

### 3.4 A Graphing in Vertex Form

**Recall:** Equation of a parabola in vertex form is

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

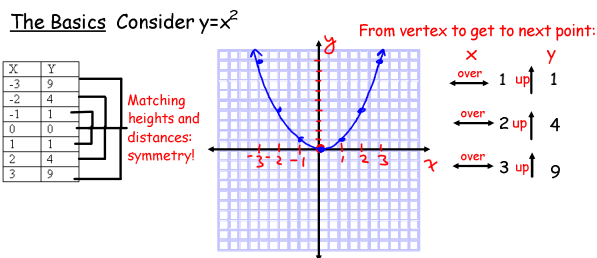
We saw yesterday how **a**, **h**, and **k** changed the graph of  $y = x^2$

If you can't see **a**, **h** or **k**, like in the equation  $y = x^2$ , where are they?  
They are still there- you just don't write them

$$y = \underset{\substack{\uparrow \\ \mathbf{1} \\ \mathbf{a}}}{(x - \underset{\substack{\uparrow \\ \mathbf{0} \\ \mathbf{h}}}{\underset{\substack{\uparrow \\ \mathbf{0} \\ \mathbf{k}}}{\mathbf{0}}})^2 + \mathbf{0}}$$

So  $y = x^2$  is a parabola in standard position  
ie no stretch and vertex at (0,0)

Mar 30-10:55 AM



Anything other than  $y = x^2$  has undergone **Transformations**.

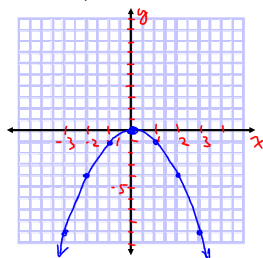
- Types of transformations
- reflection about the x axis or a vertical stretch (a)
  - vertical shift up or down (k)
  - horizontal shift left or right (h)

Means altering or repositioning the graph

**Ex 1:** Sketch  $y = -x^2$

- vertex at (0,0) start here
- $a = -1$ , opens down

Reflection in x-axis



Using the values from the standard parabola make your transformations count from the vertex:

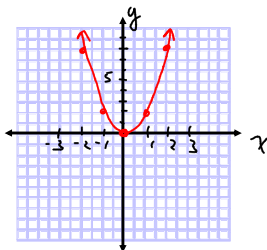
X	Y	
over 1	down 1	$1(-1) = -1$
over 2	down 4	$4(-1) = -4$
over 3	down 9	$9(-1) = -9$

multiply by "a" (-1)

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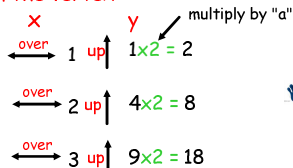
**Ex 2: Vertical Stretches**

Sketch  
a)  $y=2x^2$  vertex:  
opens:

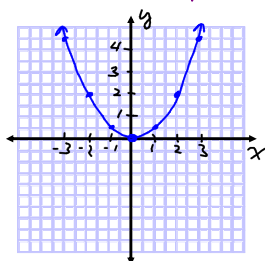


- makes graph "skinnier"
- vertical stretch by 2  
effects the y  
mult the y by 2  
leave the x the same

From the vertex:

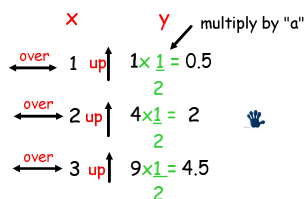


b)  $y=\frac{1}{2}x^2$  vertex:  
opens:



- makes graph "wider"
- vertical stretch by  $\frac{1}{2}$

From the vertex:

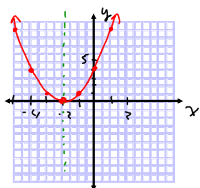


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**Ex 3: Horizontal Translations (shifts left or right)**

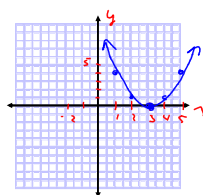
Sketch  
a)  $y=(x+2)^2$  vertex:  
opens:

This is  $y=x^2$  moved **left** 2 units.  
 $h = -2$



b)  $y=(x-3)^2$  vertex:  
opens:

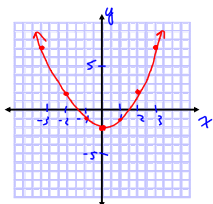
This is  $y=x^2$  moved **right** 3 units.  
 $h = 3$



**Ex 4: Vertical Translations (shifts up or down)**

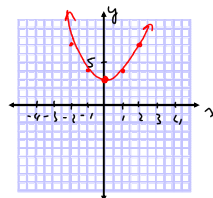
Sketch  
a)  $y=x^2-2$  vertex:  
opens:

This is  $y=x^2$  moved **down** 2 units.  
 $k = -2$



b)  $y=x^2+3$  vertex:  
opens:

This is  $y=x^2$  moved **up** 3 units.  
 $k = 3$

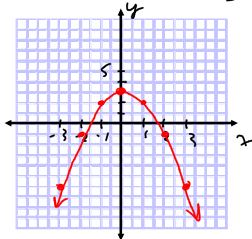


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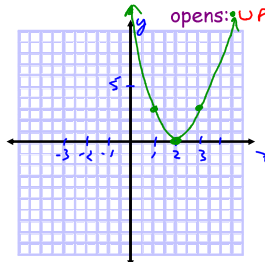
**Ex. 5** For each relation

- i) State the vertex
- ii) State the direction of opening
- iii) Graph the relation

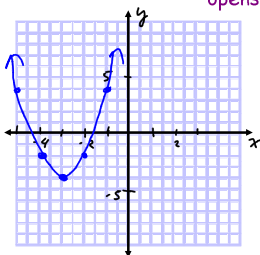
a)  $y = -x^2 + 3$  vertex: (0, 3)  
opens: DOWN



b)  $y = 3(x - 2)^2$  vertex: (2, 0)  
opens: UP



c)  $y = 2(x+3)^2 - 4$  vertex: (-3, -4)  
opens: UP



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**When Stating Transformations**

Order matters


**1st (multiplying operations)**

- Stretching
- Reflecting

**2nd (adding/subtracting operations)**

- Translations (left/right; up/down)

Stretch Before you move  
(or you'll hurt something :)

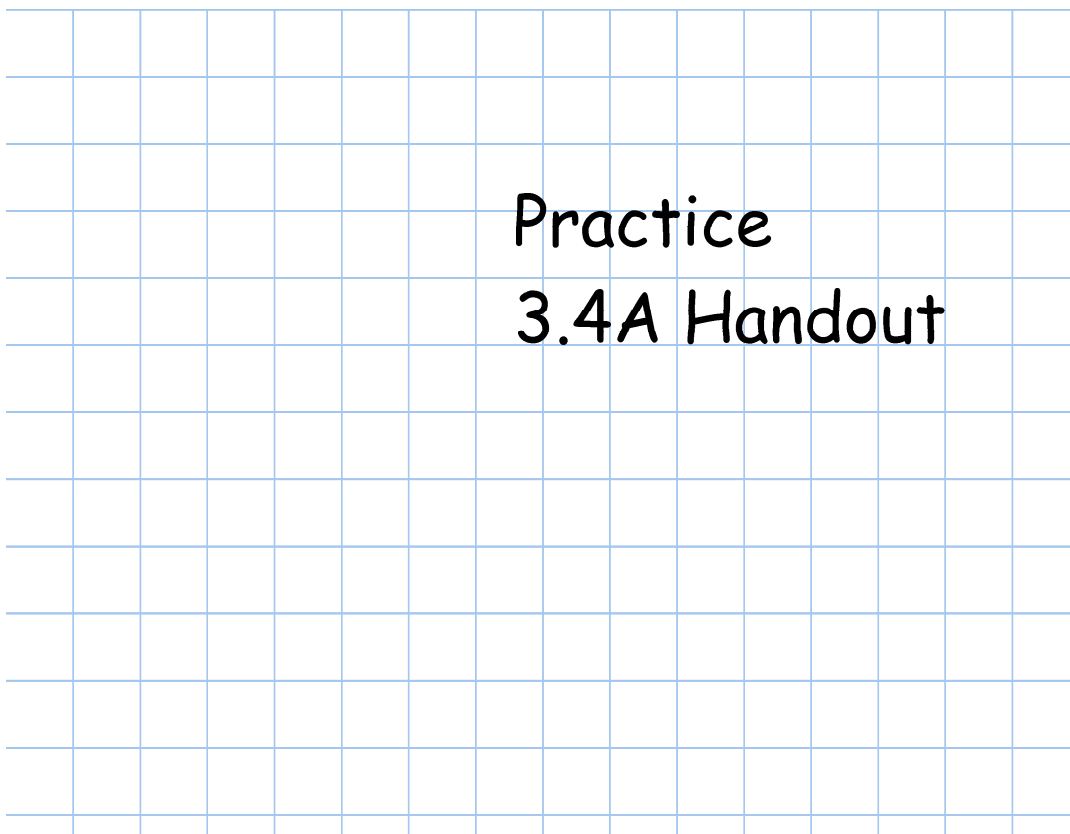


State the transformations (in order)

$y = -5(x+7)^2 - 10$

- Stretched by a factor of 5
- Vertical reflection
- Vertical shift down 10 units
- Horizontal shift left 7 units

Nov 7-10:42 AM



Practice

3.4A Handout

Apr 25-9:09 AM