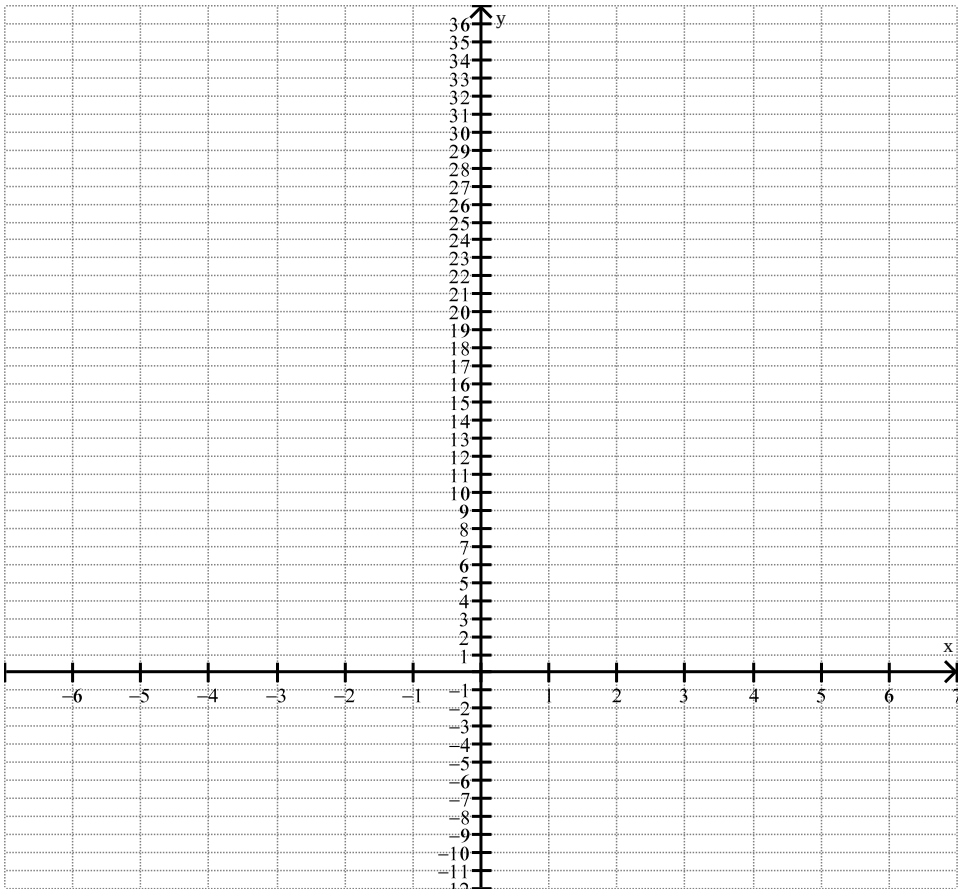
Math 0034/ LAB **Print your Name**_____

The Graph of $f(x) = x^2$ and its Translations and Vertex Form of a Quadratic Function

1) a) Complete the attached tables below for each function rule described below.

x	$f(x) = x^2$	$f(x) = (x+2)^2$	$f(x) = (x+3)^2$
-5			
-4			
-3			
-2			
-1			
0			
1			
2			
3			

b) Draw the graphs of all three functions on the grid attached below. Clearly label each graph.



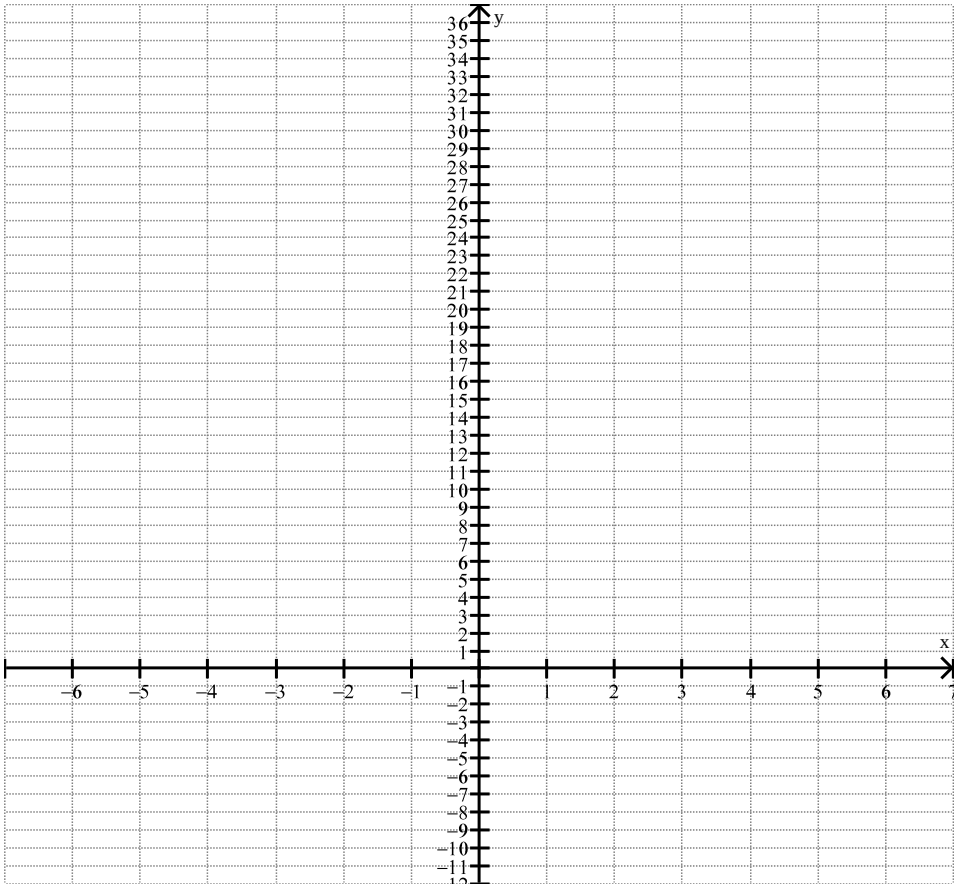
2) a) How was the graph of $f(x) = x^2$ shifted (translated) when you added 2 inside the parenthesis.

b) How was the graph $f(x) = x^2$ shifted (translated) when you added 3 inside the parenthesis?

3) a) Now complete the table below for each function rule described.

x	$f(x) = x^2$	$f(x) = (x-2)^2$	$f(x) = (x-3)^2$
-3			
-2			
-1			
0			
1			
2			
3			
4			
5			

b) Draw the graphs of all three functions on the grid attached below. Clearly label each graph.



4) a) How was the graph of $f(x) = x^2$ translated when you subtracted 2 inside the parenthesis?

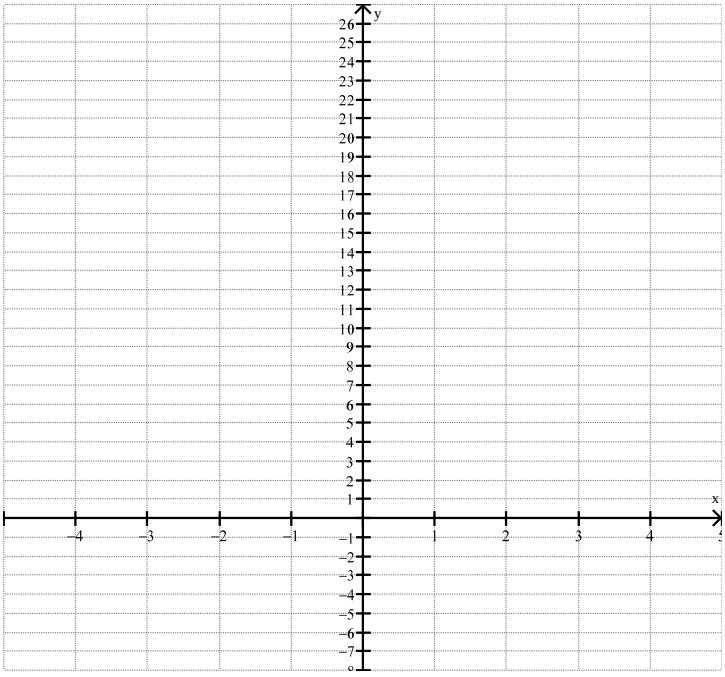
b) How was the graph of $f(x) = x^2$ translated when you subtracted 3 inside the parenthesis?

Conclusion: Given any quadratic equation in the form $f(x) = (x - t)^2$, where "t" represents any constant, generalize the two possible translations which will occur.
(i.e, if $t > 0$ and $t < 0$)

5) a) Now complete the table below for each function rule described.

x	$f(x) = x^2$	$f(x) = x^2 - 2$	$f(x) = x^2 - 3$
-3			
-2			
-1			
0			
1			
2			
3			
4			
5			

b) Draw the graphs of all three functions on the grid attached below. Clearly label each graph.



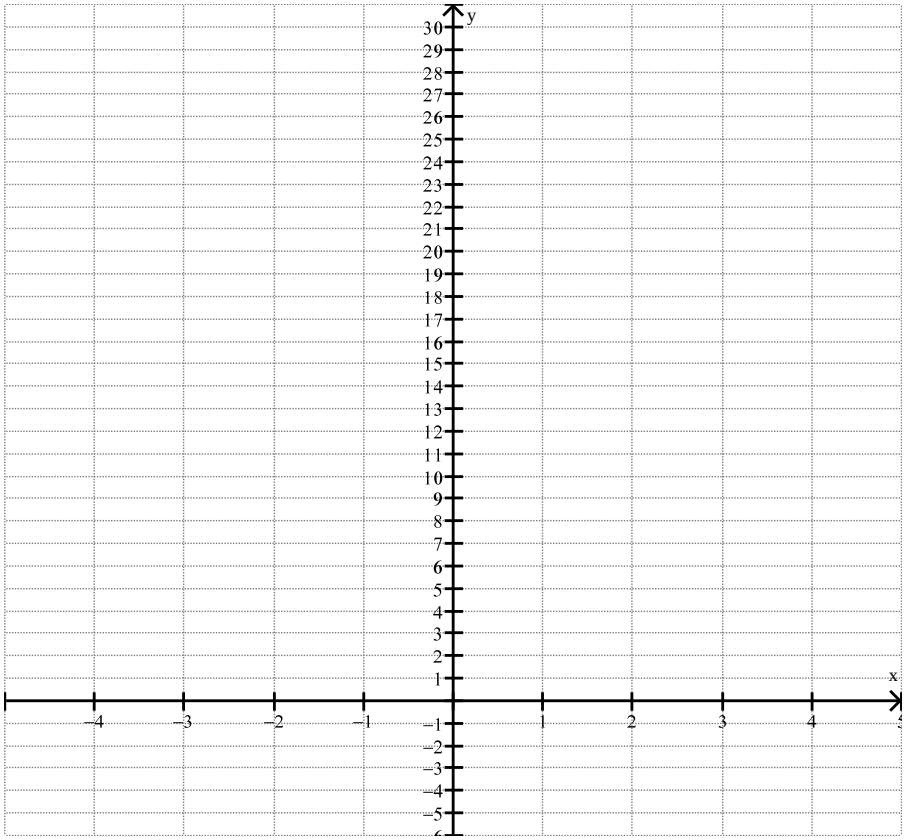
6) a) How was the graph of $f(x) = x^2$ translated when you subtracted 2 outside the parenthesis?

b) How was the graph of $f(x) = x^2$ translated when you subtracted 3 outside the parenthesis?

7) a) Now complete the table below for each function rule described.

x	$f(x) = x^2$	$f(x) = x^2 + 2$	$f(x) = x^2 + 3$
-3			
-2			
-1			
0			
1			
2			
3			
4			
5			

b) Draw the graphs of all three functions on the grid attached below. Clearly label each graph.



8) **a)** How was the graph of $f(x) = x^2$ translated when you added 2 outside the parenthesis?

b) How was the graph of $f(x) = x^2$ translated when you added 3 outside the parenthesis?

Conclusion: Given any quadratic equation in the form $f(x) = x^2 + t$, where "t" represents any constant, generalize the two possible translations which will occur.
(i.e, if $t > 0$ and $t < 0$)

Example: Now, Consider drawing a graph that combines both shifts. Lets find out how this will effect the location of the vertex.

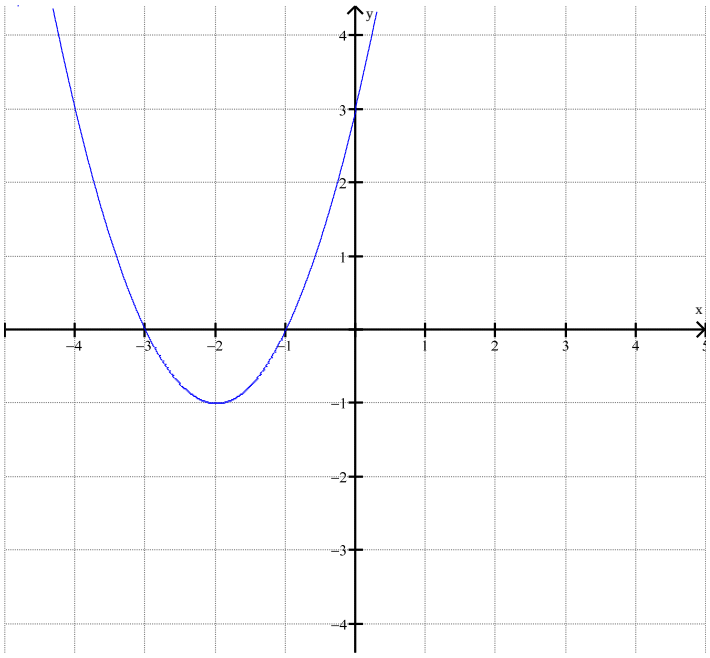
Consider the function $f(x) = (x+2)^2 - 1$

a) The basic function is $f(x) = x^2$

b) The translations are $f(x) = x^2$ has been shifted
2 units to the left and one unit down.

c) The y-intercept is $(0, 3)$

d) The x - intercept is
$0 = (x+2)^2 - 1, \ (x+2)^2 = 1$
$x + 2 = \pm 1, \ \ x = -2 \pm 1 = -3 \ or \ -1$
The x - intercepts are at $(-3, 0)$, $(-1, 0)$



e) Using the translations the vertex will be located at $(-2, -1)$

f) The domain is $(-\infty, \infty)$

g) The range is $[-1, \infty)$

9) Consider the function $f(x) = (x-1)^2 - 4$

a) What is the basic function?

b) Give the translations in words.

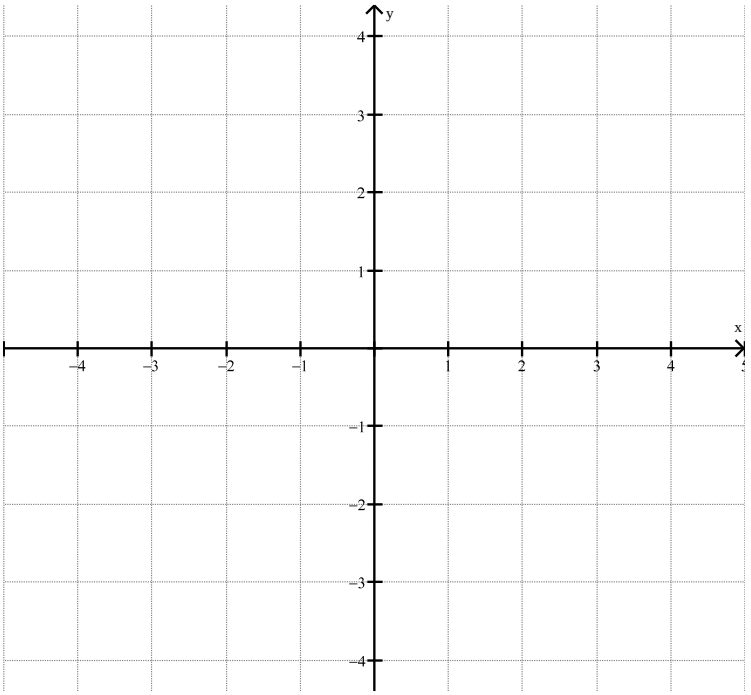
c) What is the location of its vertex?

d) Using algebra verify the location of its vertex.

e) What is the y-intercept?

f) What is the x-intercept?

g) Sketch the graph labeling all important points in the axis given below.



h) Find the domain.

i) Find the range.

10) Consider the function $f(x) = (x+3)^2 - 1$

a) What is the basic function?

b) Give the translations in words.

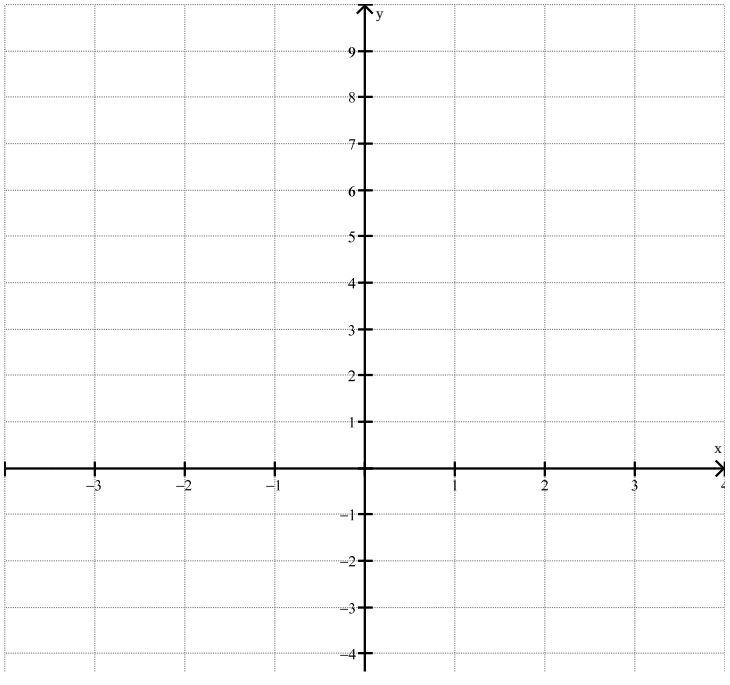
c) What is the location of its vertex?

d) Using algebra verify the location of its vertex.

e) What is the y-intercept?

f) What is the x-intercept?

g) Sketch the graph labeling all important points in the axis given below.



h) Find the domain.

i) Find the range.

The Vertex form

If $f(x)=(x-2)^2-2$, the translation is $f(x)=x^2$ has been shifted 2 units right and 2 units down. Hence the vertex becomes $(2,-2)$. Since this leads to finding the vertex quite conveniently it would lead us to the **vertex form of a quadratic function** $f(x)=a(x-h)^2+k$ **with vertex** (h,k)**, *and*** a **is a nonzero constant.**

11) a) Write the vertex form of the parabola with $a=-1$ and vertex $(2,3)$

b) Write the vertex form of the parabola with $a=3$ and vertex $(-1,-3)$

c) Write the vertex form of two parabolas that opens downward with vertex $(-2, 5)$.

12) For each of the following quadratic functions, fill in the characteristics noted in the table.

Equations	**Direction in which the graph opens**	**Axis of symmetry**	**Vertex**	**domain**	**range**
$f(x)=x^2-10$					
$f(x)=(x+5)^2-3$					
$y=-2(x+1)^2-9$					
$f(x)=-(x-1)^2-15$					

Something to think about!

13) Write the equation of a quadratic function that has a $y-$intercept of -6 and a vertex of $(2,-3)$