

$y = 5^x$

Example 4

$y = \left(\frac{1}{2}\right)^x$

Determine whether the set of data shown below displays exponential behavior.

Example 5

x	0	1	2	3	4	5
y	4	6	8	10	12	14

Example 6

x	0	1	2	3	4	5
y	3	4	7	12	19	28

Example 7

x	0	5	10	15	20	25
y	64	32	16	8	4	2

Pg 570,1-6,8-19,21-24

Growth and Decay
§9.7

<u>Exponential Growth</u> – an equation in the form $y = a(1 + r)^t$

$$y = a(1 + r)^t$$

a = initial amount
r = rate of change (expressed as decimal, $r > 0$)
t = time
y = final amount

<u>Example 1</u>
In 2010, the city of Riverview had a population of 14,075 and a growth rate of 0.85% per year.

a. Write an equation to represent the population of Riverview since 2010.

b. According to the equation, what will be the population of Riverview in 2018?

<u>Exponential Decay</u> – an equation in the form $y = a(1 - r)^t$

<u>Example 2</u>
During an economic recession, the Salvation Army found that its donations dropped by 1.2% per year. Before the recession, its donations were $390,000.

a. Write an equation to represent the charity's donations since the beginning of the recession.

b. Estimate the amount of the donations 5 years later.

<u>Compound Interest</u> – interest earned or paid on both the initial investment and previously earned interest.

$$A = P(1 + \frac{r}{n})^{nt}$$

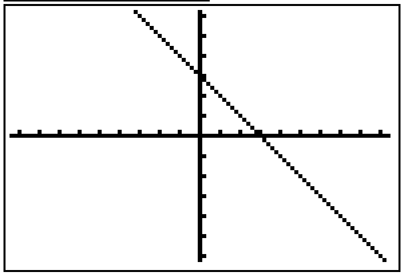
A = current amount
P = Principal (initial amount)
r = annual interest rate (decimal, $r > 0$)
n = number of times the interest is compounded each year
t = time in years

<u>Example 3</u>
When Tim was born, his grandparents invested $1000 in a fixed savings account at a rate of 7% compounded annually. Tim will receive the money when he turns 18 to help with college. What amount of money will Tim receive from the investment?

Pg 575,1-11

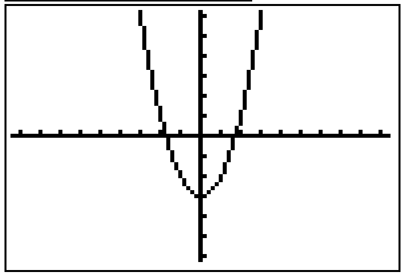
Analyzing Functions with Successive Differences
§9.9

<u>Linear Function</u>



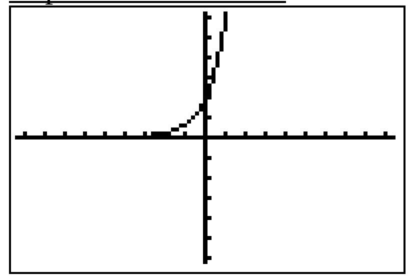
$y = mx$

<u>Quadratic Function</u>



$y = ax^2$

<u>Exponential Function</u>



$y = ab^x$

Graph each to determine whether the ordered pair represents a linear, quadratic, or exponential function.

<u>Example 1</u>

(1, 2)(2, 5)(3, 6)(4, 5)(5, 2)

<u>Example 2</u>

(-1, 6)(0, 2)(1, $\frac{2}{3}$)(2, $\frac{2}{9}$)

Look for a pattern in each table of values to determine which kind of model best describes the data. Then write an equation for the function that models the data.

<u>Example 3</u>

x	-4	-3	-2	-1	0
y	32	18	8	2	0

<u>Example 4</u>

x	-2	-1	0	1	2
y	-1	1	3	5	7

<u>Example 5</u>

x	-3	-2	-1	0	1
y	.375	.75	1.5	3	6

Pg 587,1-10,18-23