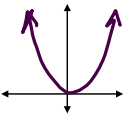


### 3.1 Quadratic Functions in Vertex Form

\* A quadratic function is a function that is a **2nd degree** polynomial.

ex.  $f(x) = 3x^2 - 5x + 5$   $h(x) = 5(x-2)^2 + 3$   
 $g(x) = 3(x+1)(x-2)$  or  $y =$

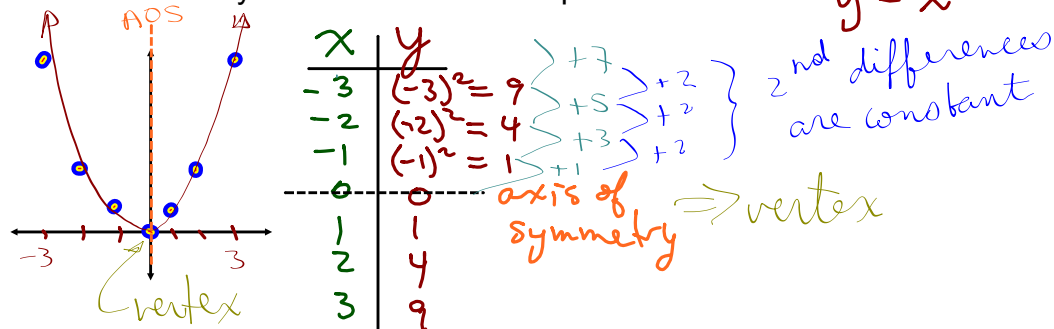
\* The base function is:  $y = x^2$

\* Graphically, a quadratic function looks like this , and is called a parabola

\* The properties that interest us are:

- direction of opening
  - vertex (max. or min. value)
  - axis of symmetry
- \* stretch factor  
\* x and y intercepts

\* Here are some key features of the base quadratic function:



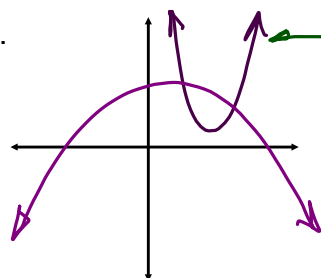
\* A quadratic function is in vertex form when it is written like this:

$$y = a(x-p)^2 + q$$

In this form we can easily identify its:

- vertex  $(p, q)$
- Axis of symmetry  $x = p$
- Direction of opening if  $a > 0 \rightarrow$  opens up

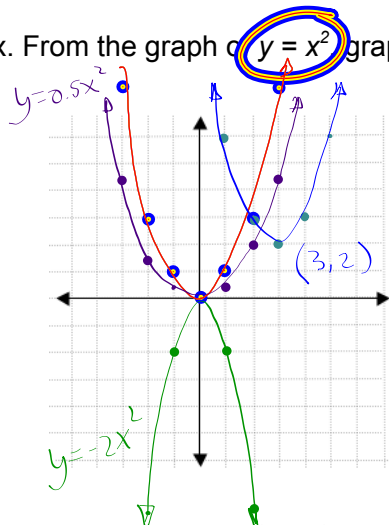
ex.



- $a < 0 \rightarrow$  opens down
- if  $a > 1 \rightarrow$  stretch (skinny)
- $0 < a < 1 \rightarrow$  "compression" (fatter)

notice the  $\ominus$  sign

ex. From the graph of  $y = x^2$  graph  $y = (x - 3)^2 + 2$ ,  $y = -2x^2$ , and  $y = 0.5x^2$



vertex  
(3, 2)  
 $a = 1$   
+1  
+3  
+5  
+7  
from  
vertex

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

$> -2$   
 $> -6$   
 $> -10$

instead  
going up  
+1  $\rightarrow$  +1/2  
+3  $\rightarrow$  +3/2  
+5  $\rightarrow$  +5/2

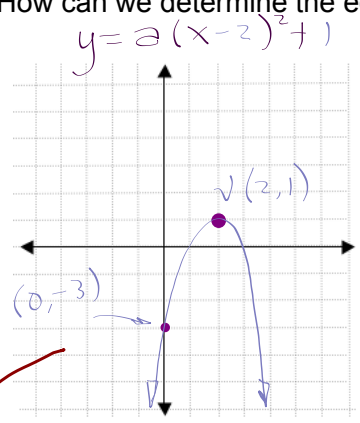
How does the value of a influence the graph?

if  $a > 0 \rightarrow$  opens up  
 $a < 0 \rightarrow$  opens down  
 $|a| > 1 \rightarrow$  skinnier  
 $0 < |a| < 1 \rightarrow$  fatter

$|a|$  means...  
"ignoring the sign"

\* We call the x-intercepts the **zeroes** of the quadratic function. This is where the graph crosses the x-axis.

\* How can we determine the equation the function based on its graph?



sub(0, -3) into  
 $y = a(x - 2)^2 + 1$  and solve for "a"  
 $-3 = a(0 - 2)^2 + 1$   
 $-3 = a(4) + 1$   
 $-4 = 4a$   
 $\frac{-4}{4} = \frac{4a}{4}$   
 $-1 = a \Rightarrow y = -(x - 2)^2 + 1$

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Range: the set of y-values the function satisfies

ex/  $\{y \in \mathbb{R} \mid y \leq 1\}$

Domain: x-values

ex/  $\{x \in \mathbb{R}\}$