3.1 Intro to Quadratics

Summary of factoring quadratics:

Trinomials	Difference of Two Perfect Squares	GCF
$x^2 + bx + c$	$x^2 - y^2$	
$ax^2 + bx + c$		

Examples: Factor each polynomial.

1) $x^2 - 9x + 20$

2) $m^2 - 9$

3) $6x^2 - 9x$

4) $s^2 + 100$ (use i)

5) $5x^2 - 17x + 6$

6) $3x^3 - 6x^2 - 9x$ (GCF first)

Solving Quadratic Equations

The solutions of a quadratic equation (or any equation) are called the __________ , ___________ or __________.

Solve each polynomial by factoring:

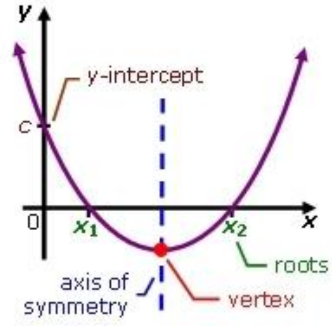
7) $9s^2 - 64 = 0$

8) $4r^3 - 9r^2 = -2r$

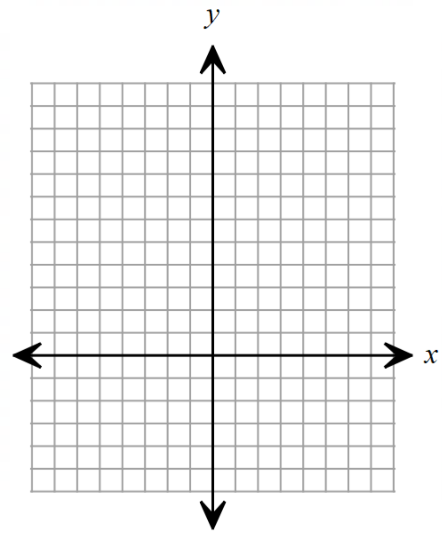
9) $5p^2 - 16p + 15 = 4p - 5$

3.2: Solving Quadratics by Using Other Methods

What is a QUADRATIC FUNCTION? A function with degree 2; shaped like a parabola.



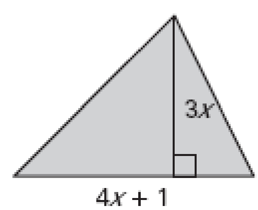
Exploration: Make a table of values to graph $y = 3x^2 + 2x - 4$.
Use -2, -1, 0, 1, 2 as the inputs. Identify as many key features as you can.



Then use the graphing calculator to find the vertex, *y*-intercept, *x*-intercepts.

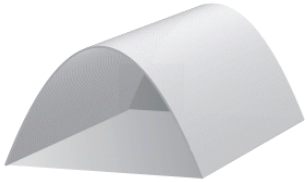
Review word problems:

Example 1: The area of the triangle shown is 27 units squared. Find the value of *x*.

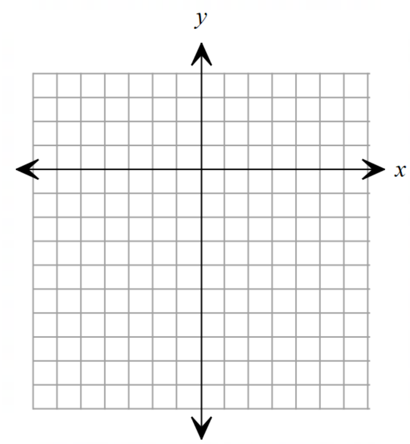


Example 2: A rectangle has an area of 36 u^2. The length is 5 units longer than the width. Find the dimensions of the rectangle.

Example 3: **Storage Building** The storage building shown can be modeled by the graph of the function $y = -10x^2 + 24{,}000x$ where x is the horizontal distance and y is the height (in cm). What is the width of the building at the base?



Solve #7 $(x-2)^2 - 9 = 0$ by graphing the quadratic and the line $y = 0$ (find the intersection points.) Why does this work?



Vertical Motion Formulas : Memorize these!

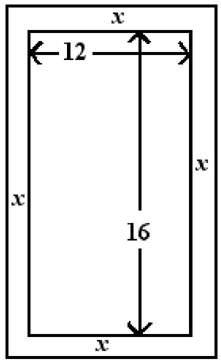
In feet: $h = -16t^2 + v_o t + h_o$

In meters: $h = -4.9t^2 + v_o t + h_o$

Note: v_o is the initial velocity; h_o is the initial height; h is the height at time t.

Example 10: An object is launched at 19.6 meters per second (m/s) from a 58.8 meter tall platform. When does the object strike the ground?

Example 11: A rectangular garden measuring 12 meters by 16 meters is to have a pedestrian pathway installed all around it, increasing the total area to 285 square meters. What will be the width of the pathway?



3.3 Notes: Graphing Quadratic Functions

Parent Function: $y = x^2$

Use a table of values to graph the parent function y = x^2 and identify as many key features as possible.

Domain:

Range:

Vertex:

Max/min:

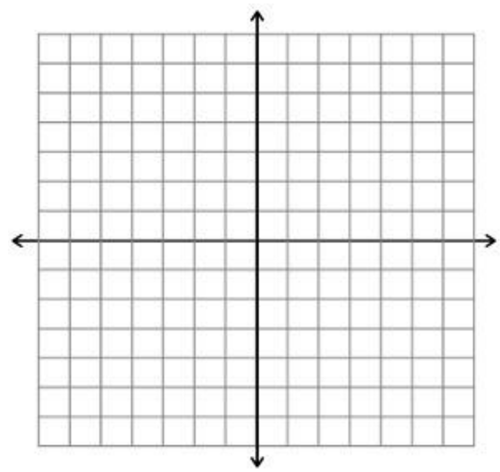
End Behavior:

Increasing or Decreasing?

y-intercept:

x-intercept:

Axis of symmetry:

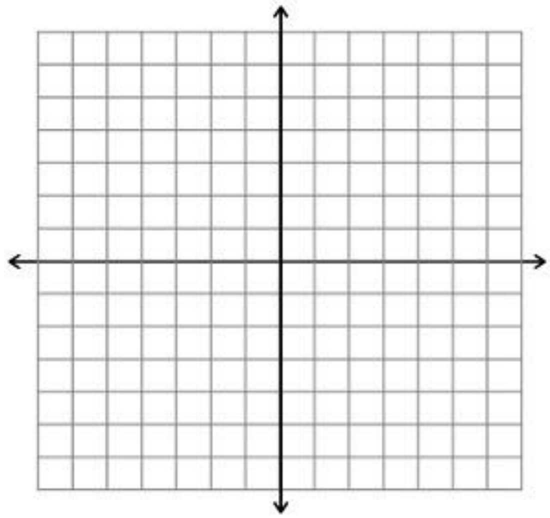


Transformations: The transformations for a quadratic equation in vertex form work the same as the transformations for absolute value functions.

$$\boldsymbol{y = a(x-h)^2 + k}$$

Vertex Form: $y = a(x - h)^2 + k$

Example 1: $y = -2(x - 3)^2 + 8$



The vertex is at ________

The max/min is at _______

The axis of symmetry is _________

To find roots: _________________________

The graph opens _______ if $a > 0$

The graph opens _______ if $a < 0$

The graph is _____________ if $|a| > 1$

The graph is _____________ if $|a| < 1$

To find the y-intercept: _________________________

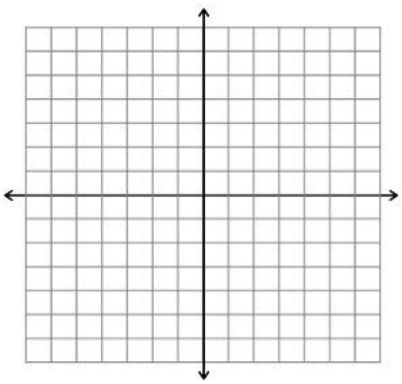
Example 2: Find the vertex and max or min value: $y = -4(x - 3)^2 + 5$.

Example 3: A football is kicked in the air, and its path can be modeled by the equation $f(x) = -16(x - 5)^2 + 21$, where x is the horizontal distance, in feet, and $f(x)$ is the height, in feet. What is the maximum height of the football?

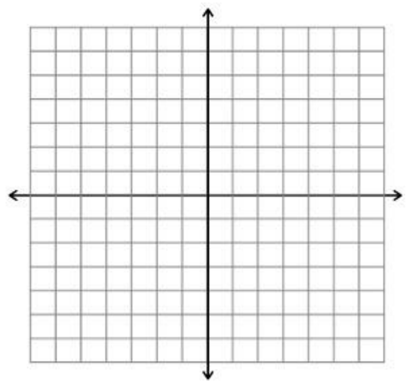
Quadratic Inequalities

$y > x^2$ $y < x^2$ $y \geq -x^2$ $y \leq -x^2$

Example 4: $\boldsymbol{y < 2(x-5)^2 - 1}$



Example 5: $\boldsymbol{y \geq -2(x-3)^2 + 8}$



Intercept Form: $y = a\,(x - p)(x - q)$

Example 6: $\boldsymbol{y = -2(x-4)(x+1)}$

x-intercepts are: _____________

The axis of symmetry has an equation of x = ________

The ____________ is halfway between (p, 0) and (q, 0). Plug back in to find y!

The vertex is at: ___________________

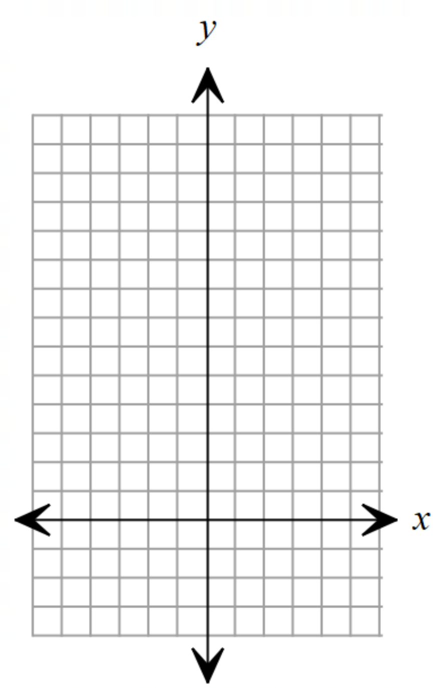
The graph opens ________ if $a > 0$

The graph opens ________ if $a < 0$

The graph is _____________ if $|a| > 1$

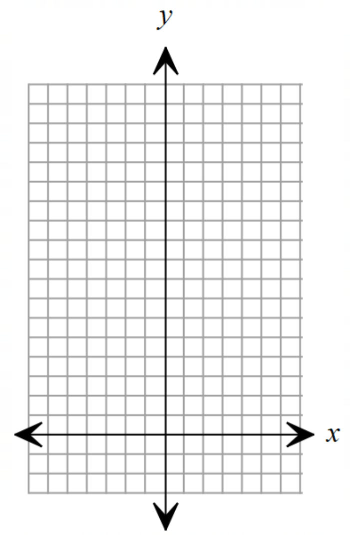
The graph is _____________ if $|a| < 1$

To find the y-intercept:

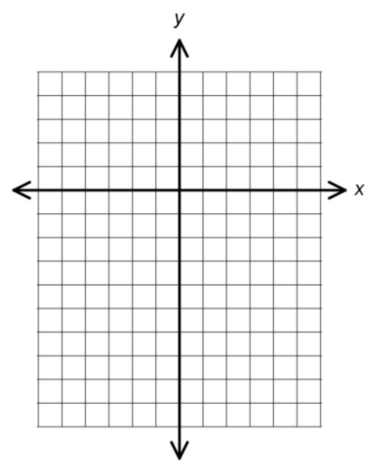


Graphing Over Specific Domains

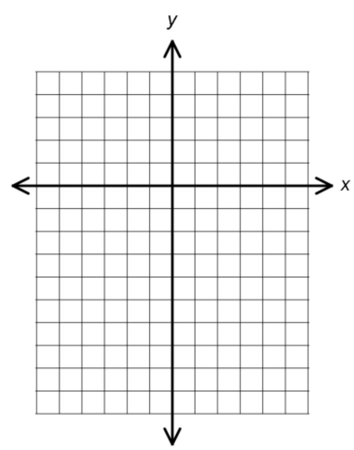
Example 7: Graph $y = x^2$ over the domain (-3, 0] ∪ [2, 4)



Example 8: Graph $f(x) = -(x-1)^2$ over the domain [-2, -1) ∪ [0, 3)



Example 9: Graph $y = -(x+3)(x-1)$ over the domain [-3,-1) ∪ (1, 3]



3.5 Notes: Standard Form of Quadratics

Standard Form: $y = ax^2 + bx + c$

y-intercept is: __________

To find the vertex:

1. ______________________________

2. ______________________________

To find the x-intercepts:

1. ______________________________

2. ______________________________

The graph opens _______ if $a > 0$

The graph opens _______ if $a < 0$

The graph is ____________ if $|a| > 1$

The graph is ____________ if $|a| < 1$

Example 1: $y = 3x^2 + 6x$

Vertex: ________ Axis of Symmetry: ________

x-int: ________

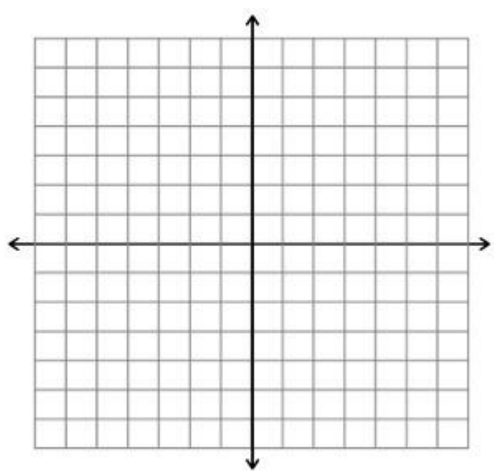
y-int: ________ Max/min: ________

Increasing: ____________________________

Decreasing: ____________________________

End Behavior:

Domain: ________ Range: ________



Example 2: A rocket is shot into the air, and its path can be modeled by $y = -5x^2 + 30x + 1400$, where x is the horizontal distance, in feet, and h is the vertical distance, in feet. Find the max height reached and the total horizontal distance traveled by the rocket when it returns to the ground.

Example 3: An object is launched directly upward at 64 feet per second (ft/s) from a platform 80 feet high. What will be the object's maximum height? When will it attain this height?

Example 4: The path of a placekicked football can be modeled by the function $y = -0.026x(x - 46)$ where x is the horizontal distance (in yards) and the y is the corresponding height (in yards). How far is the football kicked? What is the football's maximum height?

Example 5: A rainbow's path follows the quadratic $r(x) = -\frac{1}{43}(x + 30)(x - 64)$, where x is the horizontal distance in miles, and $r(x)$ is the height of the rainbow, in miles. What is the distance between the two places where the rainbow appears to hit the ground?

Example 6: Your factory produces lemon-scented widgets. You know that each unit is cheaper, the more you produce. But you also know that costs will eventually go up if you make too many widgets, due to the costs of storage of the overstock. The guy in accounting says that your cost for producing x thousands of units a day can be approximated by the formula $C = 0.04x^2 - 8.504x + 25302$. Find the daily production level that will minimize your costs and state what the cost would be.

3.6 Notes: Modeling Quadratics

Example 1: Write a quadratic function in vertex form with a vertex at (8, 2) that passes through (-4, -5).

Example 2: Write a quadratic function in intercept form whose graph has *x*-intercepts at -7 and 2 and passes through the point (-6, -2).

Example 3: Write a quadratic function in vertex form whose graph has vertex at (0 , 2) and passes through the point (1, -3).

Example 4: Write a quadratic function in intercept form with roots at (-2, 0) and (5, 0) passing through (-1, -6). *Which of the following points would be on the parabola? (0, -10); (7, 12); (-3, 8) (Choose all that apply)*

Example 5: Choose all of the following functions that represent a parabola opening downward with a stretch factor of 2 and x-intercepts at -3 and 2.

A. $y = -2\left(x + \frac{1}{2}\right)^2 + \frac{25}{2}$
B. $y = 2(x + 3)(x + 2)$
C. $y = -2x^2 - 2x + 12$
D. $y = -2(x + 3)(x - 2)$
E. $y = -2\left(x + \frac{1}{2}\right)^2 + 12$

Example 6: Write a quadratic function in standard form for the parabola passing through the points (-4, -8), (1, -3) and (2, 10). Hint: create a system of equations.