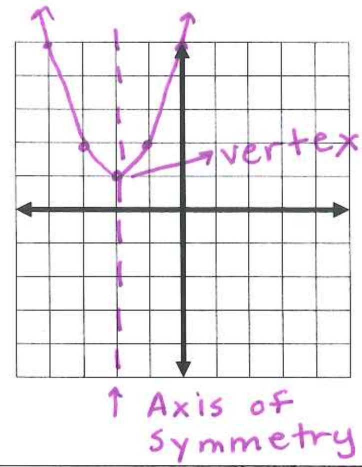
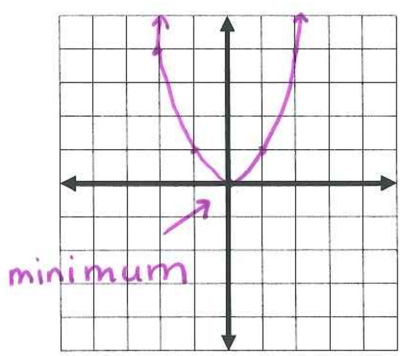
Algebra I
9-1: Quadratic Graphs and Their Properties

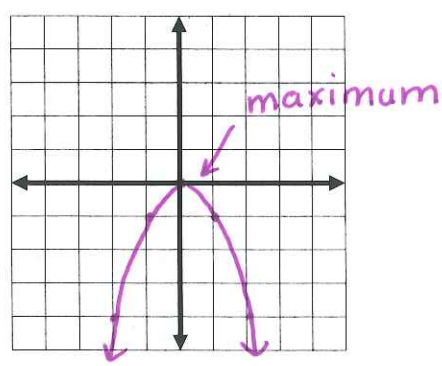
Name ______________________________
Date ______________ Class Period _______

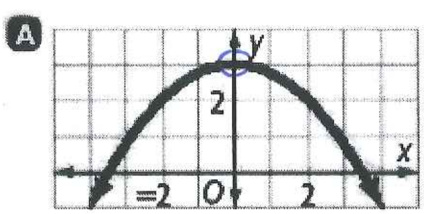
Learning Target: Today you will be able to GRAPH QUADRATIC FUNCTIONS OF THE FORM $Y = AX^2$ AND $Y = AX^2 + C$

Question/Main Ideas:	Notes:
Definition: Standard Form of a Quadratic	$y = ax^2 + bx + c$ •Graph is a Parabola – u-shape; symmetric • Vertex: high-point or low-point depending on the curve.
Characteristics of the Graphs	$y = ax^2 + bx + c$ $a > 0$; opens up $y = ax^2 + bx + c$ $a < 0$; opens down
Example 1: Indentifying a Vertex	What are the coordinates of the vertex of each graph? Is it a minimum or a maximum?

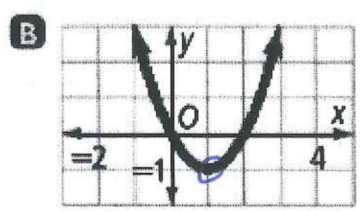








V: (0, 3)
Maximum



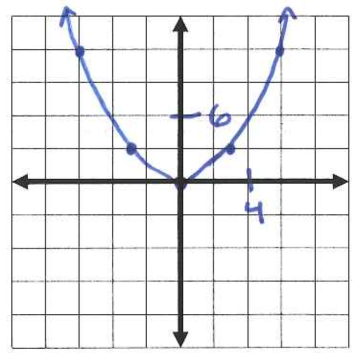
V: (1, −1)
Minimum

Example 2: Graphing $y = ax^2$

Use the given tables to graph the following.

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

x	-6	-3	0	3	6
y	12	3	0	3	12

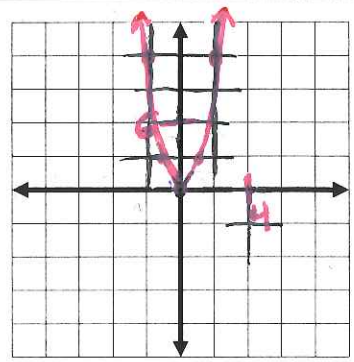


Now It's Your turn

Use the given tables to graph the following.

b. $f(x) = 3x^2$

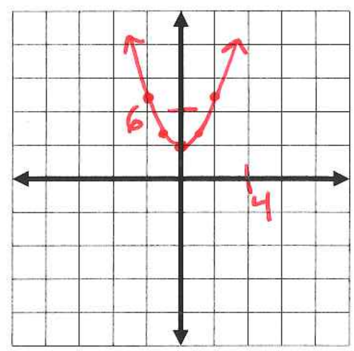
x	-2	-1	0	1	2
y	12	3	0	3	12



Use the given tables to graph the following.

c. $f(x) = x^2 + 3$

x	-2	-1	0	1	2
y	7	4	3	4	7



Observations of the Graphs

Use the above graphs to answer the following questions.

1. How does changing the "*a*" value (the number in front of the x^2) change the graph?
   - As "a" gets bigger, the graph gets skinnier
   - As "a" gets smaller, the graph gets fatter
2. How does adding a 3 at the end of the equation on example c change the graph?
   - It moves the graph up 3 units

Summary: ____________________

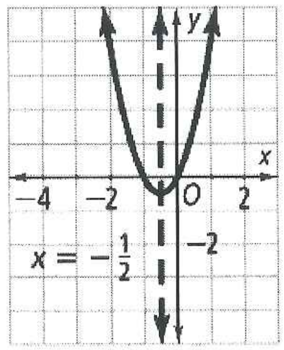
Algebra I
9-2: Quadratic Functions

Name ______________________________
Date ______________ Class Period _______

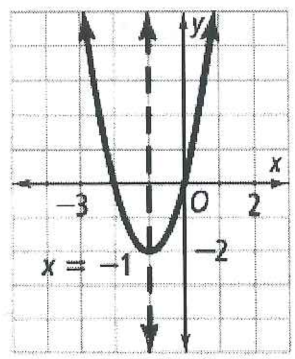
Learning Target: Today you will be able to GRAPH QUADRATIC FUNCTIONS WITH FORM Y = AX^2 + BX + C

Question/Main Ideas:	Notes:
Concept: Changing the Value of b	In the quadratic function $y = ax^2 + bx + c$, the value of b affects the position of the axis of symmetry. Consider the graphs of the following functions.

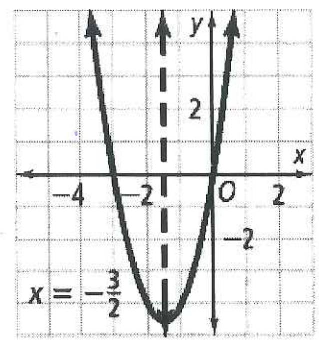
$y = 2x^2 + 2x$



$y = 2x^2 + 4x$



$y = 2x^2 + 6x$



Concept: Finding the Axis of Symmetry

$y = ax^2 + bx + c$

Vertical Line: $x = \frac{-b}{2a}$

$y = 2x^2 + 2x$

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

Concept: Finding the Vertex

The x-coordinate of the vertex is the same as the axis of symmetry. Plug that value into the equation to find the y-value.

Steps to Graphing a Quadratic without a Table

Find the axis of symmetry

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

Find the vertex by plugging in the axis of symmetry.

Find another point by choosing an x-value.

Mirror that point across the axis of symmetry

Example 1: Graphing $y = ax^2 + bx + c$

Graph the $y = x^2 - 6x + 4$ without a table. Identify the axis of symmetry, the vertex, and the y-intercept.

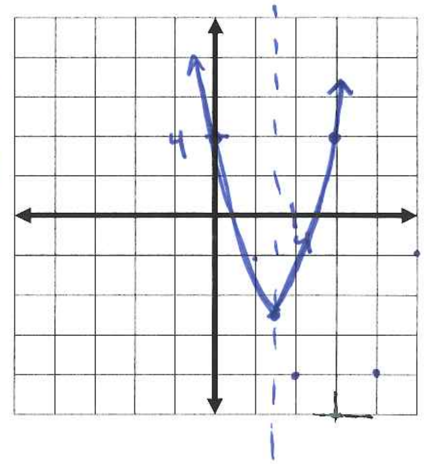
Axis of Symmetry: x = 3 $\frac{-(-6)}{2(1)} = \frac{6}{2}$

Vertex: (3 , -5) $y = (3)^2 - 6(3) + 4$

y - intercept: (0, 4) $y = 9 - 18 + 4$

easiest point to choose $y = -9 + 4$

$y = -5$



$y = 0^2 - 6(0) + 4$

$y = 4$

Now It's Your Turn

Graph the $y = -x^2 + 4x - 2$ without a table. Identify the axis of symmetry, the vertex, and the y-intercept.

Axis of Symmetry: x = 2 $\frac{-4}{2(-1)} = \frac{-4}{-2}$

Vertex: (2 , 2) $y = -2^2 + 4(2) - 2$

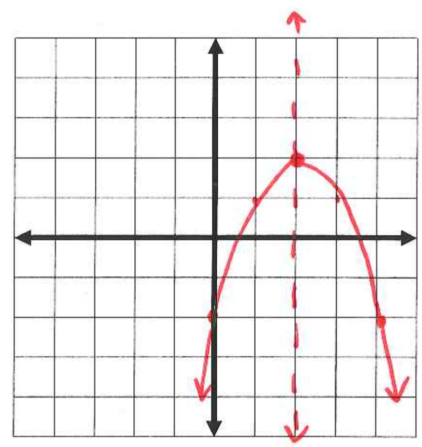
y - intercept: (0, -2) $y = -4 + 8 - 2$

$y = 4 - 2$

$y = 2$

$y = -0^2 + 4(0) - 2$

$y = -2$



Summary: ______________________________

Algebra I
9-3: Solving Quadratic Equations

Name ______________________________
Date _____________ Class Period _______

Learning Target: Today you will be able to SOLVE QUADRATIC EQUATIONS BY GRAPHING AND USING SQUARE ROOTS

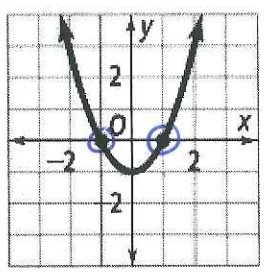
Question/Main Ideas:	Notes:
Concept: Solutions of a Quadratic Function	The solutions are where the graph crosses the x-axis. Also known as... x-intercepts and roots
Example 1: Solving by Graphing	What are the solutions of each equation? Use a graph of the related function.
Example 2: Solving Using Square Roots	Solve each equation.

Example 1: Solving by Graphing

What are the solutions of each equation? Use a graph of the related function.

A $x^2 - 1 = 0$

Graph $y = x^2 - 1$.

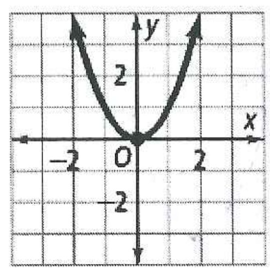


$x = -1, 1$

$x = \pm 1$

B $x^2 = 0$

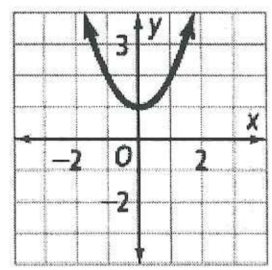
Graph $y = x^2$.



$x = 0$

C $x^2 + 1 = 0$

Graph $y = x^2 + 1$.



No Solution

Example 2: Solving Using Square Roots

Solve each equation.

a. $x^2 = 81$

$\sqrt{x^2} = \sqrt{81}$

$x = \pm 9$

b. $3x^2 - 75 = 0$

$ +75 \; +75$

$\frac{3x^2}{3} = \frac{75}{3}$

$\sqrt{x^2} = \sqrt{25}$

$x = \pm 5$

Now It's Your Turn

Solve each equation.

a. $x^2 - 36 = 0$

$+36 \quad +36$

$\sqrt{x^2} = \sqrt{36}$

$x = \pm 6$

b. $3x^2 + 15 = 0$

$-15 \quad -15$

$\frac{3x^2}{3} = \frac{-15}{3}$

$\sqrt{x^2} = \sqrt{-5}$

No solution

c. $4x^2 + 16 = 16$

$-16 \quad -16$

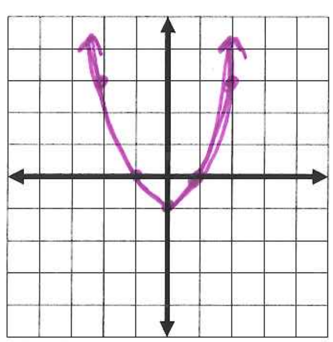
$\frac{4x^2}{4} = \frac{0}{4}$

$\sqrt{x^2} = \sqrt{0}$

$x = 0$

How many Solutions does the Quadratic Function have?

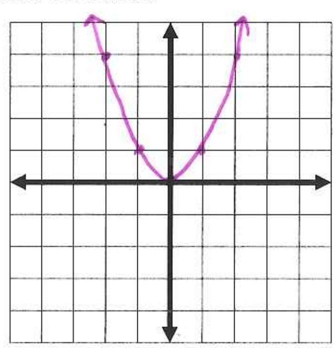
Two-Solutions



$x^2 = a$

$a > 0$

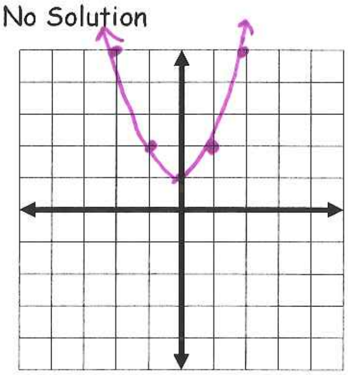
One-Solution



$x^2 = a$

$a = 0$

No Solution



$x^2 = a$

$a < 0$

Summary: ____

Algebra I
9-4: Factoring to Solve Quadratic Equations

Name ______________________________
Date _____________ Class Period ______

Learning Target: Today you will be able to SOLVE QUADRATICS BY FACTORING

Question/Main Ideas:	Notes:
Concept: Zero Product Property	$\_\_\_\_ \cdot \_\_\_\_ = 0$ one number has to be zero $a \cdot b = 0$ then a or b is zero.
Example 1: Using the Zero-Product Property	Use the Zero-Product Property to find the solutions to the given equations. a. $(4x + 1)(x - 2) = 0$ $4x+1=0$, $-1\ -1$, $\frac{4x}{4} = \frac{-1}{4}$, $x = -\frac{1}{4}$ $x-2=0$, $+2\ +2$, $x=2$ b. $(x + 1)(x - 5) = 0$ $x+1=0$, $-1\ -1$, $x=-1$ $x-5=0$, $+5\ +5$, $x=5$
Now It's Your Turn	Use the Zero-Product Property to find the solutions to the given equations. a. $(2x + 3)(x - 4) = 0$ $2x+3=0$, $-3\ -3$, $\frac{2x}{2} = \frac{-3}{2}$, $x = -\frac{3}{2}$ $x-4=0$, $+4\ +4$, $x=4$ b. $(7x - 2)(5x - 4) = 0$ $7x-2=0$, $+2\ +2$, $\frac{7x}{7} = \frac{2}{7}$, $x = \frac{2}{7}$ $5x-4=0$, $+4\ +4$, $\frac{5x}{5} = \frac{4}{5}$, $x = \frac{4}{5}$
Steps to Solving by Factoring	Set the equation equal to zero Factor out any common factors Factor remaining polynomial Set each factor equal to zero and solve

Example 2: Solve by Factoring	Solve by Factoring a. $x^2 + 8x + 15 = 0$ $(x+3)(x+5)=0$ $x+3=0$ $\quad$ $x+5=0$ $-3\ -3$ $\quad$ $-5\ -5$ $\boxed{x=-3}$ $\quad$ $\boxed{x=-5}$ b. $2x^3 - 15x^2 + 18x = 0$ $x(2x^2-15x+18)=0$ $x[(2x^2-12x)(-3x+18)]=0$ $x[2x(x-6)-3(x-6)]=0$ $x(x-6)(2x-3)$ $\boxed{x=0}$ $\quad$ $x-6=0$ $\quad$ $2x-3=0$ $\boxed{x=6}$ $\quad$ $\boxed{x=\frac{3}{2}}$
Now It's Your Turn	Solve by Factoring a. $x^2 - 5x - 14 = 0$ $(x-7)(x+2)=0$ $x-7=0$ $\quad$ $x+2=0$ $\boxed{x=7}$ $\quad$ $\boxed{x=-2}$ b. $x^3 + x^2 - 20x = 0$ $x(x^2+x-20)=0$ $x(x+5)(x-4)=0$ $\boxed{x=0}$ $\quad$ $x+5=0$ $\quad$ $x-4=0$ $\boxed{x=-5}$ $\quad$ $\boxed{x=4}$
Example 3: Writing in Standard Form First	Solve by Factoring. a. $4x^2 - 21x = 18$ $-18\ -18$ $4x^2-21x-18=0$ $-18\cdot 4=-72$ $(4x^2-24x)+(3x-18)=0$ $4x(x-6)+3(x-6)=0$ $(x-6)(4x+3)=0$ $x-6=0$ $\quad$ $4x+3=0$ $\boxed{x=6}$ $\quad$ $4x=-3$ $\boxed{x=-\frac{3}{4}}$

Summary: ____

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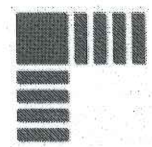
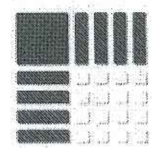
Algebra I
9-5: Completing the Square

Name ______________________________
Date ______________ Class Period _______

Learning Target: Today you will be able to SOLVE QUADRATIC EQUATIONS BY COMPLETING THE SQUARE

Question/Main Ideas:	Notes:
Concept: Perfect Square Trinomial	Factor each of the following trinomials. a. $x^2+8x+16$ b. x^2-6x+9 c. $x^2+12x+36$ $(x+4)^2$ $(x-3)^2$ $(x+6)^2$ d. What do you notice about each of the three problems above? How does each answer relate to the original problem? • Perfect Square Trinomials • Answer is a binomial squared
Concept: Completing the Square	$x^2+10x+\underline{25}$ Half of b squared $\left(\frac{b}{2}\right)^2$  
Example 1: Finding c to Complete the Square	Find the value of c that makes the following perfect square trinomials. a. $x^2-16x+c$ $\left(\frac{b}{2}\right)^2$ $\left(\frac{-16}{2}\right)^2$ $(-8)^2$ $c=64$ Your Turn: $x^2+20x+c$ $\left(\frac{b}{2}\right)^2$ $\left(\frac{20}{2}\right)^2$ $(10)^2$ $c=100$

Example 2: Solving $x^2 + bx = c$

Solve the following by completing the square.

a. $x^2 + 6x = 216$

$x^2 + 6x + \underline{9} = 216 + \underline{9}$

$\sqrt{(x+3)^2} = \sqrt{225}$

$x + 3 = \pm 15$

$x + 3 = 15 \qquad x + 3 = -15$

$x = 12 \qquad x = -18$

Your Turn: $x^2 - 4x = 90$

$x^2 - 4x + \underline{4} = 90 + \underline{4}$

$\sqrt{(x-2)^2} = \sqrt{94}$

$x - 2 = \pm 9.7$

$x - 2 = 9.7 \qquad x - 2 = -9.7$

$x = 11.7 \qquad x = -7.7$

Example 3: Solving $x^2 + bx + c = 0$

Solve the following by completing the square.

a. $x^2 - 8x - 48 = 0$

$x^2 - 8x + \underline{16} = 48 + \underline{16}$

$\sqrt{(x-4)^2} = \sqrt{64}$

$x - 4 = \pm 8$

$x - 4 = 8 \qquad x - 4 = -8$

$x = 12 \qquad x = -4$

b. $x^2 - 14x + 16 = 0$

$x^2 - 14x + \underline{49} = -16 + \underline{49}$

$\sqrt{(x-7)^2} = \sqrt{33}$

$x - 7 = \pm 5.7$

$x - 7 = 5.7 \qquad x - 7 = -5.7$

$x = 12.7 \qquad x = 1.3$

Now It's Your Turn

Solve the following by completing the square.

a. $x^2 + 10x - 75 = 0$

$x^2 + 10x + \underline{25} = 75 + \underline{25}$

$\sqrt{(x+5)^2} = \sqrt{100}$

$x + 5 = \pm 10$

$x + 5 = 10 \qquad x + 5 = -10$

$x = 5 \qquad x = -15$

b. $x^2 - 18x + 53 = 0$

$x^2 - 18x + \underline{81} = -53 + \underline{81}$

$\sqrt{(x-9)^2} = \sqrt{28}$

$x - 9 = \pm 5.3$

$x - 9 = 5.3 \qquad x - 9 = -5.3$

$x = 14.3 \qquad x = 3.7$

Summary: ______________________________

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Algebra I
9-6: The Quadratic Formula and the Discriminant

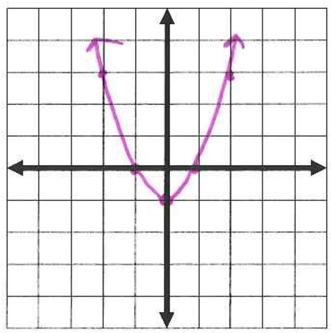
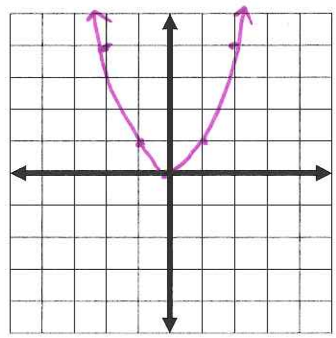
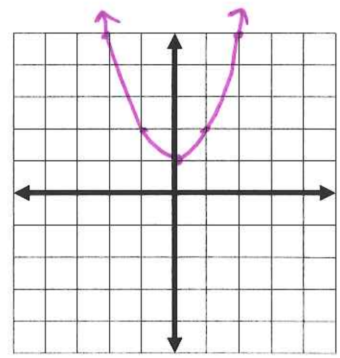
Name ______________________
Date ______________ Class Period _______

Learning Target: Today you will be able to SOLVE QUADRATIC EQUATIONS USING THE QUADRATIC FORMULA AND FIND THE NUMBER OF SOLUTIONS OF A QUADRATIC EQUATION

Question/Main Ideas:	Notes:
Concept: Quadratic Formula	$y = ax^2 + bx + c$ $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
Example 1: Using the Quadratic Formula	Solve using the Quadratic Formula. Round to the nearest hundredth is necessary. a. $x^2 - 8 = 2x$ $x^2 - 2x - 8 = 0$ $a = 1 \quad b = -2 \quad c = -8$ $x = \dfrac{-(-2) \pm \sqrt{(-2)^2 - 4(1)(-8)}}{2(1)}$ $x = \dfrac{2 \pm \sqrt{4 + 32}}{2}$ $x = \dfrac{2 \pm \sqrt{36}}{2}$ $x = \dfrac{2 \pm 6}{2}$ $x = \dfrac{2+6}{2} \quad x = \dfrac{2-6}{2}$ $x = 4 \quad x = -2$
Now It's Your Turn	Solve using the Quadratic Formula. Round to the nearest hundredth is necessary. a. $7x^2 - 2x = 8$ $7x^2 - 2x - 8 = 0$ $a = 7 \quad b = -2 \quad c = -8$ $x = \dfrac{-(-2) \pm \sqrt{(-2)^2 - 4(7)(-8)}}{2(7)}$ $x = \dfrac{2 \pm \sqrt{4 + 224}}{14}$ $x = \dfrac{2 \pm \sqrt{228}}{14}$ $x = \dfrac{2 \pm 15.1}{14}$ $x = \dfrac{2+15.1}{14} \quad x = \dfrac{2-15.1}{14}$ $x = 1.22 \quad x = -0.94$

Concept: The Discriminant

$b^2 - 4ac$ The part under the square root.

Two - Solutions	One - Solution	No Solution
$b^2 - 4ac > 0$	$b^2 - 4ac = 0$	$b^2 - 4ac < 0$
		

Example 1: Using the Discriminant

How many real solutions does each equation have?

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

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

$a = 2 \quad b = -3 \quad c = 5$

$(-3)^2 - 4(2)(5)$

$9 - 40$

-31

$\boxed{\text{No Solution}}$

b. $-2x^2 + 8x - 5 = 0$

$a = -2 \quad b = 8 \quad c = -5$

$(8)^2 - 4(-2)(-5)$

$64 - 40$

24

$\boxed{\text{Two Solutions}}$

Now It's Your Turn

How many real solutions does each equation have?

a. $6x^2 - 5x = 7$

$6x^2 - 5x - 7 = 0$

$a = 6 \quad b = -5 \quad c = -7$

$(-5)^2 - 4(6)(-7)$

$25 + 168$

193

$\boxed{\text{Two Solutions}}$

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

$a = 2 \quad b = 4 \quad c = 2$

$(4)^2 - 4(2)(2)$

$16 - 16$

0

$\boxed{\text{One Solution}}$

Summary: ____

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Algebra I
9-7: Linear, Quadratic, and Exponential Models

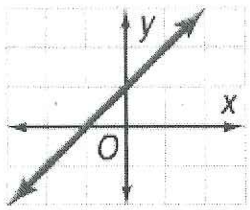
Name ______________________________
Date ______________ Class Period _______

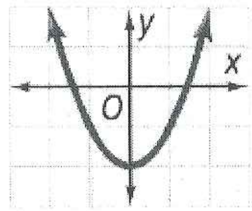
Learning Target: Today you will be able to IDENTIFY WHETHER A GIVEN SET OF DATA (GRAPH, TABLE, ETC) REPRESENTS A LINEAR, QUADRATIC, OR EXPONENTIAL MODEL

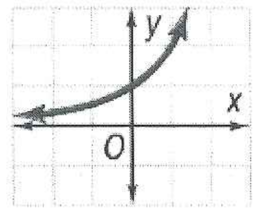
Question/Main Ideas:	Notes:

Concept Summary

Linear Functions	Quadratic Functions	Exponential Functions
$y = mx + b$	$y = ax^2 + bx + c$	$y = a \cdot b^x$



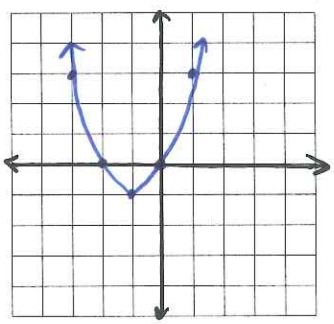




Example 1: Choosing a model by graphing

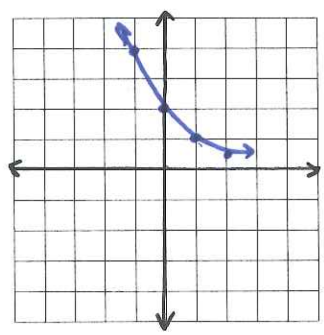
Graph each set of points. Which model is most appropriate for each set?

a. (1, 3), (0, 0), (-3, 3), (-1, -1), (-2, 0)



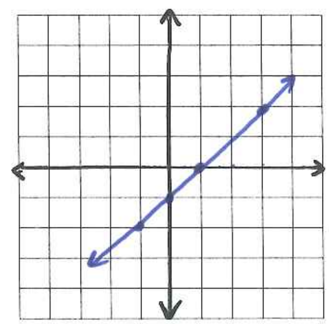
Quadratic

b. (0, 2), (-1, 4), (1, 1), (2, 0.5)



Exponential

c. (-1, -2), (0, -1), (1, 0), (3, 2)



Linear

Choosing a Model from a Table

Linear Model: Both x and y go up or down at a constant rate (add/subtract)

Exponential Model: The y values go up or down by a constant ratio (multiply / Divide)

Quadratic Model: The second differences in the y-values are constant

Example 2: Choosing a Model using Differences or Ratios

Which type of function best models the given data?

a.

+1 +1 +1 +1

x	-2	-1	0	1	2
y	-1	2	5	8	11

+3 +3 +3 +3

Linear

b.

+1 +1 +1 +1

x	-2	-1	0	1	2
y	0.25	0.5	1	2	4

·2 ·2 ·2 ·2

Exponential

c.

+1 +1 +1 +1

x	-1	0	1	2	3
y	1	-1	1	7	17

−2 +2 +6 +10

+4 +4 +4

Quadratic

Now It's Your Turn

Which type of function best models the given data?

a.

+1 +1 +1 +1

x	-3	-2	-1	0	1
y	9	5	1	-3	-7

−4 −4 −4 −4

Linear

b.

+1 +1 +1 +1

x	0	1	2	3	4
y	0	-0.25	-1	-2.25	-4

−.25 −.75 −1.25 −1.75

−.5 −.5 −.5

Quadratic

c.

+1 +1 +1 +1

x	-1	0	1	2	3
y	0.5	1	2	4	8

·2 ·2 ·2 ·2

Exponential

Summary: ______________________________

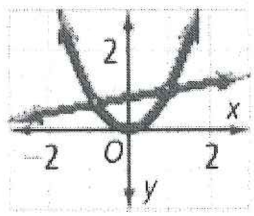
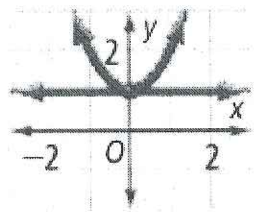
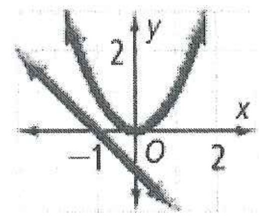
Algebra I
9-8: Systems of Linear and Quadratic Equations

Name ______________________________
Date ______________ Class Period _______

Learning Target: Today you will be able to SOLVE A SYSTEM OF EQUATIONS THAT INCLUDES A LINEAR EQUATION AND A QUADRATIC EQUATION

Question/Main Ideas:	Notes:

Types of Solutions

Two Solutions	One Solution	No Solutions
		

Example 1: Solving by Graphing

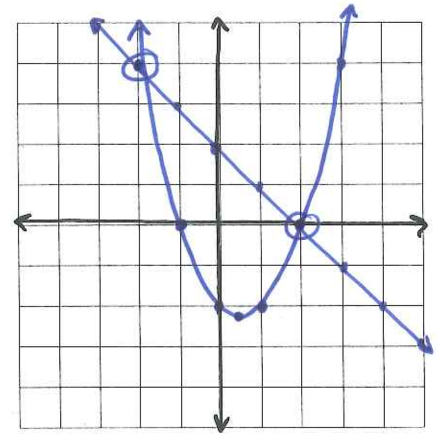
Solve the following system by graphing.

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

$\boxed{\begin{matrix}(-2, 4) \\ (2, 0)\end{matrix}}$

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

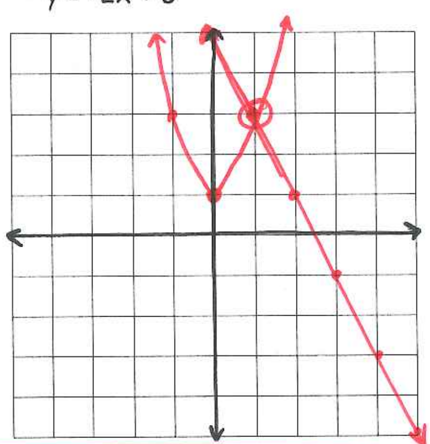
$y = (\frac{1}{2})^2 - \frac{1}{2} - 2 = -2\frac{1}{4}$



Now It's Your Turn

Solve the system by graphing.

$y = 2x^2 + 1$
$y = -2x + 5$



$\boxed{(1,3) \quad (-2,9)}$

$x = \frac{-b}{2a} = \frac{-0}{2(2)} = 0$

$y = 2(0)^2 + 1 = 1$

Graph is not the best option because 2nd point didn't show up.

Key to Solving by Elimination	Subtract the two equations to eliminate y, combine like terms.
Example 2: Solve by Elimination	Solve the following systems by elimination. a. $y = 20x + 124$ $y = -x^2 + 39x + 64$ $y = -x^2+39x+64$ $-y = 20x+124$ $0 = -x^2+19x-60$ $0 = -1(x^2-19x+60)$ $0 = -1(x-15)(x-4)$ $x = 15, 4$ $20(15)+124$ 424 $20(4)+124$ 204 $\boxed{(15, 424)(4, 204)}$ **Now It's Your Turn** b. $y = 32x + 74$ $-\ y = -x^2 + 39x + 64$ $0 = x^2-7x+10$ $0 = (x-5)(x-2)$ $x = 5, 2$ $32(5)+74$ 234 $32(2)+74$ 138 $\boxed{(5, 234)\ (2, 138)}$
Key to Solving by Substitution	Substitute y from one equation into the other, then solve.
Example 2: Solve by Substitution	Solve the following systems by substitution. a. $y = x^2 - 6x + 10$ $y = \boxed{4 - x}$ $4-x = x^2-6x+10$ $0 = x^2-5x-6$ $0 = (x-3)(x-2)$ $x = 3, 2$ $4-3$ 1 $4-2$ 2 $\boxed{(3,1)(2,2)}$ **Now It's Your Turn** b. $y - 30 = 12x \rightarrow y = \boxed{30+12x}$ $y = x^2 + 11x - 12$ $30+12x = x^2+11x-12$ $0 = x^2-x-42$ $0 = (x-7)(x+6)$ $x = 7, -6$ $30+12(7)$ 114 $30+12(-6)$ -42 $\boxed{(7, 114)\ (-6, -42)}$

Summary: ______________________________