May 19

d) Is the ball going up or down at $t = 3$? Explain.

Since intial height is 40m and vertex is (4, 120)
so we can reasonably assume that the ball is going up at $t = 3$ seonds.

e) Is the ball still in the air after 9 s? Explain.

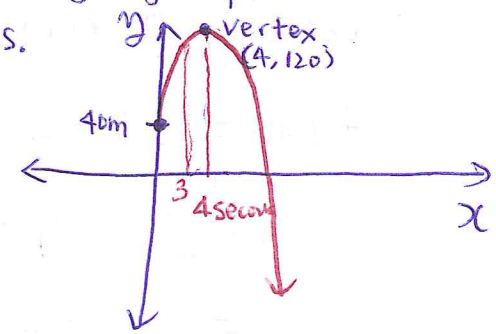
sub $t = 9$ → equation

$H(t) = -5(9-4)^2 + 120$

$H(t) = -5 \cdot 25 + 120$

$H = -125 + 120 = -5$

∴ The ball is not in the air after 9 seconds.



Example 7 Find the vertex form equation for a parabola with zeros at −4 and 2 and a y-intercept of −24.

→ (0, −24)
x y

x intercepts

$y = a(x-r)(x-s)$

$y = a(x+4)(x-2)$

$-24 = a(0+4)(0-2)$

$-24 = a \cdot (4) \cdot (-2)$

$\frac{-24}{-8} = \frac{-8a}{-8}$

$3 = a$

∴ $y = 3(x+4)(x-2)$.

→ $y = a(x-h)^2 + k$

* Vertex $= \frac{x_1 + x_2}{2} = \frac{-4+2}{2} = -1$

x coord

sub $x = -1$ into eq

$y = 3(-1+4)(-1-2)$

$y = 3(3)(-3) = -27$

∴ Vertex = (−1, −27)

∴ $y = 3(x+1)^2 - 27$

Something to think about: In the equation $y = a(x-h)^2 + k$, How does a, h, and k change the graph of $y = x^2$? Why?

Homework: Textbook pg. 351 #2a-c, 3cd, 4, 5cd, 6b-d, 7ac, 8ac, 9bde, 10ad, 13, 20, 21a-d, 24

Friday's HW

Monday's HW

Example 5 Find the vertex form equation of $f(x) = 3(x-1)(x+2)$.

Since x intercepts are 1 and $-2 \rightarrow \frac{1+(-2)}{2} = \frac{-1}{2}$

* Vertex's x coordinate $= -\frac{1}{2}$ sub this into equation

$$f(x) = 3\left(-\tfrac{1}{2}-1\right)\left(-\tfrac{1}{2}+2\right)$$
$$= 3\left(-\tfrac{1}{2}-\tfrac{2}{2}\right)\left(-\tfrac{1}{2}+\tfrac{4}{2}\right)$$
$$= 3\left(-\tfrac{3}{2}\right)\left(\tfrac{3}{2}\right)$$
$$= \frac{-27}{4}$$

$\therefore$ Vertex form is $f(x) = 3\left(x+\frac{1}{2}\right)^2 - \frac{27}{4}$

Example 6 A ball is hit into the air. Its height H (in metres) after t seconds is $H(t) = -5(t-4)^2 + 120$. (= vertex form $\therefore$ 120 is not y intercept)

a) Which direction does the parabola open? Does this make sense?

$a = -5 \rightarrow \cap \rightarrow$ open down Yes it makes sense.

b) What are the coordinates of the vertex? What does the vertex represent in this situation?

Vertex is $(4, 120)$. The vertex represents the maximum height of the ball.

c) From what height was the ball hit?

Initial height? y intercept $= ?$ $\rightarrow$ sub $x=0$ or $t=0$

$$H(t) = -5(0-4)^2 + 120$$
$$H(t) = -80 + 120$$
$$H(t) = 40\text{m}$$

$\therefore$ The ball was initially hit from 40 m cliff. (or building.)

MPM2D
Ms. Kueh

Transformations of Quadratics By Hand

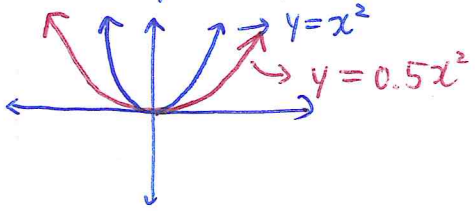
In the vertex form equation, $f(x) = a(x-h)^2 + k$, (h, k) is vertex

"a" ____ **vertically stretches/compresses** the graph

parent function

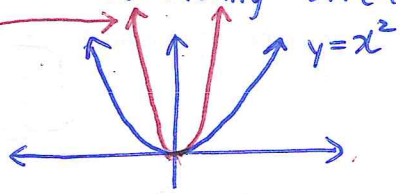
→ If -1< a < 1, then the graph of $y = x^2$ is vertically compressed.

e.g) $a = 0.5 \rightarrow y = 0.5x^2$



→ If a > 1 or a < -1, then the graph of $y = x^2$ is vertically stretched.

e.g) $a = 3 \rightarrow y = 3x^2$

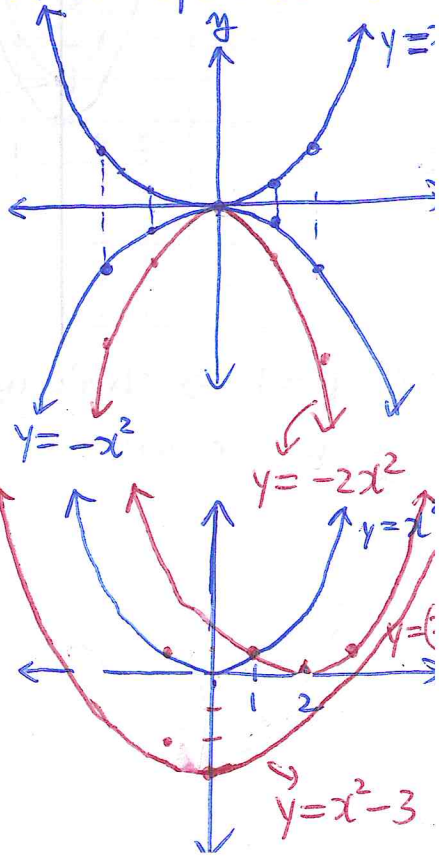


it also determines if there is a **reflection** in the x axis.

→ If a > 0, then the curve is opens up (positive is good → hold water)

→ If a < 0, then the curve reflected on x axis. or opens down.

e.g) $a = -2 \rightarrow y = -2x^2$



"h" ____ translates/shifts the graph **left or right**

If $h > 0$ → shift right by h.

If $h < 0$ → shift left by h.

$y = (x-2)^2$ → I shift x^2 right by 2.

"k" ____ translates/shifts the graph **up or down**

If $k > 0$ → shift up. by k.

If $k < 0$ → shift down by k.

$y = x^2 - 3$ → shift x^2 down by 3.

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	$2^2 = 4$	$(2, 4)$

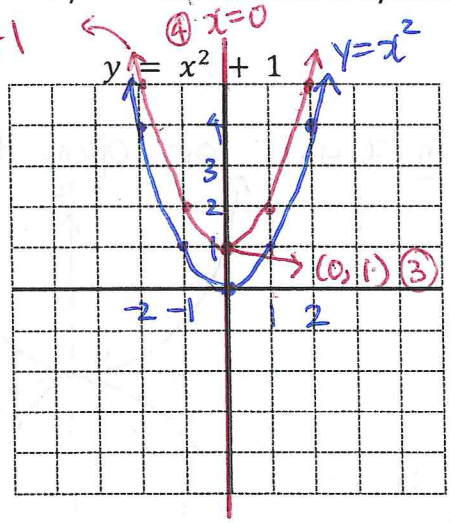
The order you apply the transformations to $y = x^2$ matters!

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

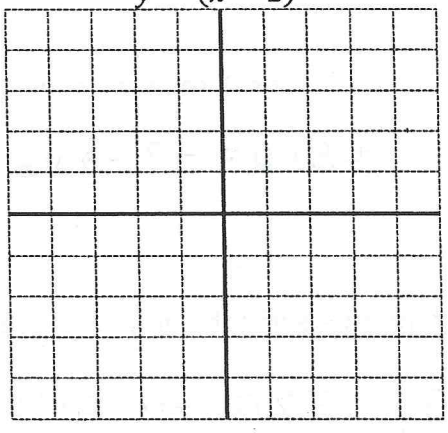
For each of the following graphs,

i) Describe the transformations in order
ii) Sketch the transformations
iii) Label the new vertex
iv) State the axis of symmetry

$y = x^2 + 1$



$y = (x - 2)^2$



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