

May 21

Sketching the graph of a quadratic relation by hand:

Start with $y = x^2$, graph it using the points listed in the table.

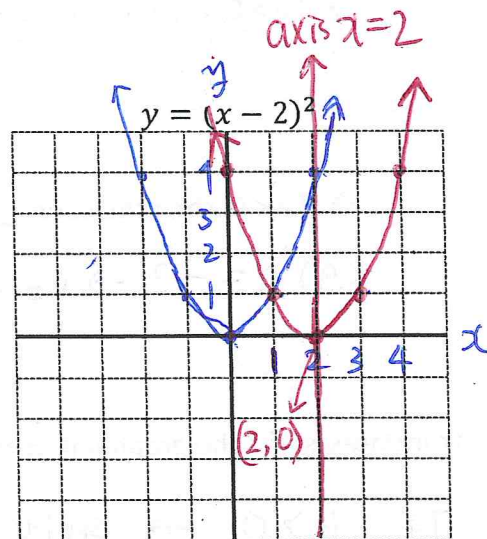
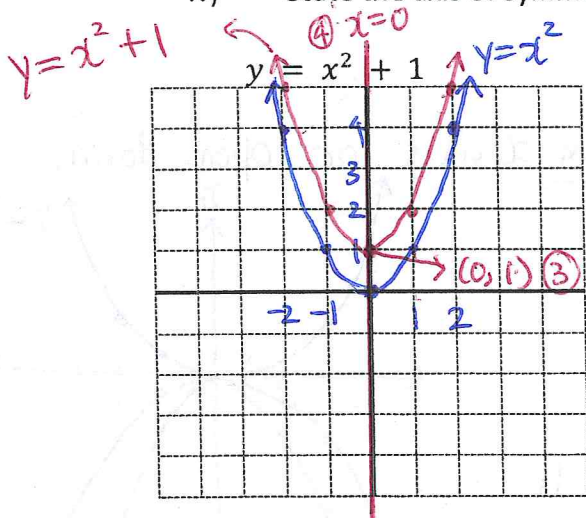
Table of value		
x	$y = x^2$	
-2	$(-2)^2 = 4$	$(-2, 4)$
-1	$(-1)^2 = 1$	$(-1, 1)$
0	$0^2 = 0$	$(0, 0)$
1	$1^2 = 1$	$(1, 1)$
2	$2^2 = 4$	$(2, 4)$

The order you apply the transformations to $y = x^2$ matters!

***Always, always shift last!!!**

For each of the following graphs,

- Describe the transformations in order
- Sketch the transformations
- Label the new vertex
- State the axis of symmetry

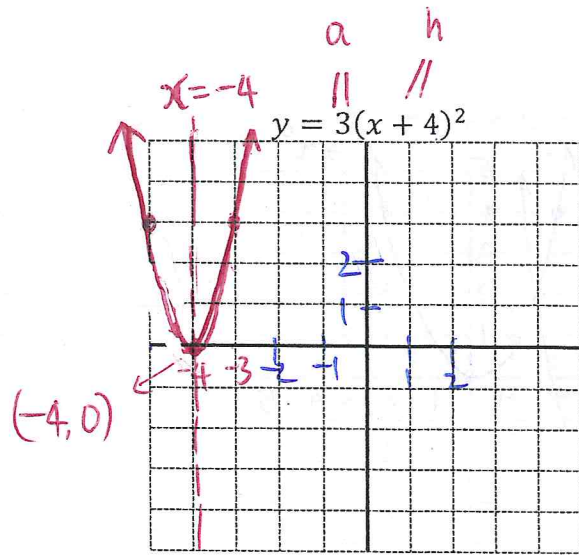
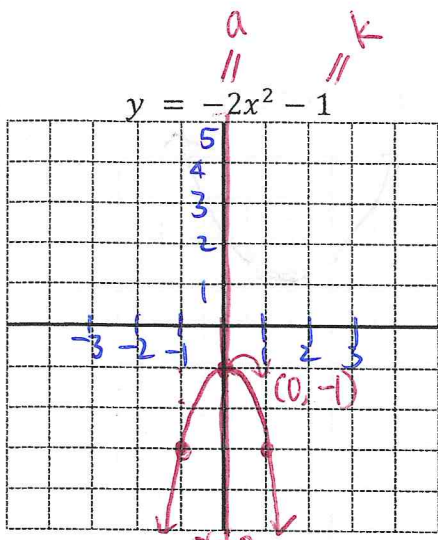


① $k = 1 \rightarrow$ shift up by 1 (only y coord will be added by 1) e.g) $(0, 0) \rightarrow (0, 1)$

- | | |
|-----------|-----------|
| $(-2, 4)$ | $(-2, 5)$ |
| $(-1, 1)$ | $(-1, 2)$ |
| $(0, 0)$ | $(0, 1)$ |
| $(1, 1)$ | $(1, 2)$ |
| $(2, 4)$ | $(2, 5)$ |

① $h = 2 \rightarrow$ shift to the right by 2 (add 2 to x coordinates)

- | | |
|-----------|----------|
| $(-2, 4)$ | $(0, 4)$ |
| $(-1, 1)$ | $(1, 1)$ |
| $(0, 0)$ | $(2, 0)$ |
| $(1, 1)$ | $(3, 1)$ |
| $(2, 4)$ | $(4, 4)$ |



Order? Left to right (or BEDMAS)

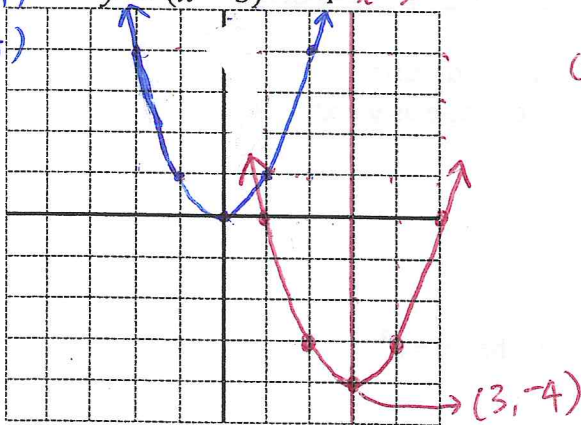
① $a = -2$: (reflect it on x axis and vertically stretch it by 2) (or you multiply -2 to y coordinates)

$k = -1$: shift it down by 1

(or you subtract 1 to y coordinates)

$(-2, 4)$	$(-2, -8)$	$(-2, -9)$
$(-1, 1)$	$(-1, -2)$	$(-1, -3)$
$(0, 0)$	$(0, 0)$	$(0, -1)$
$(1, 1)$	$(1, -2)$	$(1, -3)$
$(2, 4)$	$(2, -8)$	$(2, -9)$

$y = (x - 3)^2 - 4$ $x = 3$



① $h = 3$: shift right by 3

② $k = -4$: shift down by 4

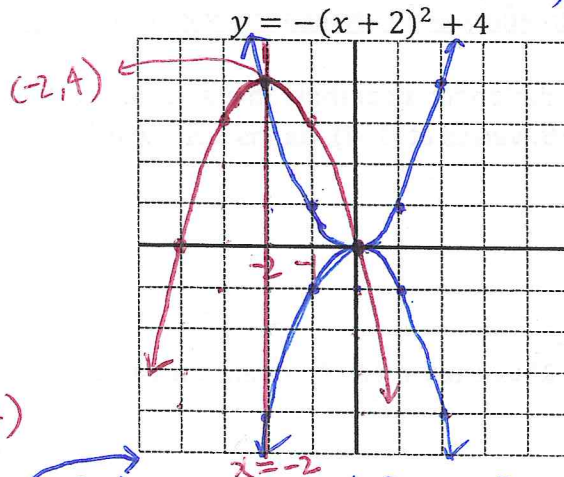
① $a = 3$ → Vertically stretch by 3

(= you multiply y coord by 3)

$h = -4$ → shift left by 4.

(= you subtract 4 only to x values)

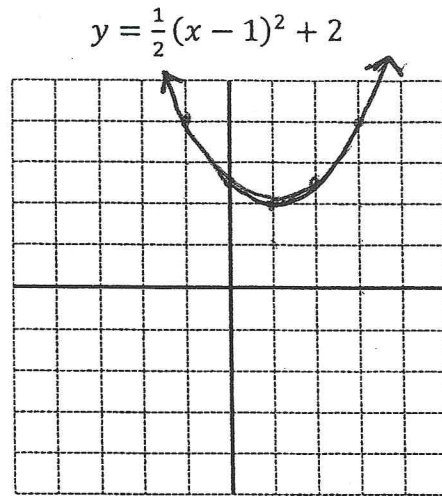
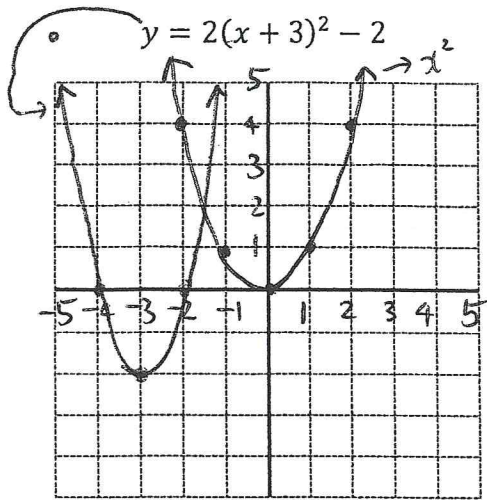
	$a = 3$	$h = -4$
$(-2, 4)$	$(-2, 12)$	$(-6, 12)$
$(-1, 1)$	$(-1, 3)$	$(-5, 3)$
$(0, 0)$	$(0, 0)$	$(-4, 0)$
$(1, 1)$	$(1, 3)$	$(-3, 3)$
$(2, 4)$	$(2, 12)$	$(-2, 12)$



① $h = -2$: shift left by 2

$k = 4$: shift up by 4

$a = -1$: reflect it on x axis.



$a=2$: vertically stretch by 2
(multiply y coordinate by 2)

$h=-3$: shift 3 to the left

$k=-2$: shift down by 2

$(-2, 4)$ $(-2, 8)$ $(-5, 6)$
 $(-1, 1)$ $(-1, 2)$ $(-4, 0)$
 $(0, 0)$ $(0, 0)$ $(-3, -2)$
 $(1, 1)$ $(1, 2)$ $(-2, 0)$
 $(2, 4)$ $(2, 8)$ $(-1, 6)$

$a = \frac{1}{2}$: vertically compress by $\frac{1}{2}$
(multiply y value by $\frac{1}{2}$)

$h=1$: shift 1 to the right

$k=2$: shift up by 2

$(-2, 4)$ $(-2, 2)$ $(-1, 4)$
 $(-1, 1)$ $(-1, \frac{1}{2})$ $(0, 2.5)$
 $(0, 0)$ $(0, 0)$ $(1, 2)$
 $(1, 1)$ $(1, \frac{1}{2})$ $(2, 2.5)$
 $(2, 4)$ $(2, 2)$ $(3, 4)$

Finding an equation in vertex form given a description of the transformations

Write a relation for a parabola that satisfies each set of conditions:

Example 9: vertex at $(1, -2)$; opens downward; the same shape as $y = x^2$

Example 10: vertex at $(-2, 3)$; opens upward; narrower than $y = x^2$

Example 11: vertex at $(3, 1)$; opens downward; wider than $y = x^2$