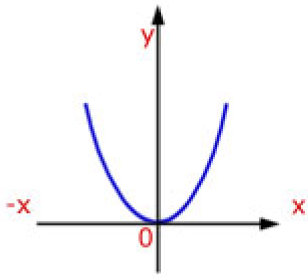
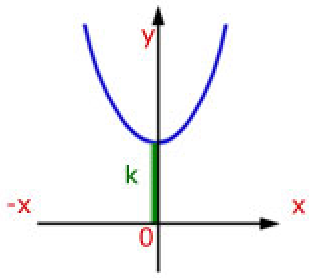
The function....**y= f(x) + k**

$y = x^2$ $y = x^2 + k$



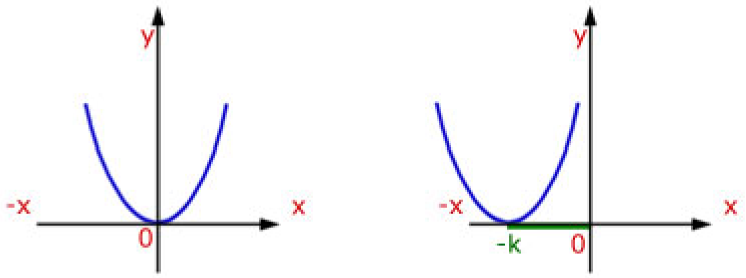


When x = 0, y = k . So the curve is moved(translated) by 'k' in the y-direction.

In vector terms the translation of the curve is $\begin{pmatrix} 0 \\ k \end{pmatrix}$

The function....**y= f(x + k)**

$y = x^2$ $\qquad\qquad$ $y = (x+k)^2$



This is best understood with an example.

Let k be equal to some number, say 3. Adding 3 into the original equation, we have:

$$\begin{aligned} y &= f(x+3) \\ y &= (x+3)^2 \\ y &= (x+3)(x+3) \\ \text{when } y &= 0,\ x = -3 \end{aligned}$$

So the curve moves -3 to the left, to where y=0. That is -k to the left.

In vector terms the translation of the curve is $\begin{pmatrix} -k \\ 0 \end{pmatrix}$

The function....**y = kf(x)**

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

In our example, y increases by a factor of 'k' for every value of x.

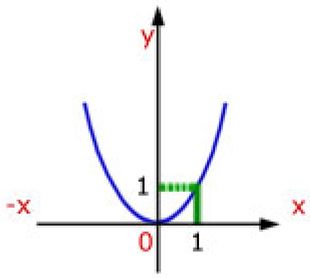
Example - let k=5

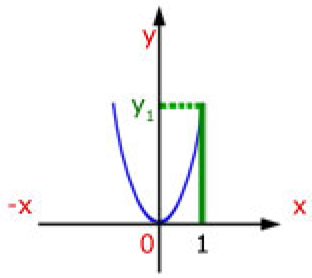
	$y = (x)^2$	$y = 5(x)^2$
$x = 1$	$y = (1)^2 = 1$	$y = 5(1)^2 = 5$
$x = 2$	$y = (2)^2 = 4$	$y = 5(2)^2 = 5(4) = 20$
$x = 3$	$y = (3)^2 = 9$	$y = 5(3)^2 = 5(9) = 45$

So for each value of x, the value of y is 5 times its previous value. The curve is stretched in the y-direction by a factor of 5. That is by a factor of k.

The function....**y= f(kx)**

$y = x^2$ $\qquad\qquad$ $y = (kx)^2$





In the above, when x=1, y=1. However, in the second function when x=1, y is a higher value. Look at the example below for x=1 and other values of x.

Remember, in this function the constant 'k' multiplies the x-value **inside** the function.

Example #1 - let k=4

	$y = (x)^2$	$y = (4x)^2$
$x = 1$	$y = (1)^2 = 1$	$y = (4\times1)^2 = 16$
$x = 2$	$y = (2)^2 = 4$	$y = (4\times2)^2 = 64$
$x = 3$	$y = (3)^2 = 9$	$y = (4\times3)^2 = 144$

You will notice that the y-value jumps by a factor of 16 for each increasing x-value. The y-value increases by a factor of 4 squared.

With more complicated functions the value of y for a given value of x, increases once more, narrowing the curve in the x-direction(or stretching in the y-direction).

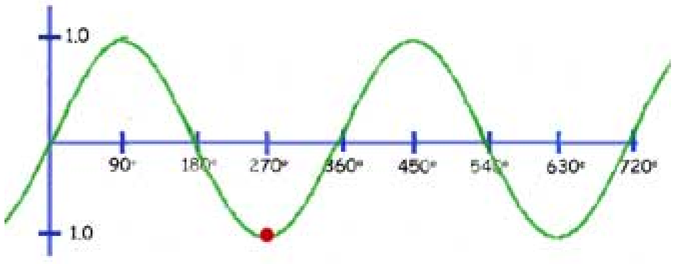
Example #2 a more complicated function with k=4

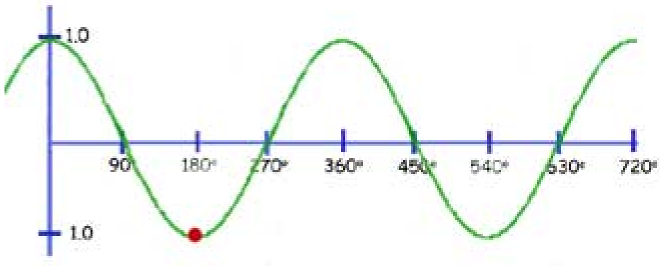
	$y = (x)^2 - 2(x) + 3$	$y = (4x)^2 - 2(4x) + 3$
	$y = x^2 - 2x + 3$	$y = 16x^2 - 8x + 3$
$x = 1$	$y = 1 - 2 + 3$	$y = 16(1) - 8(1) + 3$
$x = 1$	$y = 2$	$y = 16 - 8 + 3$
$x = 1$	$y = 2$	$y = 11$

The function....**y= sin(x+k)**

Here the graph is translated by the value of k, to the **left**
So when k=90 deg. The curve moves horizontally 90 deg. (looking at the red dot, from 270 deg. to 180 deg.)

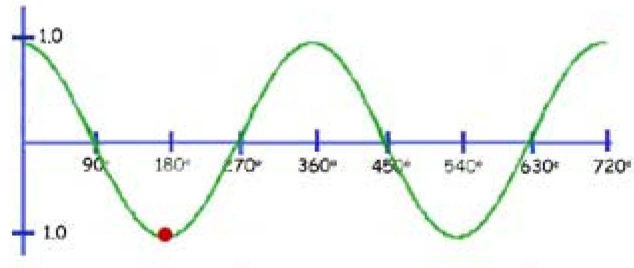
$y = \sin(x)$

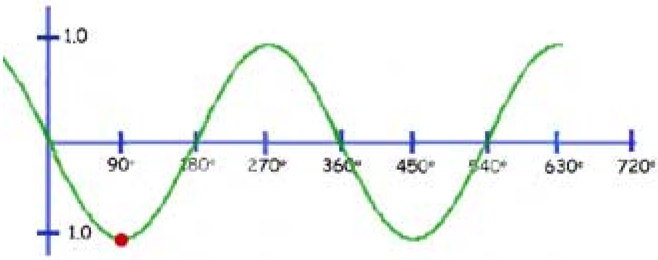




The function....**y= cos(x+k)**

This is exactly the same as for the sine function.
The graph is translated by the value of k, to the **left**
So when k=90 deg. The curve moves horizontally 90 deg. (looking at the red dot, from 180 deg. to 90 deg.)





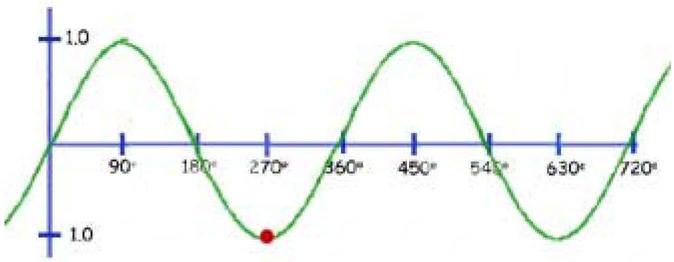
The function....**y= sin(kx)**

Here the graph is squeezed horizontally(concertinered) by a factor of k.

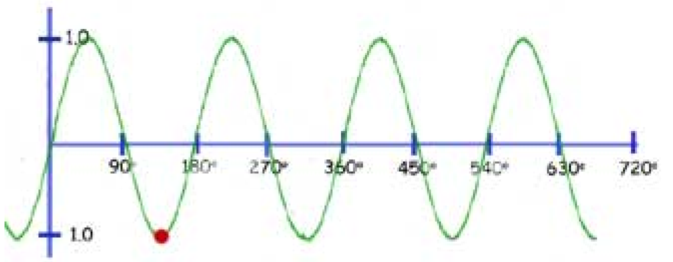
In our example below, k = 2. So one whole wavelength of 360 deg. is reduced to 180 deg.

Conversely you may think of any value of x being halved(red spot reading changes from 270 deg. to 135 deg)

$$y = \sin(x)$$



$$y = \sin(2x)$$



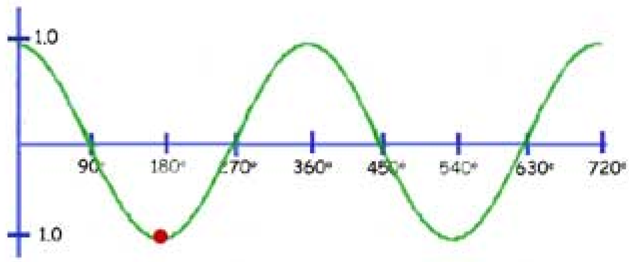
<u>The function</u>....**y= cos(kx)**

As with the previous function, the graph is squeezed horizontally(concertinered) by a factor of k.

In our example below, k = 2. So one whole wavelength of 360 deg. is reduced to 180 deg.

Conversely you may think of any value of x being halved(red spot reading changes from 180 deg. to 90 deg).

$$y = \cos(x)$$



$$y = \cos(2x)$$