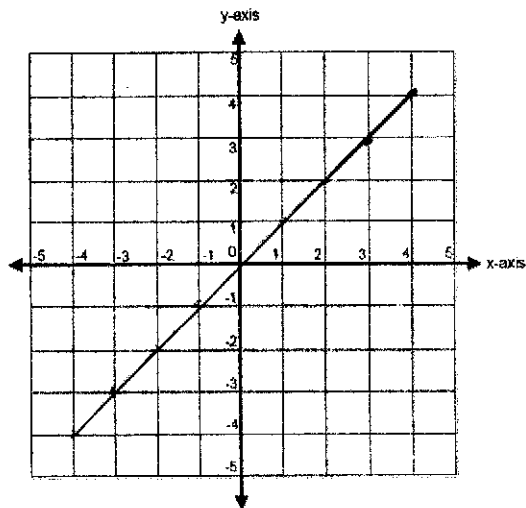
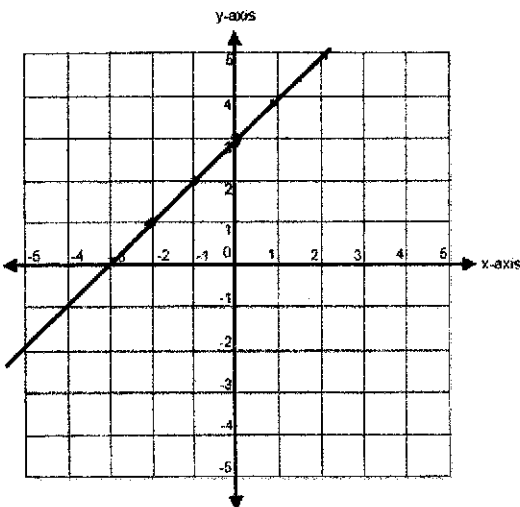


**Transformations of Functions
Vertical Shift**

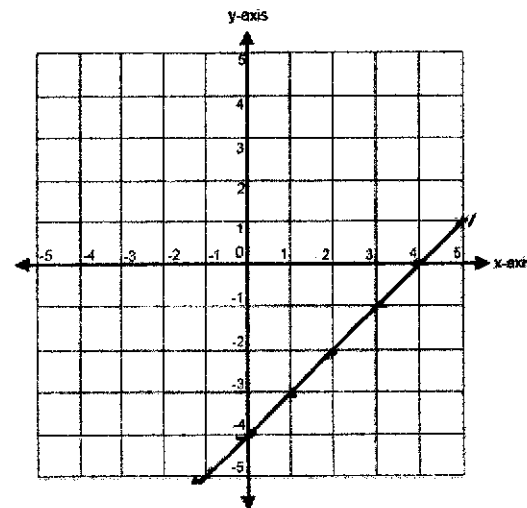
$y = x$



$y = x + 3$



$y = x - 4$



Given the function $f(x)$, if we define a new function $g(x)$ as $g(x) = f(x) + k$, where k is a constant. Then $g(x)$ is a vertical shift of the function $f(x)$, where all the outputs have been increased by k .

If k is positive the graph will shift up

If k is negative the graph will shift down

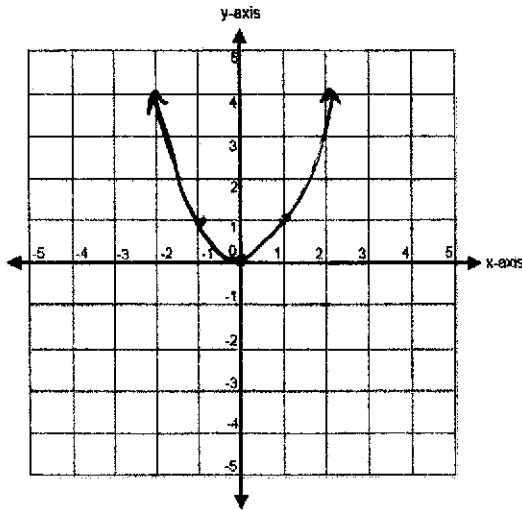
A function $f(x)$ is given as a table below. Create a table for the function $g(x) = f(x) - 3$

x	2	4	6	8
$f(x)$	1	3	7	11

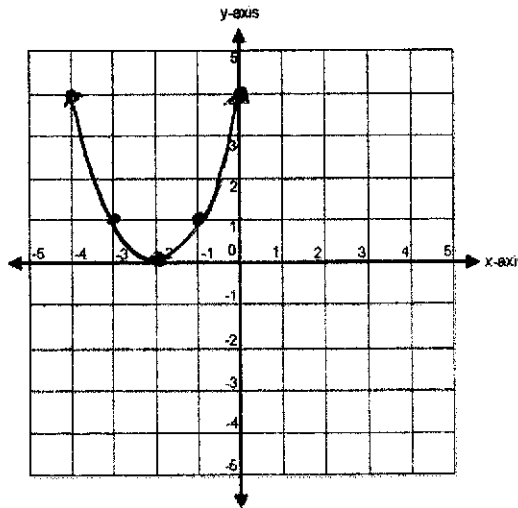
x	2	4	6	8
$g(x)$	-2	0	4	8

Horizontal Shift

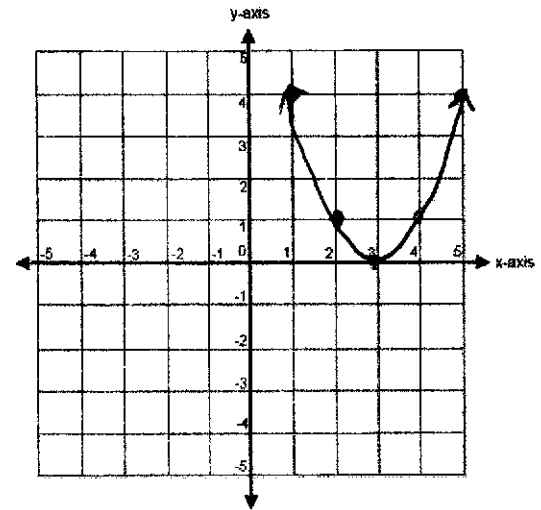
$$y = x^2$$



$$y = (x + 2)^2$$



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



Given the function $f(x)$, if we define a new function $g(x)$ as $g(x) = f(x + k)$, where k is a constant. Then $g(x)$ is a horizontal shift of the function $f(x)$.

If k is positive shifts the graph to the left

If k is negative shift the graph to the right

A function $f(x)$ is given as a table below. Create a table for the function $g(x) = f(x - 3)$

x	2	4	6	8
$f(x)$	1	3	7	11

x	5	7	9	11
$g(x)$	1	3	7	11

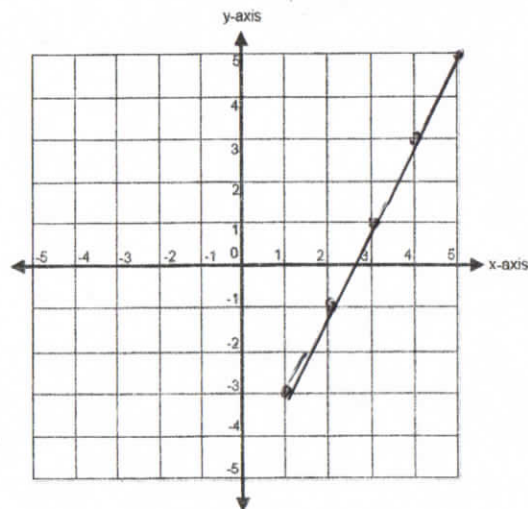
Remember:

Vertical Shifts are outside changes that affect the output (vertical) axis values shifting the transformed function up or down.
Horizontal Shifts are inside changes that affect the input (horizontal) axis values shifting the transformed function left or right.

Reflections

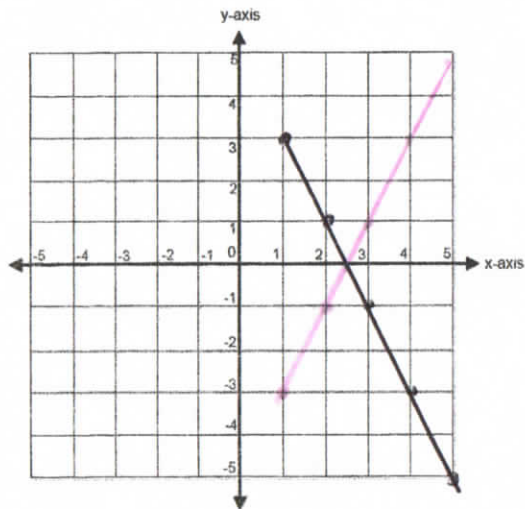
Graph

x	1	2	3	4	5
$f(x)$	-3	-1	1	3	5



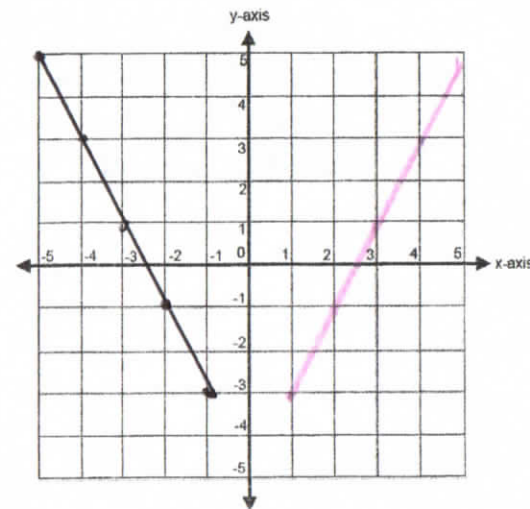
Using the table to the left graph

$$g(x) = -f(x)$$



Using the table in Graph 1 - Graph

$$h(x) = f(-x)$$



$g(x) = -f(x)$ then $g(x)$ is a vertical reflection of the function $f(x)$, sometimes called a reflection about the x-axis.

$h(x) = f(-x)$ then $h(x)$ is a horizontal reflection of the function $f(x)$ reflection about the y-axis.

$f(x)$

x	2	4	6	8
$f(x)$	1	3	7	11

Complete the tables:

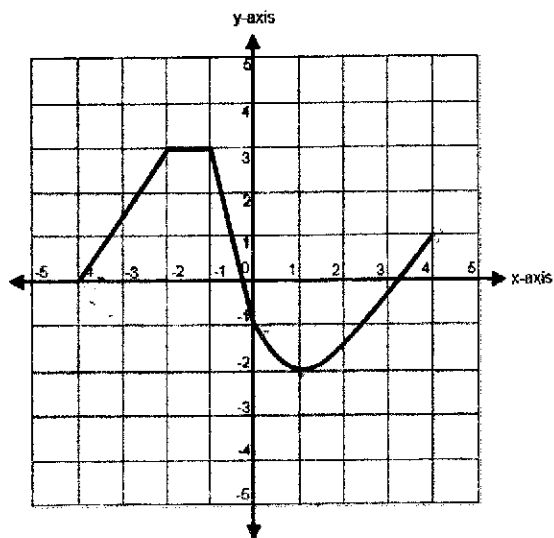
$$g(x) = -f(x)$$

x	2	4	6	8
$g(x)$	-1	-3	-7	-11

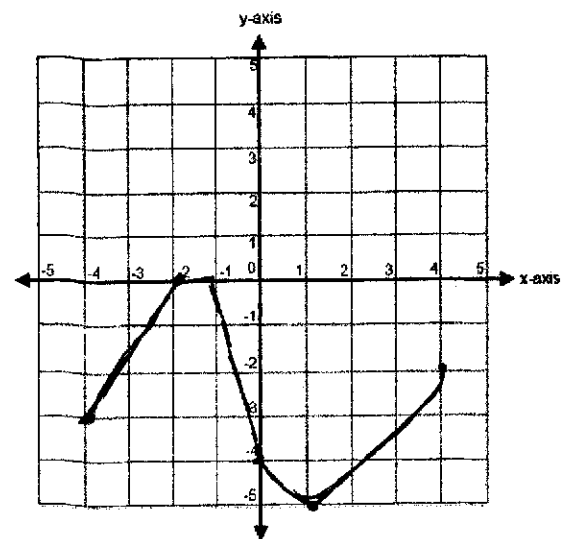
$$h(x) = f(-x)$$

x	-2	-4	-6	-8
$h(x)$	1	3	7	11

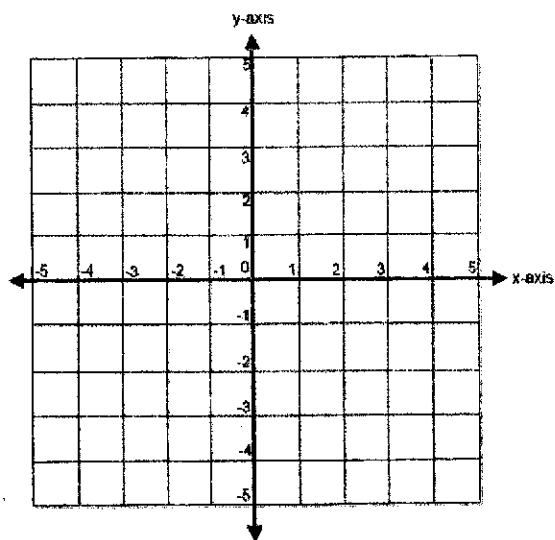
Given $f(x)$



$f(x) - 3$



$f(x + 1)$



$f(x - 2) + 1$

