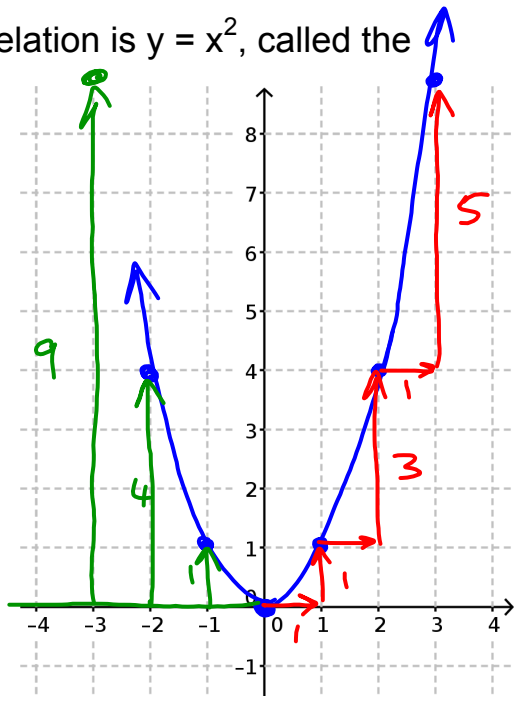
Reflecting & Stretching Quadratic Relations

The simplest quadratic relation is $y = x^2$, called the parent function.

x	$y = x^2$
-2	$(-2)^2 = 4$
-1	$(-1)^2 = 1$
0	0
1	1
2	4
3	9



Step Pattern?

1, 3, 5, 7, ...

1, 4, 9, 16, ...

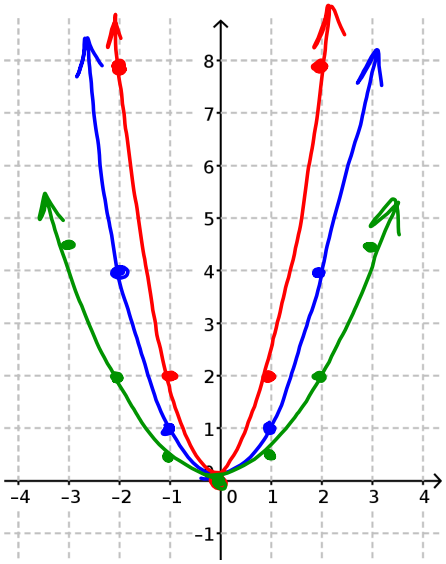
May 2-4:13 PM

Compare the graphs and TOV for $y = x^2$, $y = 2x^2$, and $y = \frac{1}{2}x^2$. What do you notice?

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

May 2-4:18 PM

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



Step Patterns?

1, 3, 5, 7, ...

2, 6, 10, 14, ...

$\frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \frac{7}{2}, \ldots$

They are multiples of the step pattern from the parent function.

May 2-4:29 PM

See Geogebra quadratic translation demo
(click here for link)

Apr 29-9:10 PM

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

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

"vertically reflected"

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

$y = ax^2 + bx + c$

Nov 8-1:22 PM

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

For a vertical scaling, we only care about the size, or magnitude, of 'a', so we ignore the sign. This is called the "absolute value", and has the symbol |a|.

When |a| > 1, the graph of $y = x^2$ gets thinner. The parent function undergoes a vertical stretch.

e.g., $y = 2x^2$, $y = 5x^2$, $y = -52x^2$

When 0 < |a| < 1, the graph of $y = x^2$ gets wider. The parent function undergoes a vertical compression.

e.g., $y = \frac{1}{2}x^2$, $y = \frac{-1}{4}x^2$, $y = 0.999x^2$

May 2-4:31 PM

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

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

Vertical compression by 4 OR by $\frac{1}{4}$

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

① V. reflection

② V. stretch by 3

May 2-4:35 PM

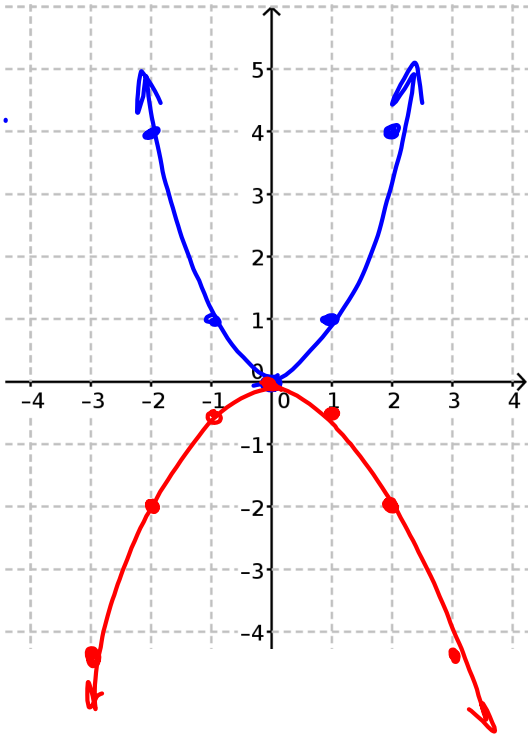
Ex. 2. Graph using the transformed step pattern.

(a) $y = -0.5x^2$

$y = x^2$: 1, 3, 5, 7, 9, ...

$y = -0.5x^2$: $-0.5, -1.5, -2.5, \ldots$

$-\frac{1}{2}, -\frac{3}{2}, -\frac{5}{2}$



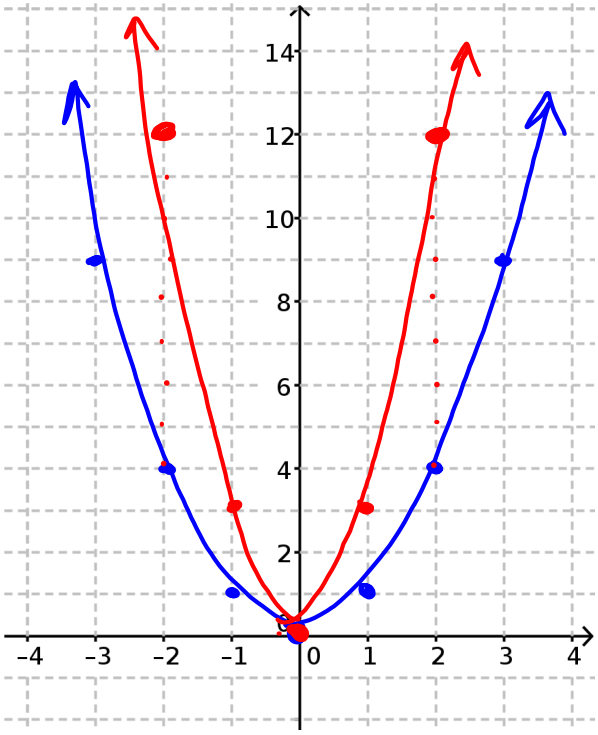
Apr 11-8:49 PM

Ex. 2. Graph using the transformed step pattern.

(b) $y = 3x^2$

x^2: 1, 3, 5, 7, ..

$3x^2$: 3, 9, 15, ...



Apr 11-8:49 PM

Assigned Work:

p. 256 # 1, 2, 4 ,5 ,8

d e b

2.(d) $(-4, 16)$, $a = \frac{1}{2}$

x y

V. compression

$y \times \frac{1}{2}$

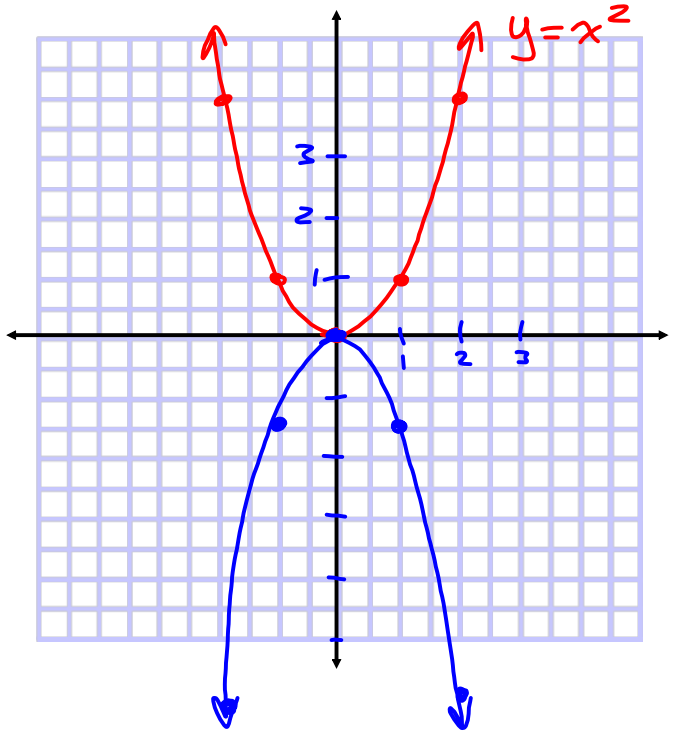
$(-4, 16) \xrightarrow{y \times \frac{1}{2}} (-4, 8)$

Mar 20 - 4:57 PM

4(e) $y = -\frac{3}{2}x^2$

$y = x^2$: 1, 3, 5, 7, ...

$\times\left(-\frac{3}{2}\right)$: $-\frac{3}{2}, -\frac{9}{2}, -\frac{15}{2}, -\frac{21}{2}$



Apr 14-1:58 PM

8(b) $y = -\frac{2}{3}x^2$ $P(2,4) \rightarrow ?$

① V. reflection $y \times (-1)$

② V. compression by $\frac{2}{3}$ $y \times \left(\frac{2}{3}\right)$

$P(2,4) \xrightarrow{①} (2,-4) \xrightarrow{②} \left(2, -\frac{8}{3}\right)$

$\frac{-4}{1}\left(\frac{2}{3}\right) = \frac{-8}{3}$

Apr 14-2:05 PM