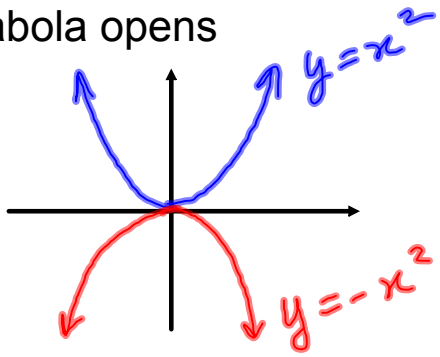
May 3/2010

Graphing by Transformations
Part II: Vertical Stretches of a Quadratic Relation

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

The sign of a determines if the parabola opens up or down.



$y = x^2$ a = 1, so a > 0

$y = -x^2$ a = -1, so a < 0
vertical reflection

The sign of a determines if there is a vertical reflection of the parent function, $y = x^2$.

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What about the size of 'a' in $y = a(x - h)^2 + k$?

Compare the TOV for $y = x^2$, $y = 2x^2$, and $y = \frac{1}{2}x^2$.

x	$y = x^2$	$y = 2x^2$	$y = \frac{1}{2}x^2$
-3	9	18	4.5
-2	4	8	2
-1	1	2	0.5
0	0	0	0
1	1	2	0.5
2	4	8	2
3	9	18	4.5

In each case, the step pattern has been multiplied by the value of 'a'.

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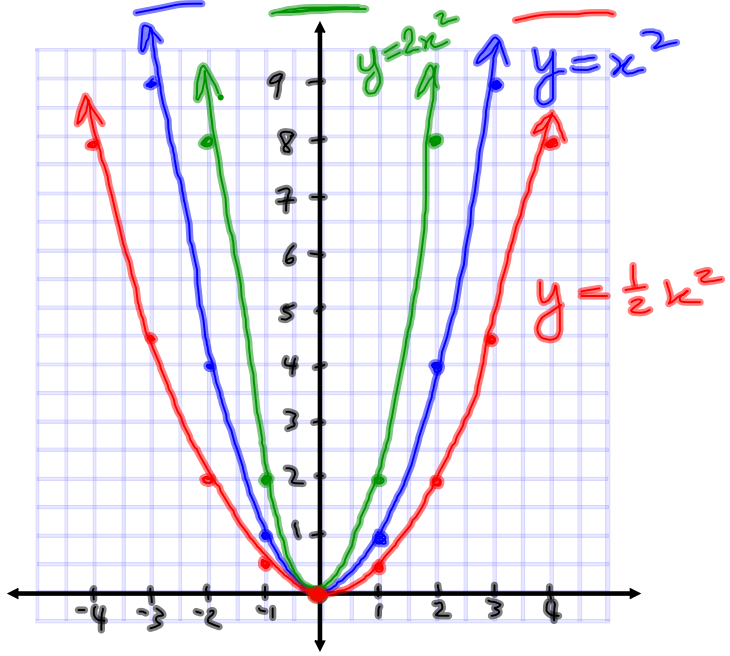
Graph $y = x^2$, $y = 2x^2$ and $y = \frac{1}{2}x^2$.



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See Geogebra quadratic translation demo
(click here for link)

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When 'a' is a number other than 1 or -1, we say that $y = x^2$ has been vertically stretched.

For a vertical stretch, we only care about the size, or magnitude, of 'a', so we ignore the sign.

|a| means "absolute value" or "magnitude" of 'a'. It is always a positive number.

When $|a| > 1$, the graph of $y = x^2$ gets thinner.

When $|a| < 1$, the graph of $y = x^2$ gets wider.
(this is often referred to as a vertical compression)

$|-3| = 3$ $\left|\frac{1}{2}\right| = \frac{1}{2}$ $\left|-\frac{3}{4}\right| = \frac{3}{4}$

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Ex.1 Describe the transformations to $y = x^2$ that yield the following:

* in vertex form, read transformations from left to right.

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

v. stretch by $\frac{1}{4}$

(b) $y = -3x^2$

v. reflection
v. stretch by 3

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

v. reflection
v. stretch by 2
shift left by 4
shift up by 1

(d) $y = -(x + 7)^2 - 2$

v. reflection
shift left by 7
shift down by 2

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Assigned Work:

p. 365 # 3ce, 6, 7egi, 8, 9, 12

use transformations & step pattern to sketch graph

Mar 20 - 4:57 PM