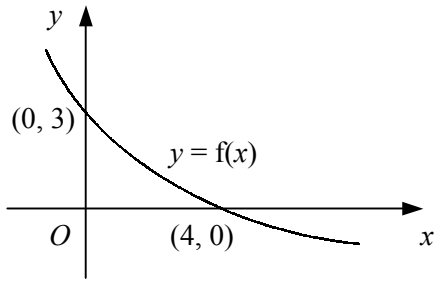
1 Describe how the graph of $y = f(x)$ is transformed to give the graph of

a $y = f(x - 1)$ **b** $y = f(x) - 3$ **c** $y = 2f(x)$ **d** $y = f(4x)$

e $y = -f(x)$ **f** $y = \frac{1}{5} f(x)$ **g** $y = f(-x)$ **h** $y = f(\frac{2}{3}x)$

2



The diagram shows the curve with equation $y = f(x)$ which crosses the coordinate axes at the points (0, 3) and (4, 0).

Showing the coordinates of any points of intersection with the axes, sketch on separate diagrams the graphs of

a $y = 3f(x)$ **b** $y = f(x + 4)$ **c** $y = -f(x)$ **d** $y = f(\frac{1}{2}x)$

3 Find and simplify an equation of the graph obtained when

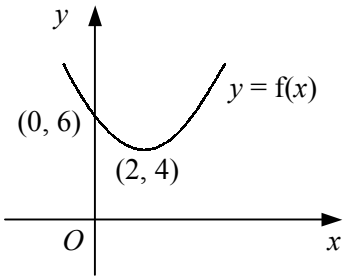
a the graph of $y = 2x + 5$ is translated by 1 unit in the positive y-direction,

b the graph of $y = 1 - 4x$ is stretched by a factor of 3 in the y-direction, about the x-axis,

c the graph of $y = 3x + 1$ is translated by 4 units in the negative x-direction,

d the graph of $y = 4x - 7$ is reflected in the x-axis.

4



The diagram shows the curve with equation $y = f(x)$ which has a turning point at (2, 4) and crosses the y-axis at the point (0, 6).

Showing the coordinates of the turning point and of any points of intersection with the axes, sketch on separate diagrams the graphs of

a $y = f(x) - 3$ **b** $y = f(x + 2)$ **c** $y = f(2x)$ **d** $y = \frac{1}{2} f(x)$

5 Describe a single transformation that would map the graph of $y = x^3$ onto the graph of

a $y = 4x^3$ **b** $y = (x - 2)^3$ **c** $y = -x^3$ **d** $y = x^3 + 5$

6 Describe a single transformation that would map the graph of $y = x^2 + 2$ onto the graph of

a $y = 2x^2 + 4$ **b** $y = x^2 - 5$ **c** $y = \frac{1}{9}x^2 + 2$ **d** $y = x^2 + 4x + 6$

7 Find and simplify an equation of the graph obtained when

a the graph of $y = x^2 + 2x$ is translated by 1 unit in the positive x-direction,

b the graph of $y = x^2 - 4x + 5$ is stretched by a factor of $\frac{1}{3}$ in the x-direction, about the y-axis.

c the graph of $y = x^2 + x - 6$ is reflected in the y-axis,

d the graph of $y = 2x^2 - 3x$ is stretched by a factor of 2 in the x-direction, about the y-axis.

8 $\mathrm{f}(x) \equiv x^2 - 4x$.

a Find the coordinates of the turning point of the graph $y = \mathrm{f}(x)$.

b Sketch each pair of graphs on the same set of axes showing the coordinates of the turning point of each graph.

i $y = \mathrm{f}(x)$ and $y = 3 + \mathrm{f}(x)$ **ii** $y = \mathrm{f}(x)$ and $y = \mathrm{f}(x - 2)$ **iii** $y = \mathrm{f}(x)$ and $y = \mathrm{f}(2x)$

9 Sketch each pair of graphs on the same set of axes.

a $y = x^2$ and $y = (x + 3)^2$ **b** $y = x^3$ and $y = x^3 + 4$

c $y = \frac{1}{x}$ and $y = \frac{1}{x - 2}$ **d** $y = \sqrt{x}$ and $y = \sqrt{2x}$

10 **a** Describe two different transformations, each of which would map the graph of $y = \frac{1}{x}$ onto the graph of $y = \frac{1}{3x}$.

b Describe two different transformations, each of which would map the graph of $y = x^2$ onto the graph of $y = 4x^2$.

11 $\mathrm{f}(x) \equiv (x + 4)(x + 2)(x - 1)$.

Showing the coordinates of any points of intersection with the axes, sketch on separate diagrams the graphs of

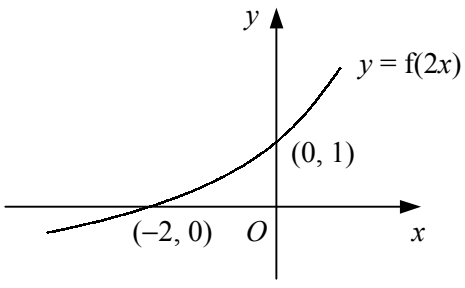
a $y = \mathrm{f}(x)$ **b** $y = \mathrm{f}(x - 4)$ **c** $y = \mathrm{f}(-x)$ **d** $y = \mathrm{f}(2x)$

12 The curve $y = \mathrm{f}(x)$ is a parabola and the coordinates of its turning point are (a, b).

Write down, in terms of a and b, the coordinates of the turning point of the graph

a $y = 3\mathrm{f}(x)$ **b** $y = 4 + \mathrm{f}(x)$ **c** $y = \mathrm{f}(x + 1)$ **d** $y = \mathrm{f}(\frac{1}{3}x)$

13



The diagram shows the curve with equation $y = \mathrm{f}(2x)$ which crosses the coordinate axes at the points $(-2, 0)$ and $(0, 1)$.

Showing the coordinates of any points of intersection with the coordinate axes, sketch on separate diagrams the curves

a $y = 3\mathrm{f}(2x)$ **b** $y = \mathrm{f}(x)$