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# P1 Chapter 4: Transforming Graphs

## Scaling Graphs

# Stretching Graphs

Sketch  $y = x^2(x - 4)$ . On the same axes,  
sketch the graph with equation

$$y = (2x)^2(2x - 4)$$

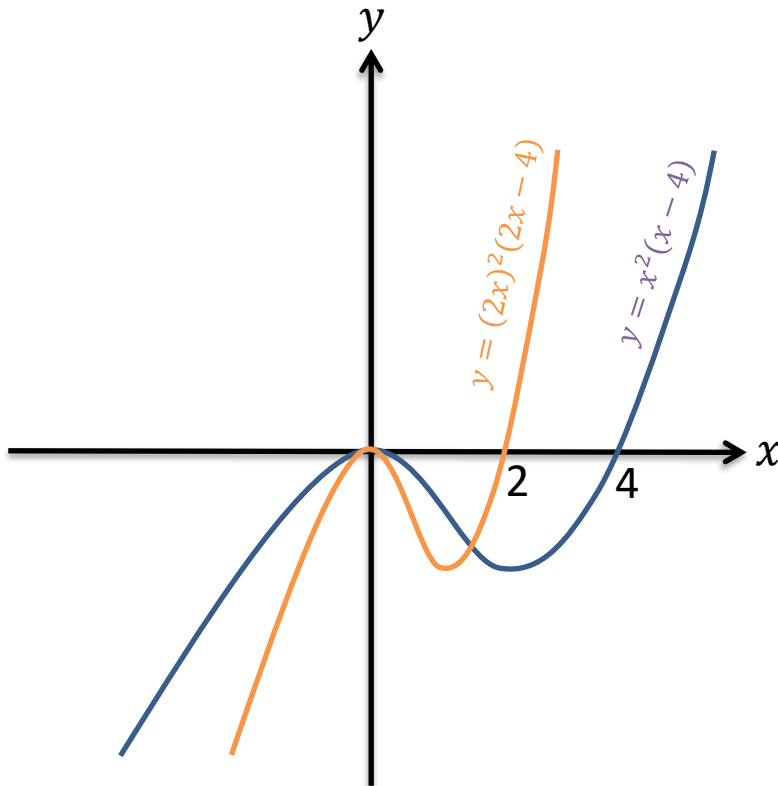
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# Stretching Graphs

Sketch  $y = x^2(x - 4)$ . On the same axes, sketch the graph with equation  $y = (2x)^2(2x - 4)$

The **input**  $x$  has been doubled to  $2x$ , again a change inside the function, so we do the opposite and halve the  $x$  values.

Ensure that 0 remains 0 and you halve any roots.



# Reflections of Graphs

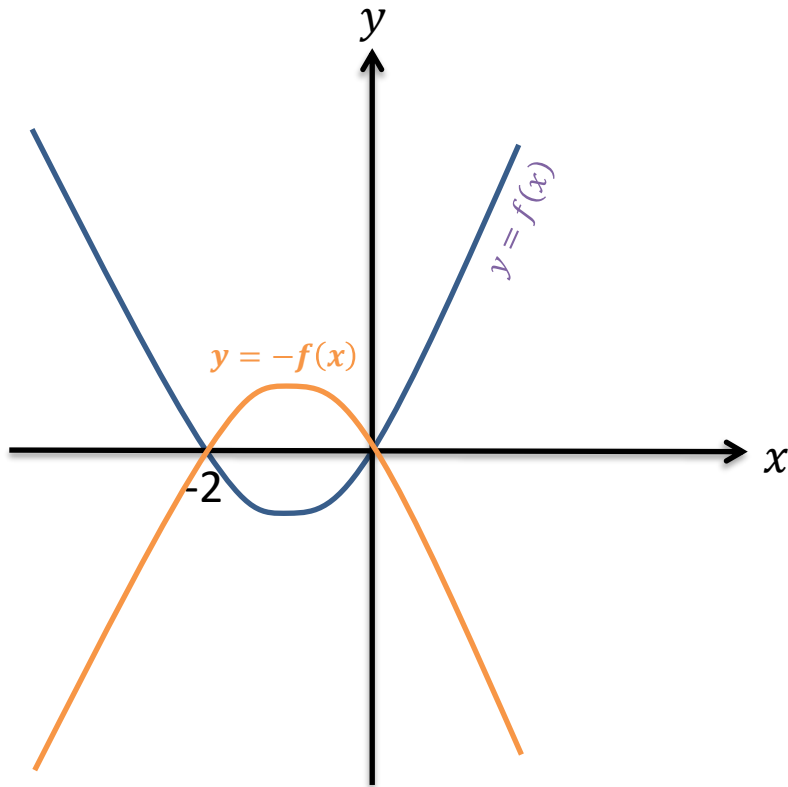
If  $y = x(x + 2)$ , sketch  $y = f(x)$  and  $y = -f(x)$  on the same axes.

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# Reflections of Graphs

If  $y = x(x + 2)$ , sketch  $y = f(x)$  and  $y = -f(x)$  on the same axes.

You did this at GCSE. The minus is outside the function, so affects the output, i.e. the  $y$  value. The  $y$  values are negated, resulting in a reflection in the  $x$ -axis.



# Test Your Understanding

If  $y = (x + 1)(x - 2)$ , sketch  $y = f(x)$  and  $y = f\left(\frac{x}{3}\right)$  on the same axes.

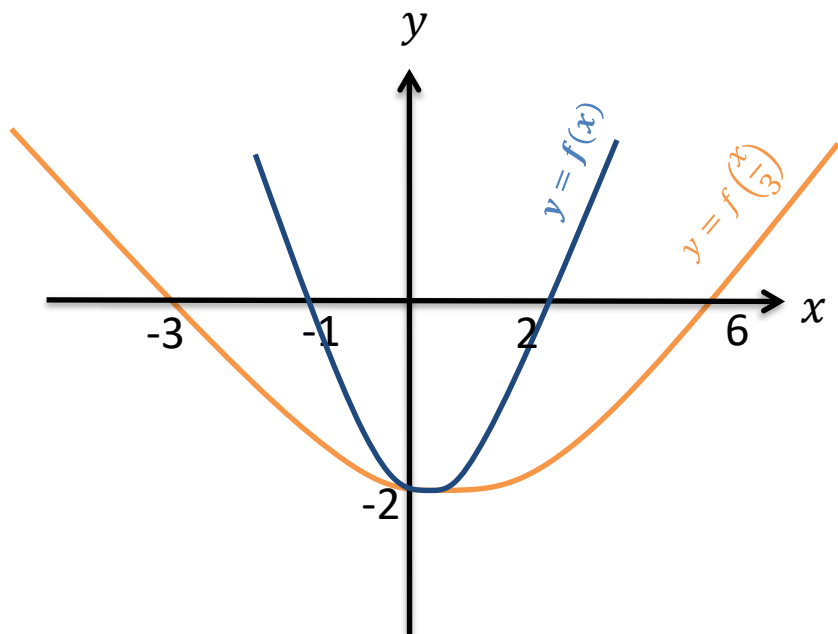
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Sketch the graph of  $y = \frac{2}{x} + 1$ , ensuring you indicate any intercepts with the axes.

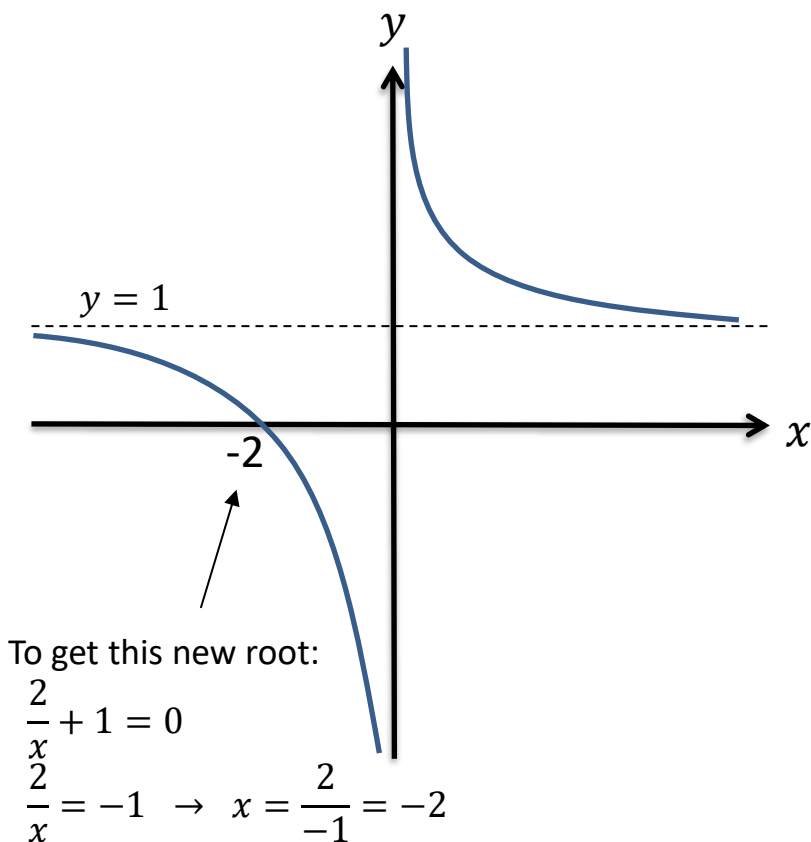
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# Test Your Understanding

If  $y = (x + 1)(x - 2)$ , sketch  $y = f(x)$  and  $y = f\left(\frac{x}{3}\right)$  on the same axes.



Sketch the graph of  $y = \frac{2}{x} + 1$ , ensuring you indicate any intercepts with the axes.



# Exercise 4.6

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# Homework Exercise

1 Apply the following transformations to the curves with equations  $y = f(x)$  where:

i  $f(x) = x^2$       ii  $f(x) = x^3$       iii  $f(x) = \frac{1}{x}$

In each case show both  $f(x)$  and the transformation on the same diagram.

a  $f(2x)$       b  $f(-x)$       c  $f(\frac{1}{2}x)$       d  $f(4x)$       e  $f(\frac{1}{4}x)$   
f  $2f(x)$       g  $-f(x)$       h  $4f(x)$       i  $\frac{1}{2}f(x)$       j  $\frac{1}{4}f(x)$

2 a Sketch the curve with equation  $y = f(x)$  where  $f(x) = x^2 - 4$ .

b Sketch the graphs of  $y = f(4x)$ ,  $\frac{1}{3}y = f(x)$ ,  $y = f(-x)$  and  $y = -f(x)$ .

**Hint** For part **b**, rearrange the second equation into the form  $y = 3f(x)$ .

3 a Sketch the curve with equation  $y = f(x)$  where  $f(x) = (x - 2)(x + 2)x$ .

b Sketch the graphs of  $y = f(\frac{1}{2}x)$ ,  $y = f(2x)$  and  $y = -f(x)$ .

4 a Sketch the curve with equation  $y = x^2(x - 3)$ .

b On the same axes, sketch the curves with equations:

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

## Problem-solving

Let  $f(x) = x^2(x - 3)$  and try to write each of the equations in part **b** in terms of  $f(x)$ .

5 a Sketch the curve  $y = x^2 + 3x - 4$ .

b On the same axes, sketch the graph of  $5y = x^2 + 3x - 4$ .

6 a Sketch the graph of  $y = x^2(x - 2)^2$ .

b On the same axes, sketch the graph of  $3y = -x^2(x - 2)^2$ .

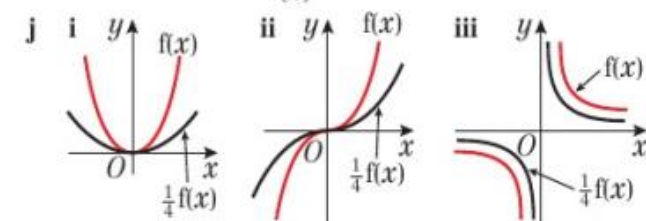
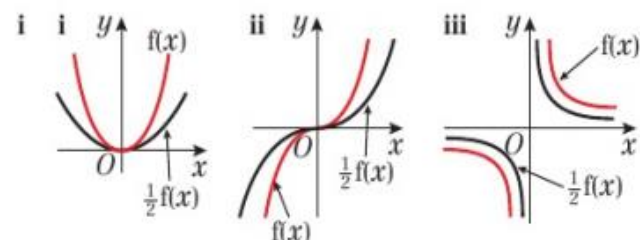
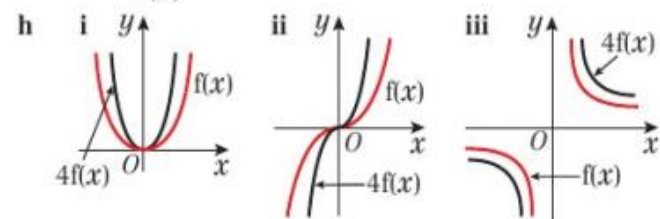
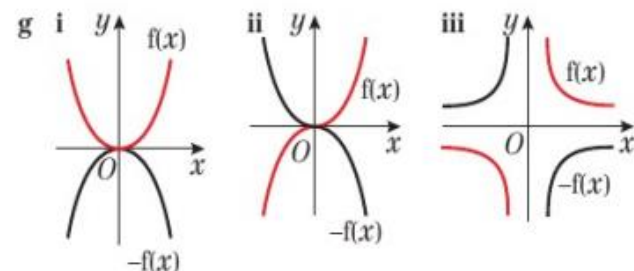
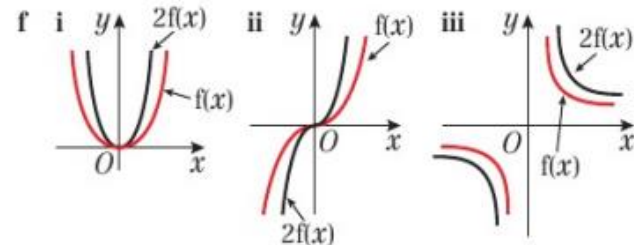
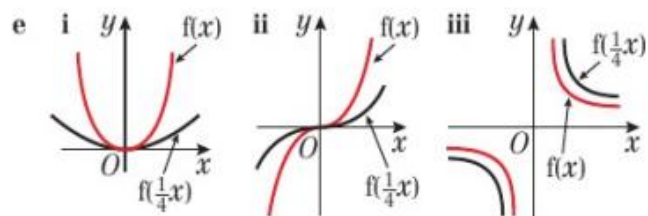
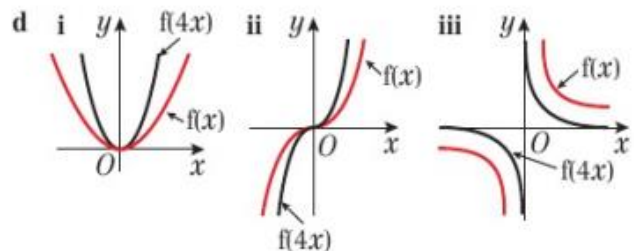
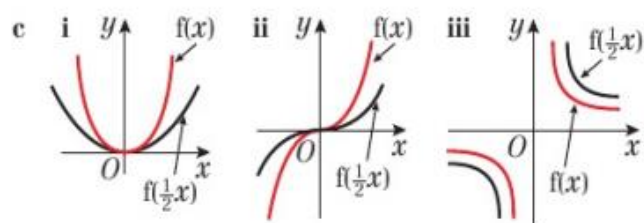
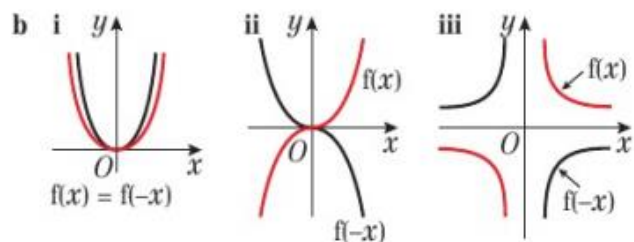
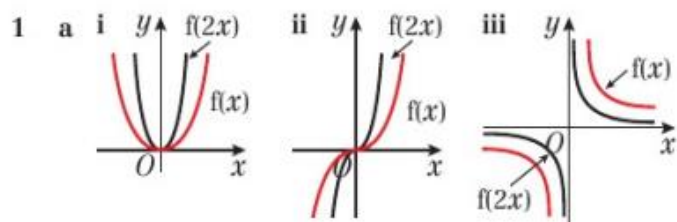
# Homework Exercise

- 7 The point  $P(2, -3)$  lies on the curve with equation  $y = f(x)$ .
- a State the coordinates that point  $P$  is transformed to on the curve with equation  $y = f(2x)$ . (1 mark)
  - b State the coordinates that point  $P$  is transformed to on the curve with equation  $y = 4f(x)$ . (1 mark)
- 8 The point  $Q(-2, 8)$  lies on the curve with equation  $y = f(x)$ .  
State the coordinates that point  $Q$  is transformed to on the curve with equation  $y = f(\frac{1}{2}x)$ . (1 mark)
- 9 a Sketch the graph of  $y = (x - 2)(x - 3)^2$ . (4 marks)
- b The graph of  $y = (ax - 2)(ax - 3)^2$  passes through the point  $(1, 0)$ .  
Find two possible values for  $a$ . (3 marks)

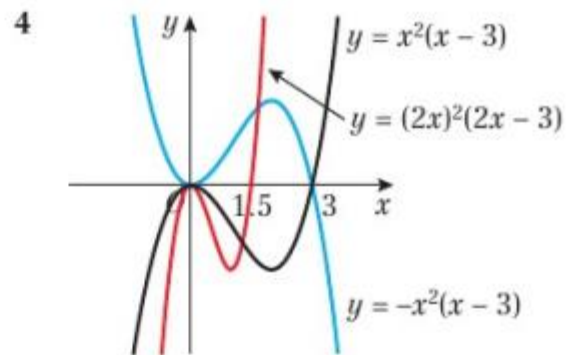
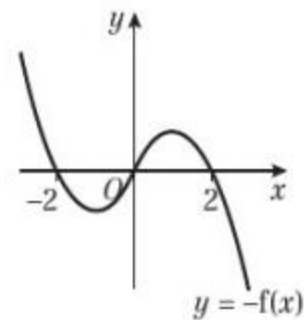
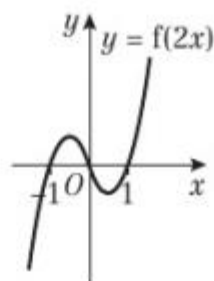
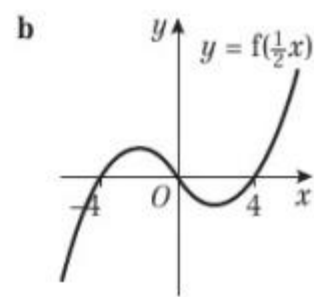
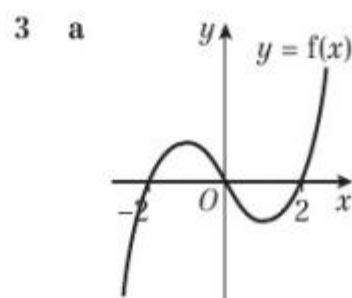
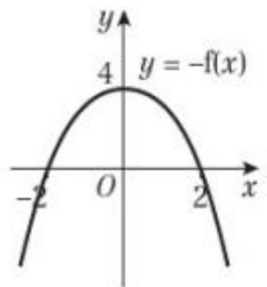
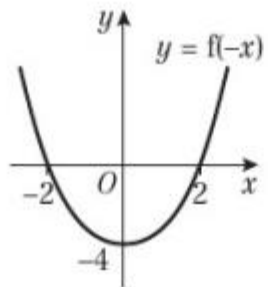
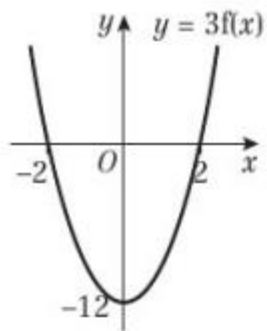
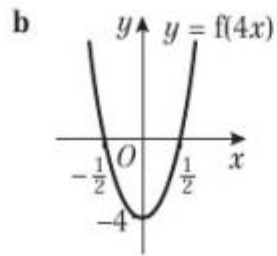
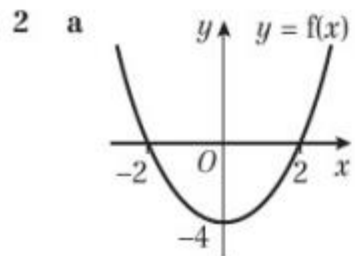
## Challenge

- 1 The point  $R(4, -6)$  lies on the curve with equation  $y = f(x)$ . State the coordinates that point  $R$  is transformed to on the curve with equation  $y = \frac{1}{3}f(2x)$ .
- 2 The point  $S(-4, 7)$  is transformed to a point  $S'(-8, 1.75)$ . Write down the transformation in the form  $y = af(bx)$ .

# Homework Exercise

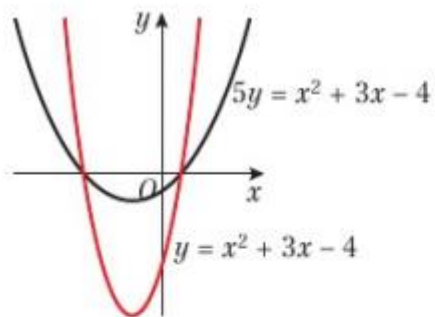


# Homework Answers

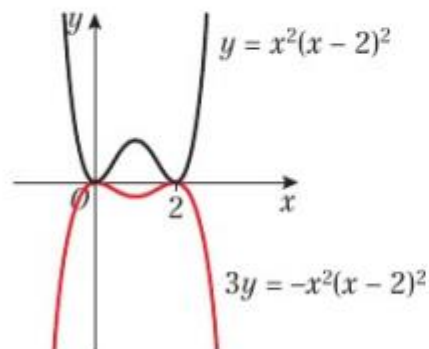


# Homework Answers

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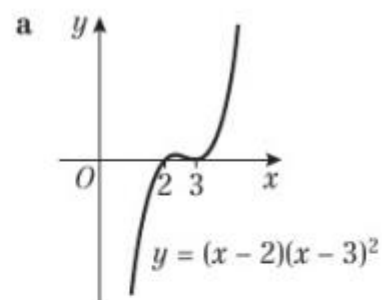


7 a (1, -3)

b (2, -12)

8 (-4, 8)

9



b 2 and 3

Challenge

1 (2, -2)

2  $\frac{1}{4}f(\frac{1}{2}x)$