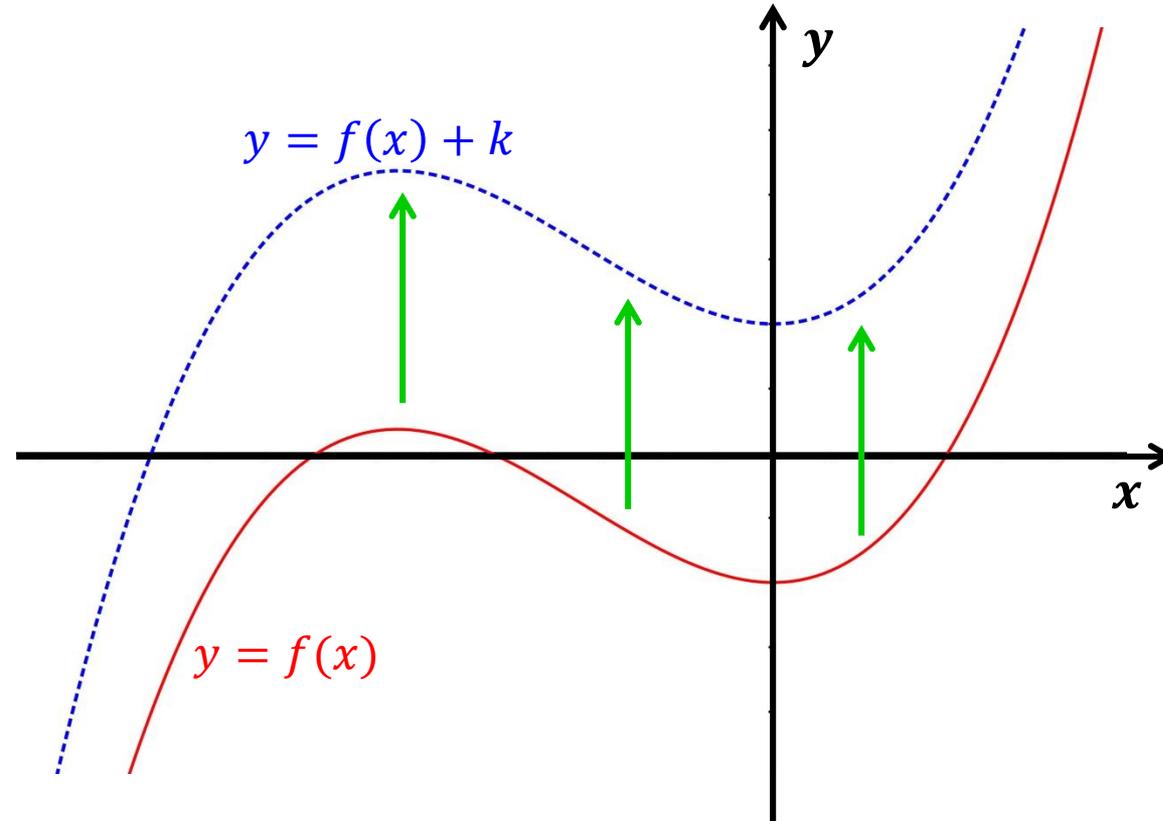


# Transforming graphs

## A. Translation of graphs



$$y = f(x)$$

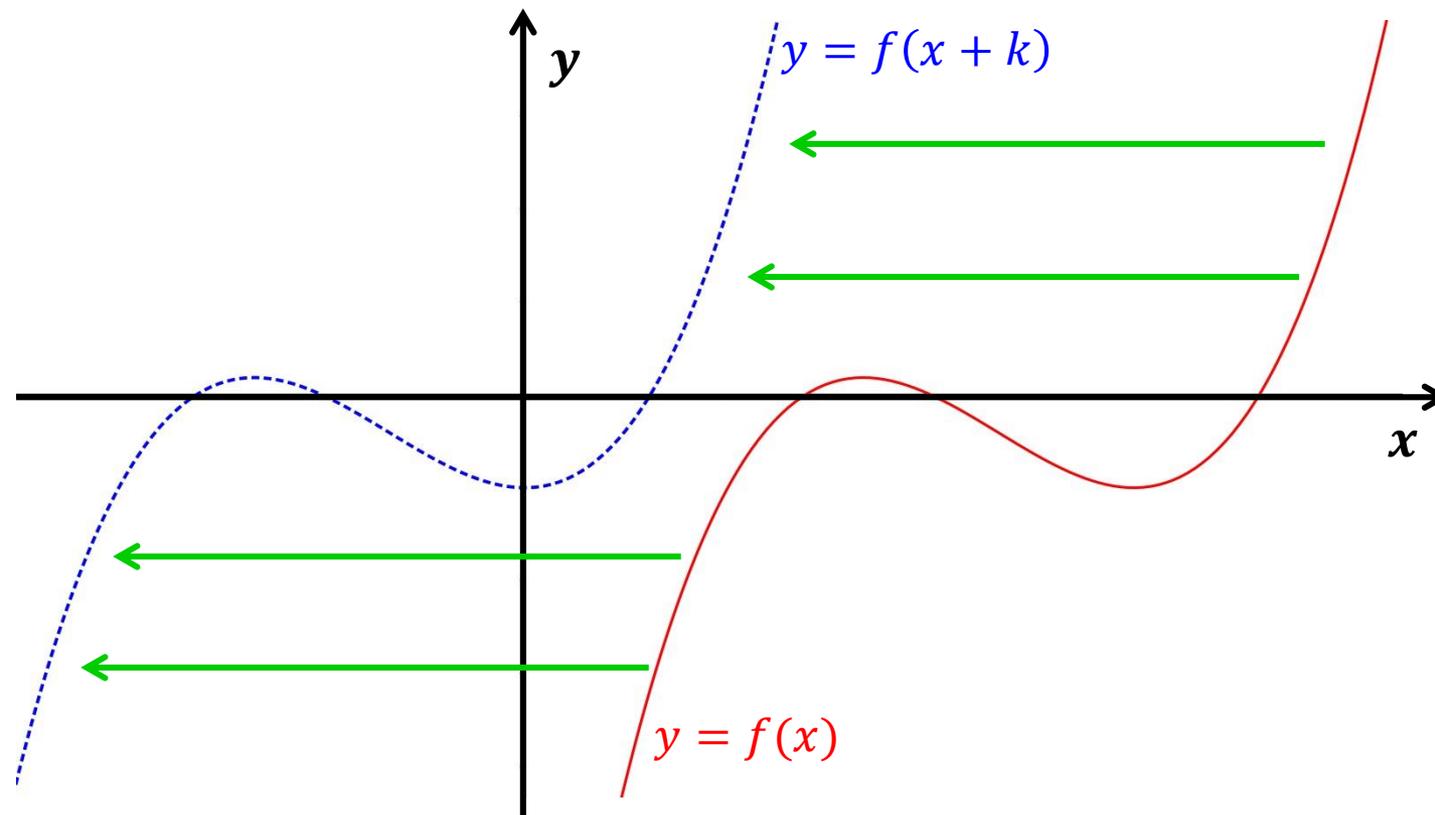
$$y = f(x) + k$$

### Description of transformation:

Translation parallel to the  $y$ -axis by positive  $k$  units (up).  $y = f(x) + k$

Translation parallel to the  $y$ -axis by negative  $k$  units (down).  $y = f(x) - k$

## A. Translation of graphs

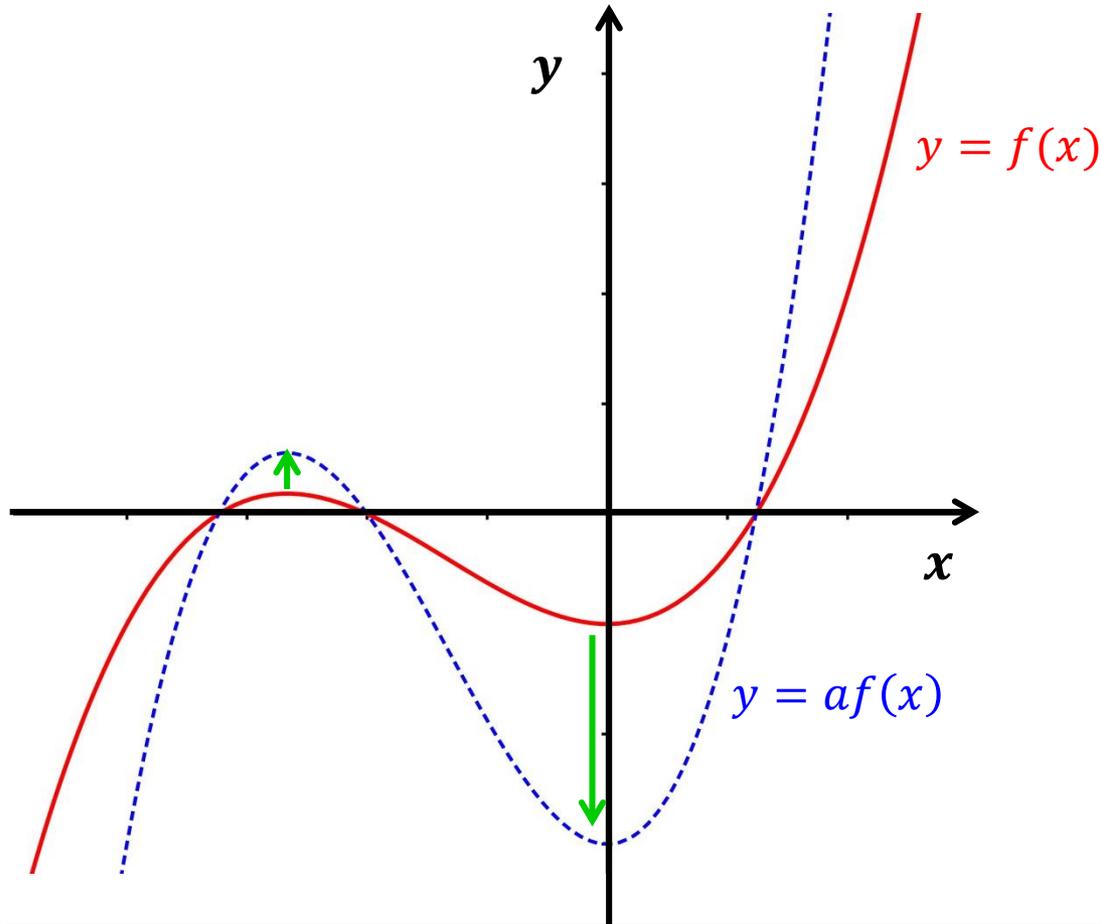


### Description of transformation:

Translation parallel to the  $x$ -axis by positive  $k$  units (left).  $y = f(x + k)$

Translation parallel to the  $x$ -axis by negative  $k$  units (right).  $y = f(x - k)$

## B. Stretching graphs



**Note:** The points of intersection with the  $x$  – *axis* remain the same!!!  
Only the  $y$ -coordinate is affected

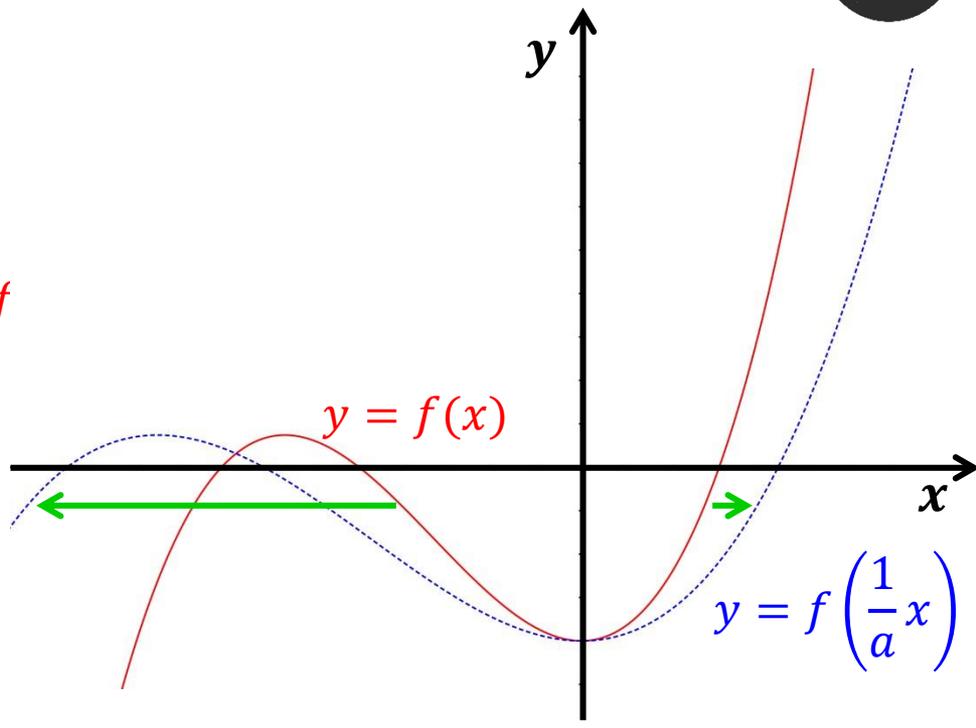
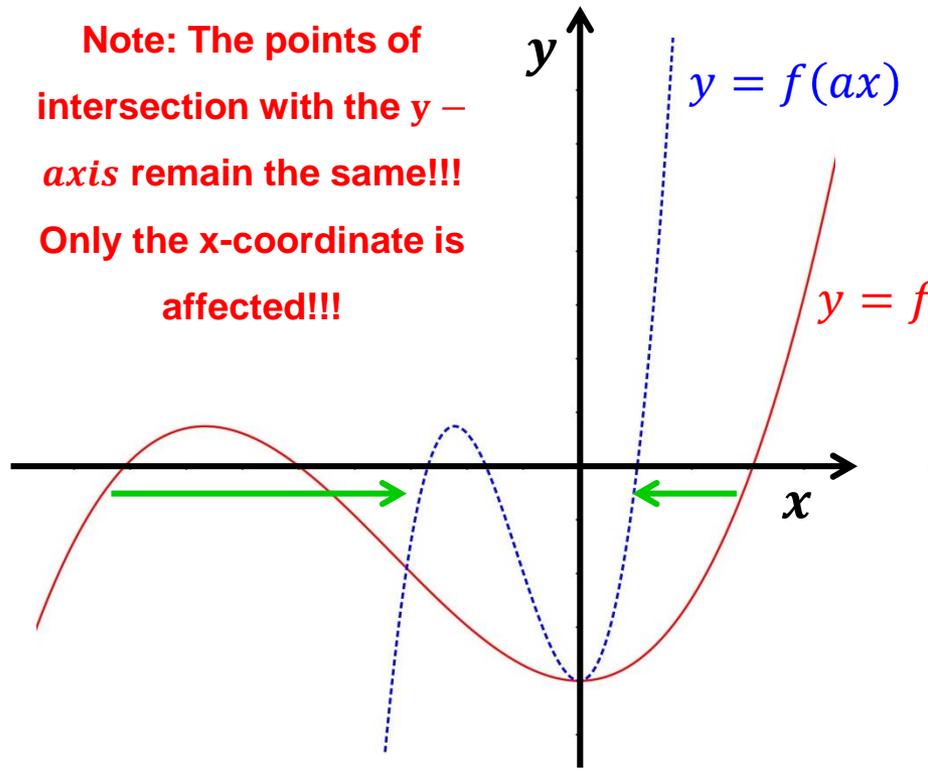
### Description of transformation:

Stretch parallel to the  $y$  -axis by a factor of  $a$  units.  $y = af(x)$

Stretch parallel to the  $y$ -axis by a factor of  $\frac{1}{a}$  units.  $y = \frac{1}{a}f(x)$

# B. Stretching graphs

**Note: The points of intersection with the y – axis remain the same!!!**  
**Only the x-coordinate is affected!!!**

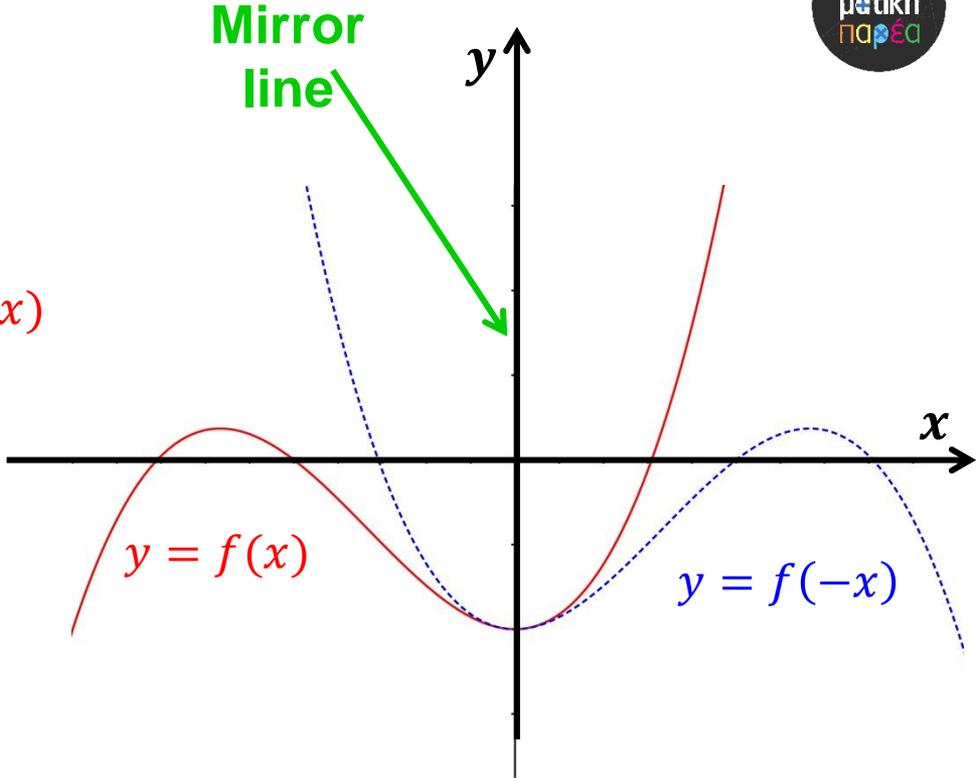
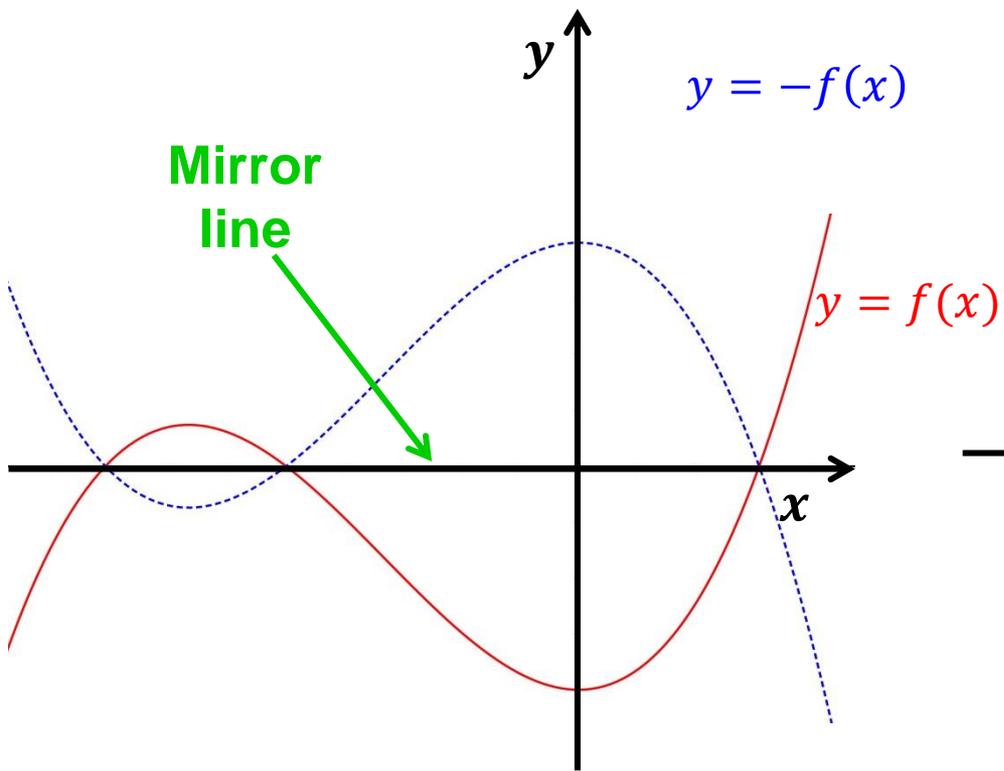


**Description of transformation:**

Stretch parallel to the  $x$ -axis by a factor of  $a$  units.  $y = f(ax)$

Stretch parallel to the  $x$ -axis by a factor of  $\frac{1}{a}$  units.  $y = f\left(\frac{1}{a}x\right)$

# B. Reflecting graphs



**Description of transformation:**  
Reflection in the  $x$ -axis.  $y = -f(x)$   
Reflection in  $y$ -axis.  $y = f(-x)$

## Exercises:

1. Sketch the following graphs on the same set of axis. Describe the transformation that has taken place in each case.

i)  $y = x$  and  $y = 2x$

ii)  $y = x$  and  $y = -x$

iii)  $y = x^2$  and  $-y = x^2$

iv)  $y = x^2$  and  $y = (-x)^2$

v)  $y = \sqrt{x}$  and  $y = 2\sqrt{x}$

vi)  $y = \sqrt{x}$  ,  $y = \sqrt{2x}$  and  $y = \sqrt{\frac{1}{2}x}$

vii)  $y = \frac{1}{x^2}$  and  $y = -\frac{1}{2x^2}$

2. a) Show that the point  $(16,4)$  lies on the curve  $y = \sqrt{x}$

b) The point  $(16,4)$  is transformed by a stretch of factor  $\frac{1}{2}$  parallel to the x-direction.

What will the coordinates of this point be after this translation?

c) What is the equation of the new graph?

3. The diagram shows the graph of  $y = f(x)$  for  $-2 \leq x \leq 1$ . Outside this interval,  $y = f(x)$  is zero.

i)  $y = f(x + 1)$

ii)  $y = -f(3x)$

