Name: KEY! Date: _____ Hour: _____

# Chapter 9A

# Quadratics

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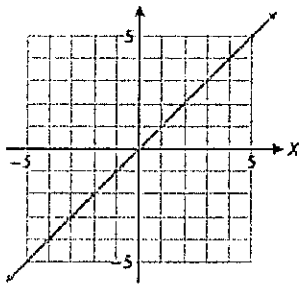
# Lesson 9-1: Identifying Quadratic Functions

## Vocabulary

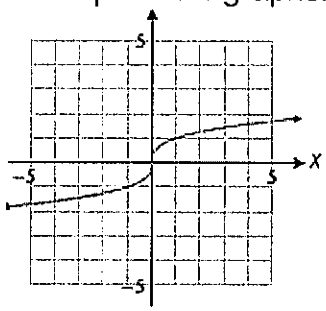
Quadratic Function: a function that can be written in the standard form: $y = ax^2 + bx + c$

* the degree must be 2! *

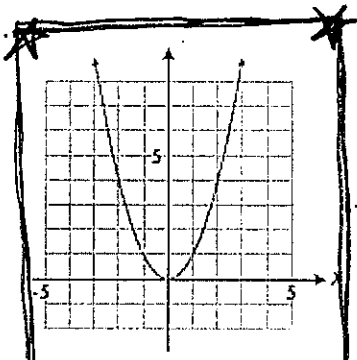
Quadratic **GRAPHS** & non-quadratic graphs...



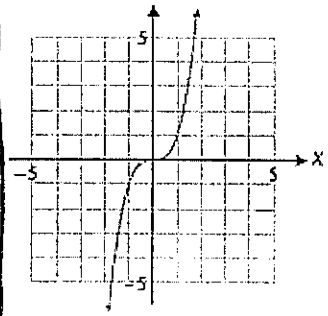
non



non



Quadratic



non

Quadratic **TABLES** & non-quadratic tables...

NOT Quad!

$y = 2x + 1$

| constant | x | y | 1st Diff. |
|---|---|---|---|
| +2 | -4 | -7 | +4 |
| +2 | -2 | -3 | +4 |
| +2 | 0 | 1 | +4 |
| +2 | 2 | 5 | +4 |
| | 4 | 9 | |

Quad!

$y = x^2 - 3$

| constant | x | y | 2nd Diff. |
|---|---|---|---|
| +2 | -4 | 13 | -12 |
| +2 | -2 | 1 | -4 |
| +2 | 0 | -3 | +4 |
| +2 | 2 | 1 | +8 |
| | 4 | 13 | +12 |

2nd Diff. are Same

NOT Quad!

$y = 2^x - 3$

| constant | x | y | 2nd Diff. |
|---|---|---|---|
| +2 | -4 | -2.9375 | +.1875 |
| +2 | -2 | -2.75 | -.25 |
| +2 | 0 | -3 | +4 |
| +2 | 2 | 1 | +8 |
| | 4 | 13 | +12 |

2nd Diff are not Same

Quadratic **EQUATIONS** & non-quadratic equations...

$y = 7x + 3$

non

$y - 10x^2 = 8$

non

$y + x = 2x^2$

$-x \quad -x$

$y = 2x^2 - x$

Quad!

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

non

$x - 4x^2 + 6 = y$

Quad

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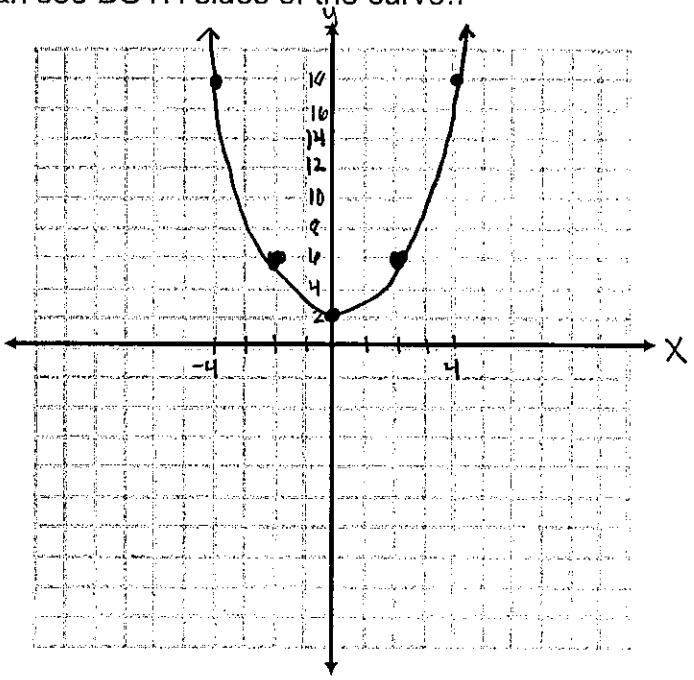
## Practice

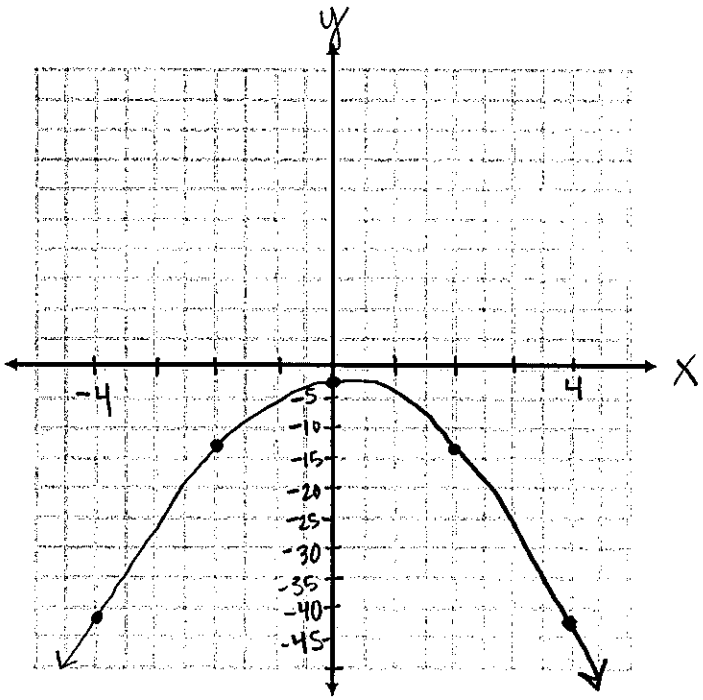
1. Graph the function $y = x^2 + 2$
(Hint: pick enough points so that you can see BOTH sides of the curve!)

| X | Y |
|---|---|
| -4 | 18 |
| -2 | 6 |
| 0 | 2 |
| 2 | 6 |
| 4 | 18 |




2. Graph the function $y = -2x^2 + 2x - 1$

| X | Y |
|---|---|
| -4 | -41 |
| -2 | -13 |
| 0 | -1 |
| 2 | -13 |
| 4 | -41 |



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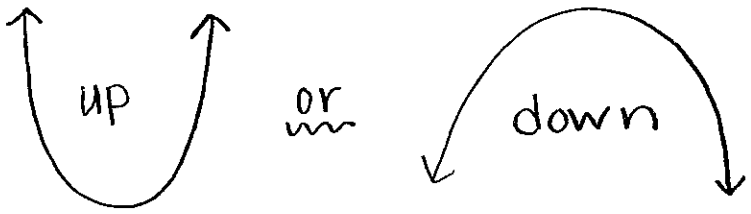
## CHARACTERISTICS OF A PARABOLA

**Parabolas can open UP or DOWN...**




Using the standard form for a quadratic function: $y = ax^2 + bx + c$

If 'a' is positive, the parabola will open up.

If 'a' is negative, the parabola will open down.

.....

**Parabolas can be SKINNY or WDE...**

Using the standard form for a quadratic function: $y = ax^2 + bx + c$

★ ***Ignore the negative sign, simply look at the # for 'a'...

If 'a' is more than 1, the parabola will be skinny.

If 'a' is less than 1, the parabola will be wide.

## Practice

For each quadratic, tell if the parabola will open UP or DOWN, and if it will be SKINNY or WIDE.

1. $y = (-4)x^2 - x + 1$ (a)

down & skinny

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

$+\frac{1}{3}x^2$

$y = (\frac{1}{3})x^2 + x - 3$ (a)

up & wide

3. $y = 5x(-3)x^2$ (a)

down & skinny

4. $y - 5x^2 = 2x - 6$

$+5x^2$

$y = (5)x^2 + 2x - 6$ (a)

up & skinny

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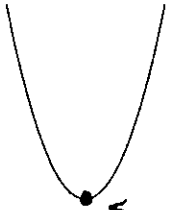
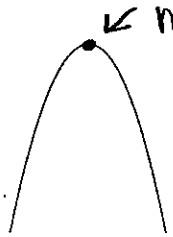
**Parabolas can have a MINIMUM or MAXIMUM...**

Look at the VERTEX of the quadratic...

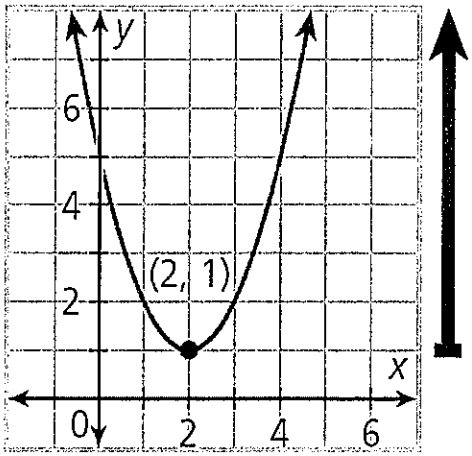


↖ min. (at bottom)



↙ max (at top)

**Parabolas have a DOMAIN (all possible** x-values **) and RANGE (all possible** y-values **)...**




Unless a specific domain is given, the domain will always be...

DOMAIN = all real #'s
X's

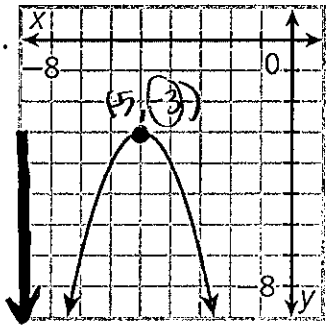
The range is based on the max or min...

RANGE = #'s bigger than 1
y's

↳ look @ vertex's y-value: (2, 1)

## Practice

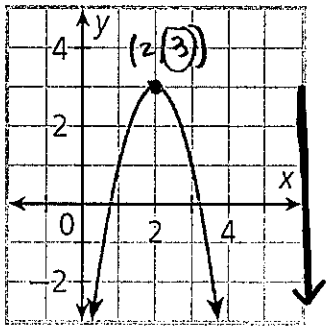
1.




D = all real #'s

R = #'s smaller than −3

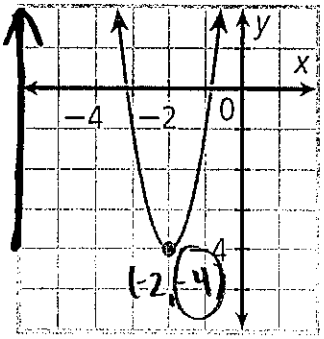
2.




D = all real #'s

R = #'s smaller than 3

3.




D = all real #'s

R = #'s bigger than −4

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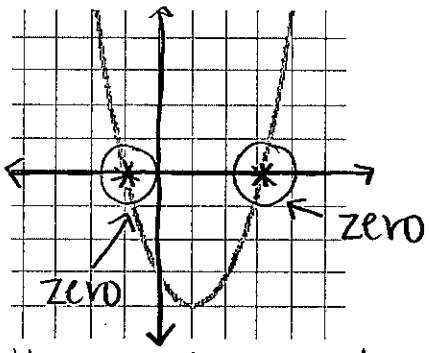
# Lesson 9-2: Zeros of a Quadratic

## Vocabulary

Zero of a function/*x*-intercepts/roots: an x-value that makes the function equal to zero.

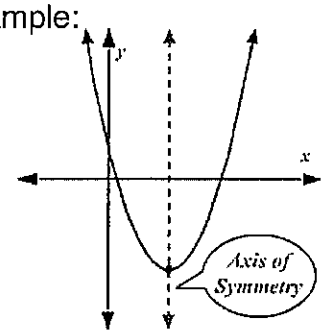
Example:



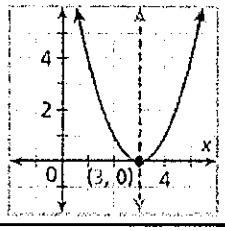
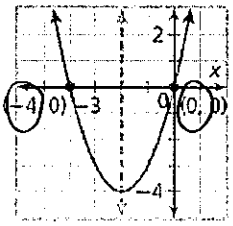

This function has two zeros/roots/x-int.

Axis of Symmetry: the vertical line that divides the parabola in half (goes through the vertex)

Example:




The axis of symmetry always goes through the vertex, and always has the equation x = ?

| Finding the Axis of Symmetry by Using Zeros | | |
|---|---|---|
| **Words** | **Numbers** | **Graph** |
| One Zero If only one zero, use the vertex! | Vertex: (3, 0) ↑ Axis of Symm: x = 3 |   |
| Two Zeros If two zeros, find the average of the two zeros! | $\frac{-4+0}{2} = \frac{-4}{2}$ Axis of Sym.: x = −2 |   |

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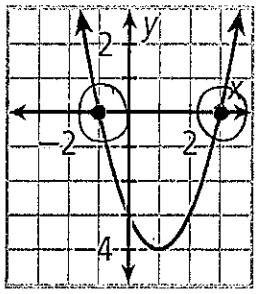
## Practice

**Use the graph to find the zeroes. Verify algebraically.**

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



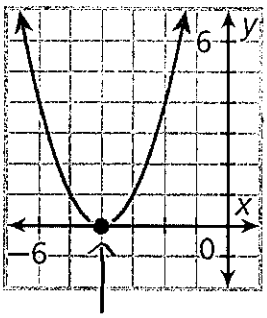

-1 & 3

Check:

$(-1)^2 - 2(-1) - 3 = 0$ ✓

$(3)^2 - 2(3) - 3 = 0$ ✓

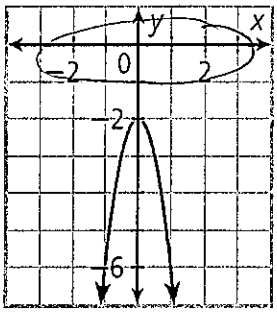
2. $y = x^2 + 8x + 16$




-4

Check: $(-4)^2 + 8(-4) + 16 = 0$ ✓

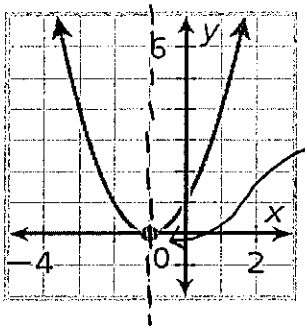
3. $y = -4x^2 - 2$




← no zeros!

**Find the axis of symmetry for each parabola.**

4.



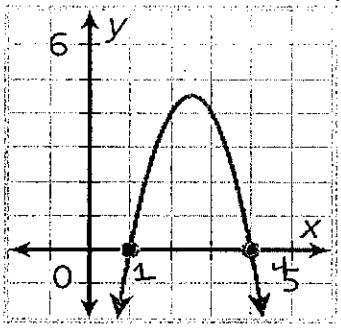

One Zero

Vertex (-1, 0)

So...

$x = -1$

5.




Two Zeros

$1 + 4 - \frac{5}{2}$

$= 2.5$

So, $x = 2.5$

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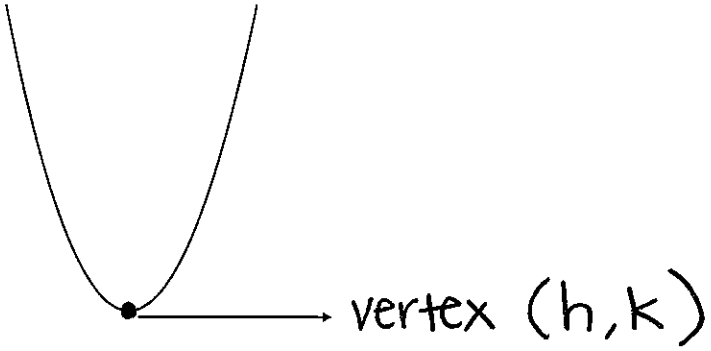
# Calculating the Vertex




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

Example: $y = 3x^2 + 12x - 5$

a = 3
b = 12
c = -5

**FINDING THE VERTEX**

1) Find h.

Know! $h = \frac{-b}{2a}$ $\frac{-12}{2 \cdot 3} = \frac{-12}{6} = -2$ h = -2

2) Find k by plugging 'h' value in for 'x' in original equation.

$k = 3(-2)^2 + 12(-2) - 5 = -17$ k = -17

*The vertex is* (-2, -17).

*The axis of symmetry is* X = -2.

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**Practice** → (h, k)

Find the vertex.

1) $y = 1x^2 - 4x + 1$ $a = 1$, $b = -4$, $c = 1$

① $h = \frac{-b}{2a} \rightarrow \frac{--4}{2 \cdot 1} = \frac{4}{2} = 2$

② $k = (2)^2 - 4(2) + 1 = -3$

$(2, -3)$

2) $y = -2x^2 - 8x + 1$ $a = -2$, $b = -8$, $c = 1$

① $h = \frac{-b}{2a} \rightarrow \frac{--8}{2 \cdot -2} = \frac{8}{-4} = -2$

② $k = -2(-2)^2 - 8(-2) + 1 = 9$

$(-2, 9)$

3) $y = 4x^2 - 1x - 3$ $a = 4$, $b = -1$, $c = -3$

① $h = \frac{-b}{2a} \rightarrow \frac{--1}{2 \cdot 4} = \frac{1}{8} = .125$

② $k = 4(.125)^2 - 1(.125) - 3 = -3.0625$

$(.125, -3.0625)$

4) $y = 4x^2 + 6$ $a = 4$, $b = 0$, $c = 6$

① $h = \frac{-b}{2a} \rightarrow \frac{-0}{2 \cdot 4} = \frac{0}{8} = 0$

② $k = 4(0)^2 + 6 = 6$

$(0, 6)$

5) $y = 1x^2 - 1x$ $a = 1$, $b = -1$, $c = 0$

① $h = \frac{-b}{2a} \rightarrow \frac{--1}{2 \cdot 1} = \frac{1}{2} = .5$

② $k = (.5)^2 - (.5) = -.25$

$(.5, -.25)$

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# Vertex Form

**Vertex Form of a Parabola:**

from standard form

find find find

$$\underset{\text{leave}}{y} - (k) = (a)\left(\underset{\text{leave}}{x} - (h)\right)^2$$

vertex $(h, k)$

**Practice**

Convert each to vertex form.

1) $y = x^2 + 12x + 40$ $a = 1, b = 12, c = 40$

$h = \frac{-b}{2a} \rightarrow \frac{-12}{2 \cdot 1} = \frac{-12}{2} = -6$

$k = 1(-6)^2 + 12(-6) + 40 = 4$

$y - 4 = 1(x + 6)^2$

2) $y = x^2 - 6x - 40$ $a = 1,\ b = -6,\ c = -40$

$h = \frac{-b}{2a} \rightarrow \frac{-6}{2 \cdot 1} = \frac{6}{2} = 3$

$k = (3)^2 - 6(3) - 40 = -49$

$y + 49 = 1(x - 3)^2$

3) $y = \frac{1}{4}x^2 - 3x + 2$ $a = 1/4,\ b = -3,\ c = 2$

$h = \frac{-b}{2a} \rightarrow \frac{--3}{2 \cdot 1/4} = \frac{3}{.5} = 6$

$k = \frac{1}{4}(6)^2 - 3(6) + 2 = -7$

$y + 7 = 1(x - 6)^2$

4) $y = -x^2 - 16x - 68$ $a = -1,\ b = -16,\ c = -68$

$h = \frac{-b}{2a} \rightarrow \frac{--16}{2 \cdot -1} = \frac{16}{-2} = -8$

$k = -1(-8)^2 - 16(-8) - 68 = -4$

$y + 4 = -1(x + 8)^2$