* important lesson b/c allows to visualize function

Transformations of Quadratic Function

= changes made to the graph of the original parabola y = x^2

3 Ways to Describe Transformations of Quadratic Function

- Equation in vertex form
- Word descriptions
- Mapping notation

Equation in Vertex Form

vertical stretch (VS) by a factor of "a"

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

vertical translation (VT) by k units [up / down]

reflection (R) in x-axis

horizontal translation (HT) by h units [left / right]

Word Descriptions

- Horizontal translation: left or right by "h" units
- Vertical translation: up or down by "k" units
- Reflection in x-axis: vertical reflection (flipping upside down)
- Vertical stretch (expansion): by a factor of **a** where a > 1
  - Graph looks narrower than the original
- Vertical stretch (compression): by a factor of **a** where 0 < a < 1
  - Graph looks wider than the original

Mapping Notation

VS by a factor of "a"

(x, y) -> (x $\mp$ h, $\pm$ay $\pm$ k) ← VT by "k" units

R in x-axis

HT by "h" units

Ex-1) Describe all transformations in "Word Descriptions"

a. $y = -x^2 + 3$

- reflection in x-axis
- vertical translation up by 3 units

b. $y = x^2 - 5$

- VT down by 5 units

c. $y = (x + 6)^2$

- HT left by 6 units

d. $y = (x - 8)^2$

- HT right by 8 units

e. $y = (x + 0.5)^2 - 1.5$

- HT left by 0.5 units
- VT down by 1.5 units

f. $y = (x - 2.4)^2 + 3.6$

- HT right by 2.4 units
- VT up by 3.6 units

g. $y = -(x - 2)^2$

- R in x-axis
- HT right by 2 units

h. $y = -x^2 - 12$

- R in x-axis
- VT down by 12 units

Ex-2) Describe all vertical stretches in "Word Descriptions"

a. y = $2x^2$

- vertical stretch expansion by a factor of 2

b. y = $0.4x^2$

- VSC by a factor of 0.4

c. f(x) = $3.5x^2$

- VSE by a factor of 3.5

d. y = $0.02x^2$

- VSC by a factor of 0.02

e. f(x) = $25x^2$

- VSE by a factor of 25

f. y = $1.01x^2$

- VSE by a factor of 1.01

g. f(x) = x^2 = original parabola

- no VS

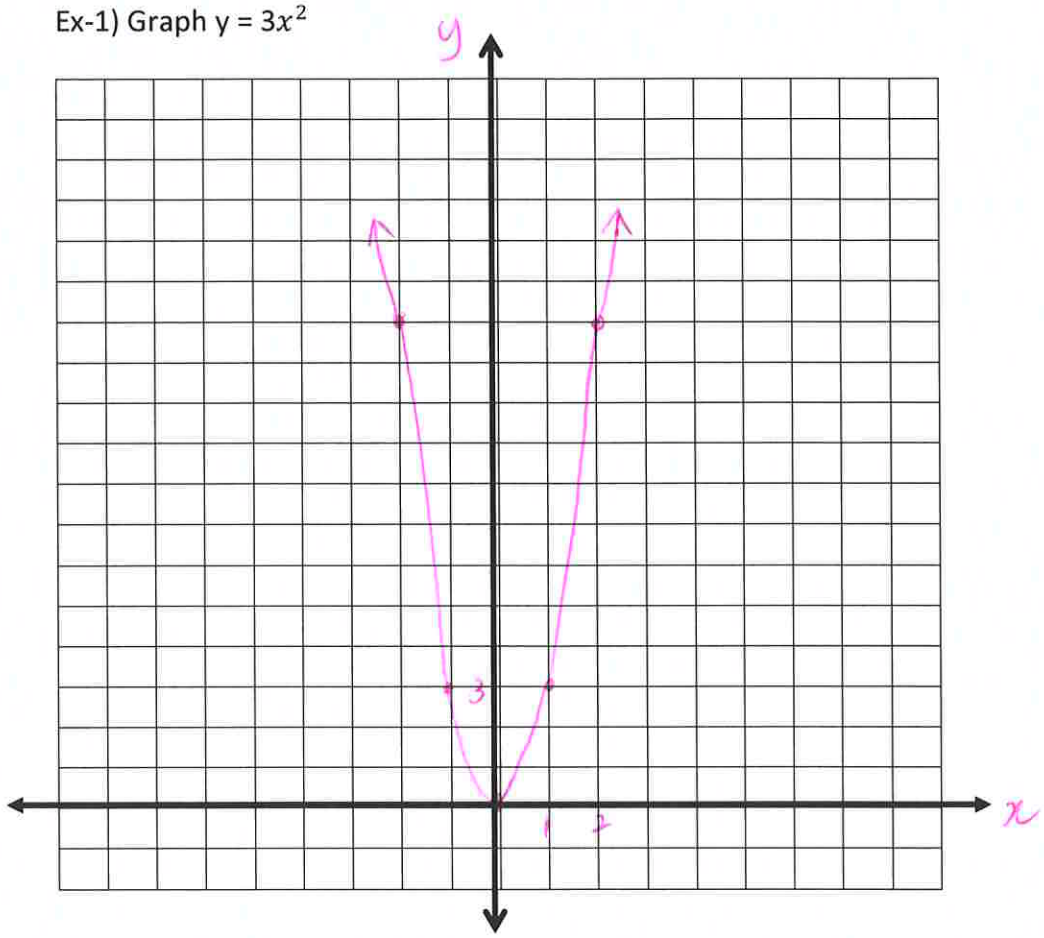
h. y = $0.2x^2$

- VSC by a factor of 0.2

* Don't forget to label your axes

Graphing Quadratic Functions

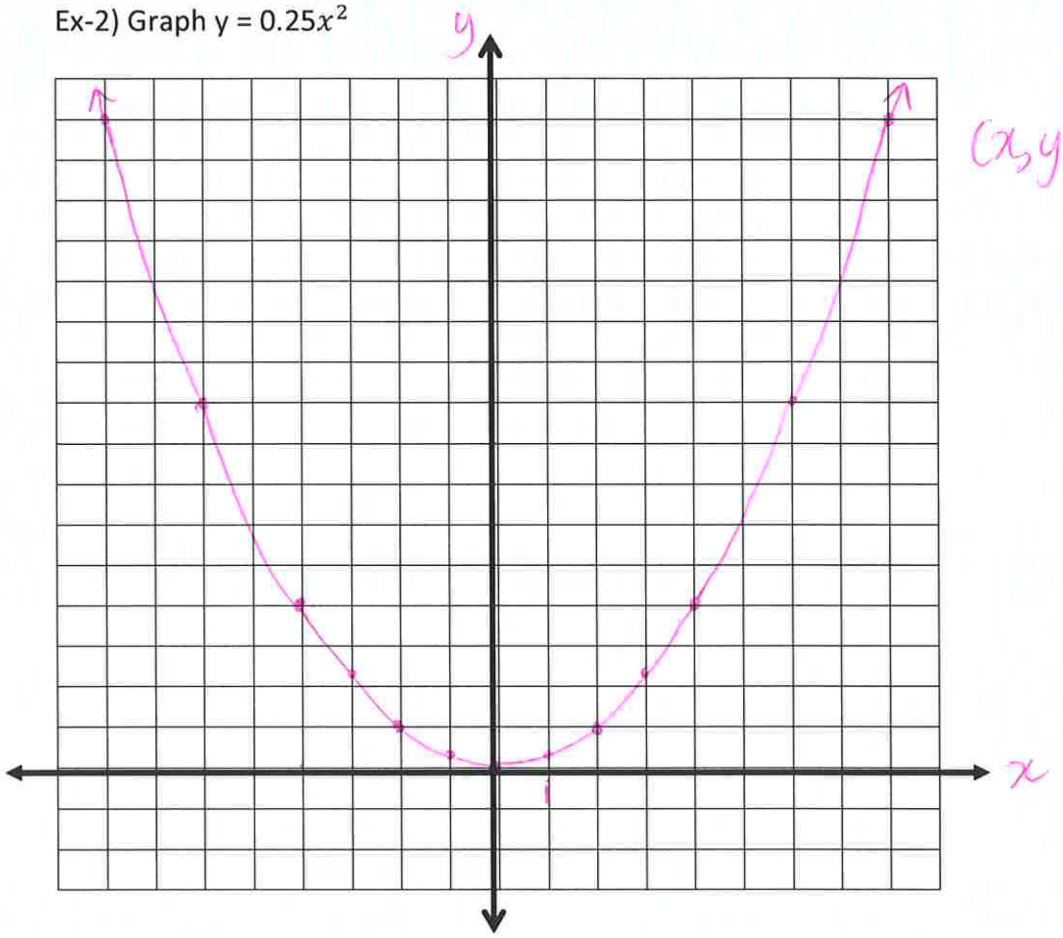
Ex-1) Graph y = $3x^2$



$(x, y) \rightarrow (x, 3y)$

Domain	$\{x \mid x \in \mathbb{R}\}$	Vertex	(0, 0)
Range	$\{y \mid y \geq 0, y \in \mathbb{R}\}$	Axis of Symmetry	$x = 0$
x-intercept	(0, 0)	End behavior	opens up
y-intercept	(0, 0)	Transformations	VSE by a factor of 3

Ex-2) Graph $y = 0.25x^2$

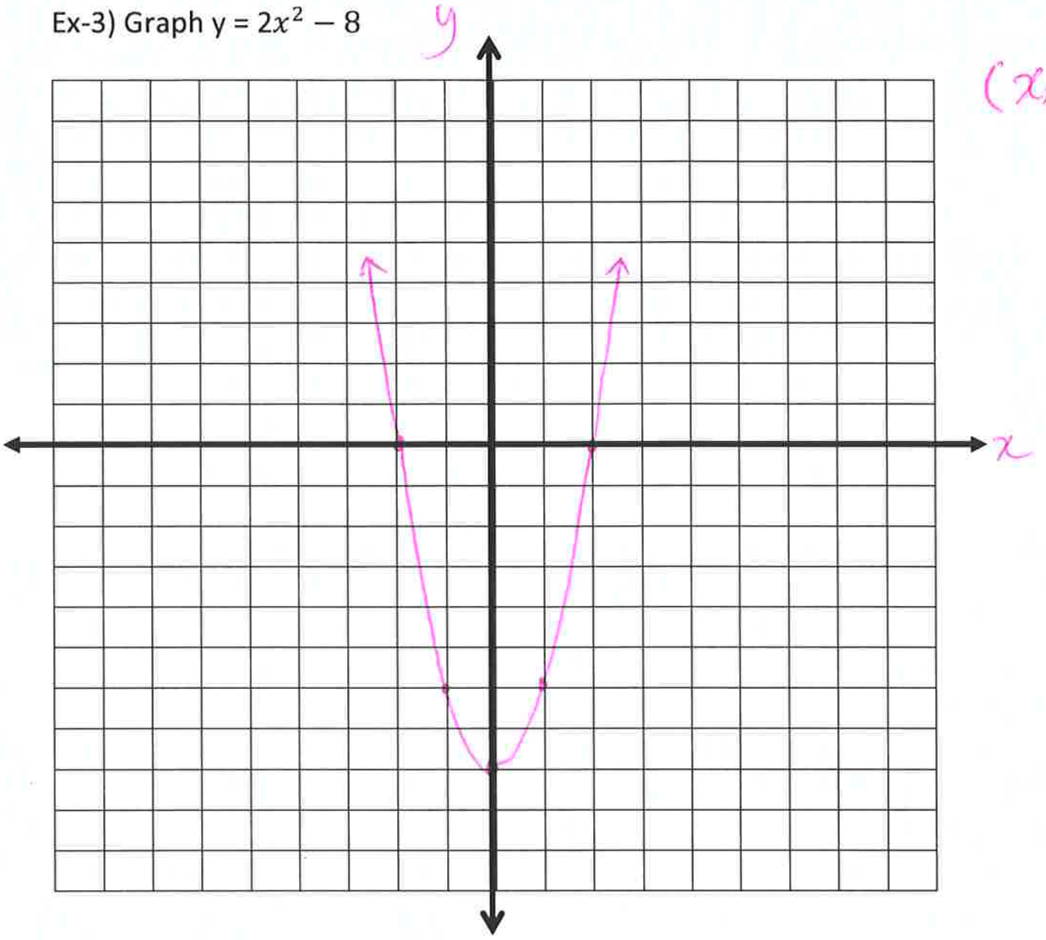


$(x, y) \rightarrow (x, 0.25y)$

Domain	$\{x \mid x \in \mathbb{R}\}$	Vertex	$(0, 0)$
Range	$\{y \mid y \geq 0, y \in \mathbb{R}\}$	Axis of Symmetry	$x = 0$
x-intercept	$(0, 0)$	End behavior	opens up
y-intercept	$(0, 0)$	Transformations	VSC by a factor of 0.25

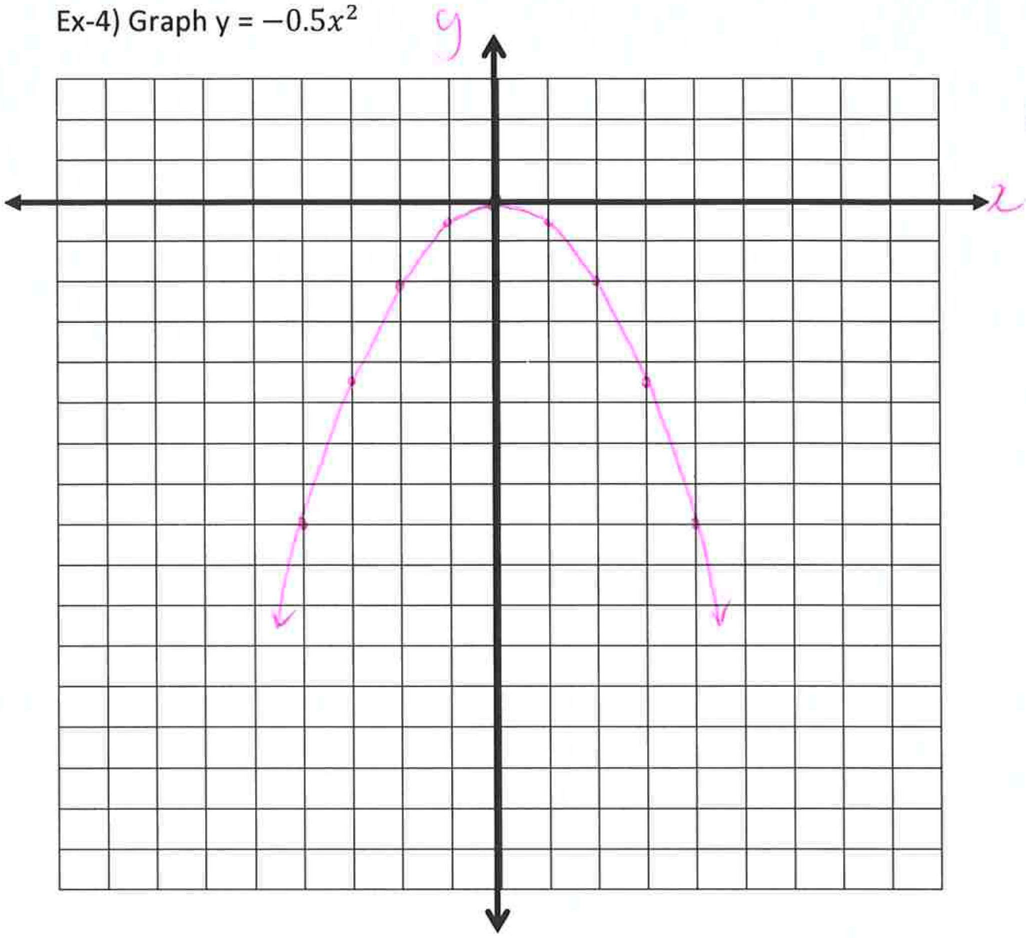
Ex-3) Graph y = $2x^2 - 8$

$(x,y) \rightarrow (x, 2y-8)$



Domain	$\{x \mid x \in \mathbb{R}\}$	Vertex	$(0, -8)$
Range	$\{y \mid y \geq -8, y \in \mathbb{R}\}$	Axis of Symmetry	$x=0$
x-intercept	$(2,0), (-2,0)$	End behavior	opens up
y-intercept	$(0, -8)$	Transformations	• VSE by a factor of 2 • VT down by 8 units

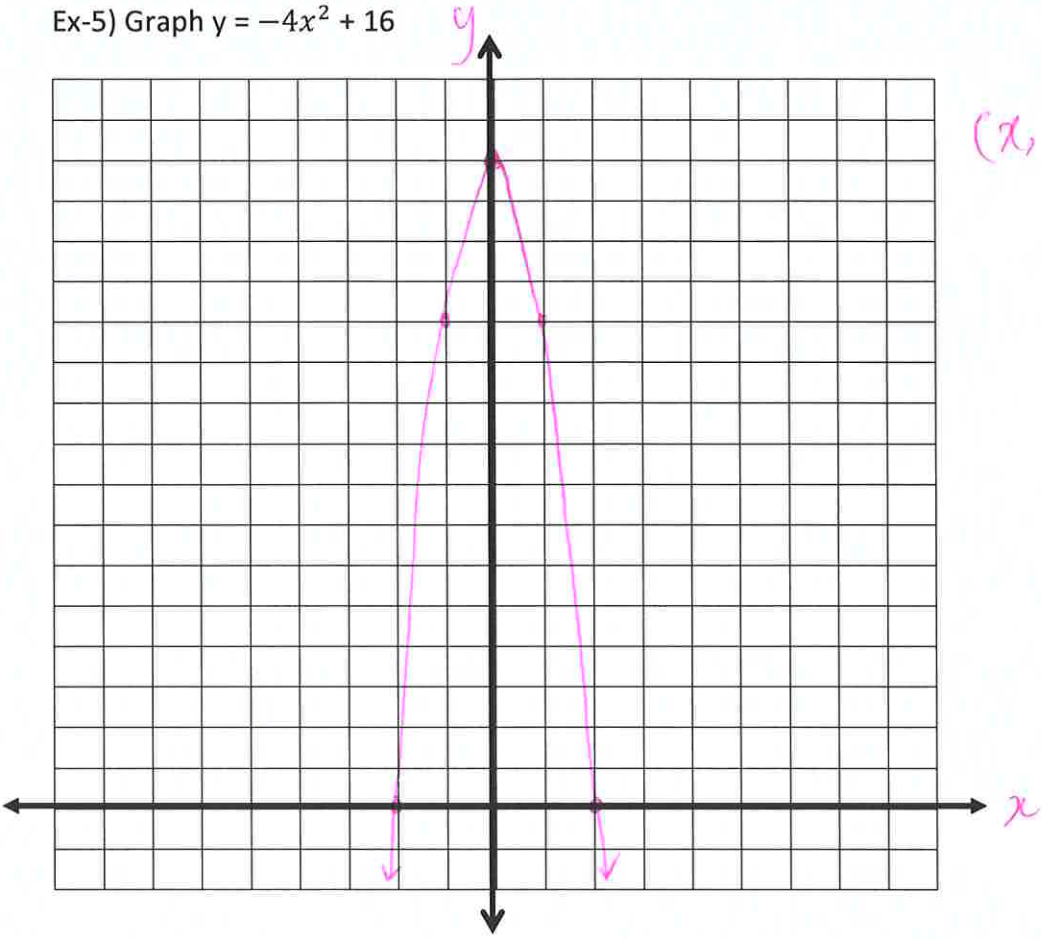
Ex-4) Graph y = $-0.5x^2$



$(x,y) \rightarrow (x, -0.5y)$

Domain	$\{x \mid x \in \mathbb{R}\}$	Vertex	$(0,0)$
Range	$\{y \mid y \leq 0, y \in \mathbb{R}\}$	Axis of Symmetry	$x = 0$
x-intercept	$(0,0)$	End behavior	opens down
y-intercept	$(0,0)$	Transformations	• R in x-axis • VSC by a factor of 0.5

Ex-5) Graph y = $-4x^2 + 16$

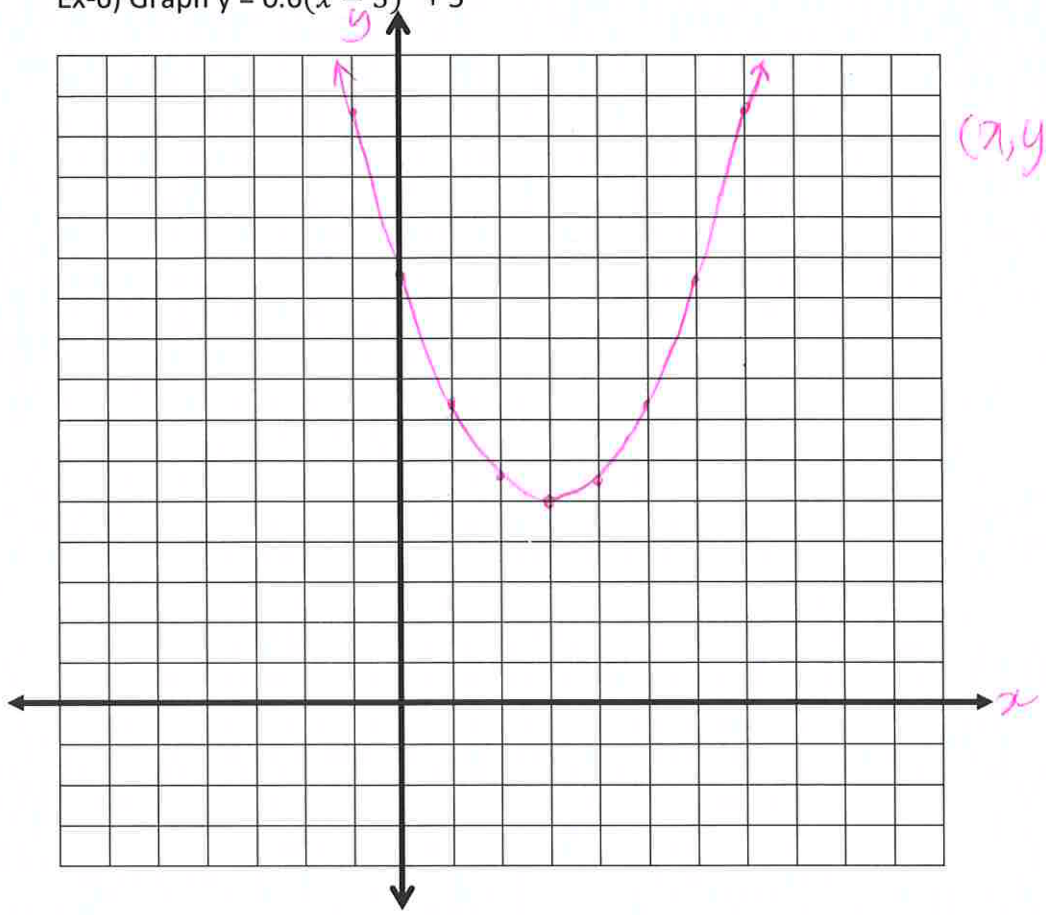


$(x, y) \rightarrow (x, -4y+16$

Domain	$\{x \mid x \in \mathbb{R}\}$	Vertex	$(0, 16)$
Range	$\{y \mid y \leq 16, y \in \mathbb{R}\}$	Axis of Symmetry	$x = 0$
x-intercept	$(2, 0), (-2, 0)$	End behavior	opens down
y-intercept	$(0, 16)$	Transformations	• R in x-axis • VSE by a factor of 4

• VT up by 16

Ex-6) Graph $y = 0.6(x-3)^2 + 5$



$(x, y) \rightarrow (x+3, 0.6y+5)$

Domain	$\{x \mid x \in \mathbb{R}\}$	Vertex	$(3, 5)$
Range	$\{y \mid y \geq 5, y \in \mathbb{R}\}$	Axis of Symmetry	$x = 3$
x-intercept	none	End behavior	opens up
y-intercept	$(0, 10.4)$	Transformations	• VSC by a factor of 0.6 • HT right by 3 units • VT up by 5 units

$0.6(0-3)^2+5$

$= 0.6(3)^2+5$

$= 0.6(9)+5$

$= 10.4$