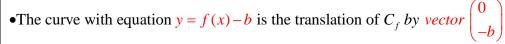
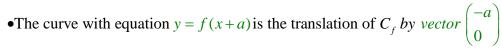
## Transformations of graphs

## Translations of graphs

A curve  $C_f$  has equation y = f(x).

"a"is a positive number.







• The curve with equation y + b = f(x + a) is the translation of  $C_f$  by vector  $\begin{pmatrix} -a \\ -b \end{pmatrix}$ 

*Examples*: The curve with equation  $y = (x-3)^2 + 2$  is the translation of the curve  $y = x^2$  by  $vector \begin{pmatrix} 3 \\ 2 \end{pmatrix}$ .

The circle  $(x-3)^2 + (y+1)^2 = 9$  is the translation of the circle  $x^2 + y^2 = 9$  by the vector  $\begin{pmatrix} 3 \\ -1 \end{pmatrix}$ .



## Parabolas

All parabolas of the form  $y = x^2 + bx + c$  are the image of the parabola  $y = x^2$ 

To work out the vector of this translation, use the completed square form:

$$y = x^{2} + bx + c = (x + p)^{2} + q$$

The vector of the translation is  $\begin{pmatrix} -p \\ q \end{pmatrix}$ .

*Note*: This vector is the vector  $\overrightarrow{OV}$ , where V(-p,q) is the vertex of the parabola.

