Topic assessment

Do not use a graphical calculator for this test.

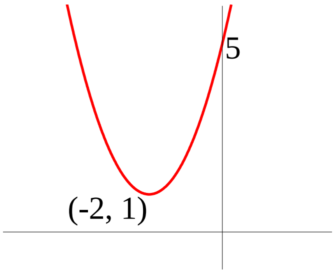
1. Sketch the following graphs on separate diagrams.
   (i) $y = x^3$ [1]
   (ii) $y = (x+1)^3$ [2]
   (iii) $y = x^3 - 2$ [2]

2. (i) Sketch the graph $y = \frac{1}{x}$. [2]
   (ii) Hence sketch the graph of $y = \frac{1}{x+2}$ on a separate diagram. Show the coordinates of any points where the graph cuts the coordinate axes. [3]
   (iii) Write down the equations of the asymptotes of the graph in (ii). [2]

3. (i) Given that $\mathrm{f}(x) = (x-2)(x-1)(x+2)$, sketch the graphs of $y = \mathrm{f}(x)$ and $y = \mathrm{f}(x-1)$ on the same axes. [4]
   (ii) Write down the equation of the graph $y = \mathrm{f}(x-1)$ in factorised form. [1]
   (ii) Use algebra to find the x-coordinates of the points where the graphs intersect. [4]

4. Given that $\mathrm{g}(x) = x^2 - 2x + 4$,
   (i) Find the equation of the curve obtained by translating the curve $y = \mathrm{g}(x)$ horizontally 1 unit to the left. [2]
   (ii) Find the equation of the curve obtained by stretching the curve $y = \mathrm{g}(x)$ parallel to the y-axis with scale factor 2. [2]
   (iii) Find the equation of the curve obtained by reflecting the curve $y = \mathrm{g}(x)$ in the y-axis. [2]

5. The diagram below shows the graph $y = \mathrm{f}(x)$, which has a turning point at (-2, 1) and crosses the y-axis at (0, 5).



Sketch, on separate diagrams, each of the following graphs, showing the coordinates of the turning point and the point at which the graph crosses the
y-axis in each case.

   (i) $y = 3\mathrm{f}(x)$ [3]
   (ii) $y = \mathrm{f}(\frac{1}{2}x)$ [3]
   (iii) $y = \mathrm{f}(x) + 1$ [3]
   (iv) $y = -\mathrm{f}(x)$ [3]

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6. (i) Sketch the graph of $y = \mathrm{f}(x)$, where $\mathrm{f}(x) = (x+1)^2(2-x)$.
Show the coordinates of the points where the graph cuts the coordinate axes. [3]
(ii) Hence sketch the graph of $y = \mathrm{f}(2x)$, on a separate diagram, showing the coordinates of the points where the graph cuts the coordinate axes. [3]
(iii) Find the equation of the graph $y = \mathrm{f}(2x)$ in the form
$y = Ax^3 + Bx^2 + Cx + D$. [3]

7. Sketch the following graphs for $-360° \le x \le 360°$.
(i) $y = \cos \tfrac{1}{2} x$ [3]
(ii) $y = -3\cos x$ [3]
(iii) $y = \tan(-x)$ [3]
(iv) $y = \sin(x + 30°)$ [3]

Total 60 marks

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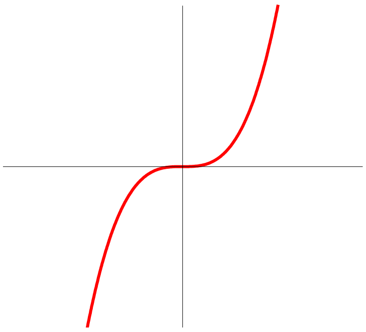
Solutions to topic assessment

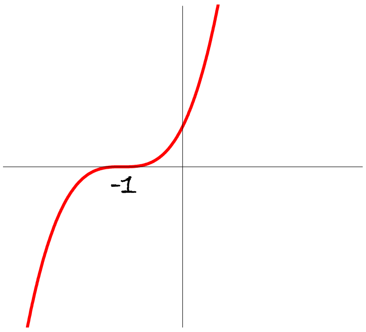
1. (i) $y = x^3$



[1]

(ii) $y = (x + 1)^3$

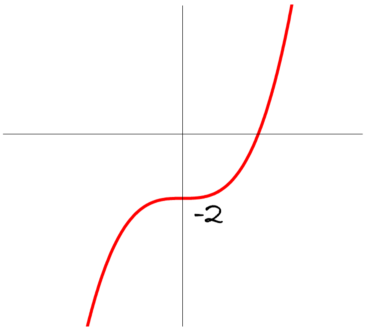
The graph of $y = x^3$ is translated 1 unit to the left.



[2]

(iii) $y = x^3 - 2$

The graph of $y = x^3$ is translated 2 units downwards.



[2]

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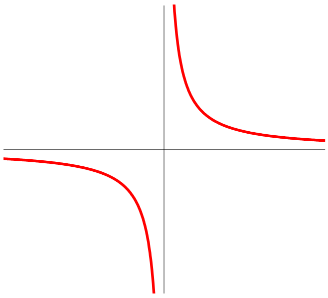
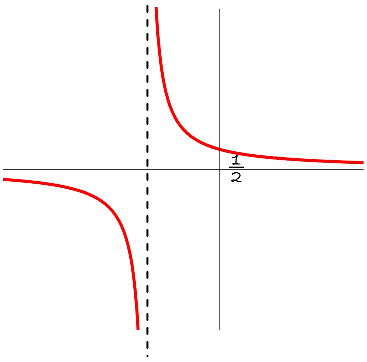
2. (i) $y = \frac{1}{x}$



(ii) To obtain $y = \frac{1}{x+2}$, the graph of $y = \frac{1}{x}$ is translated 2 units to the left.

When $x = 0$, $y = \frac{1}{2}$.



[3]

(iii) The asymptotes are $x = -2$ and $y = 0$.

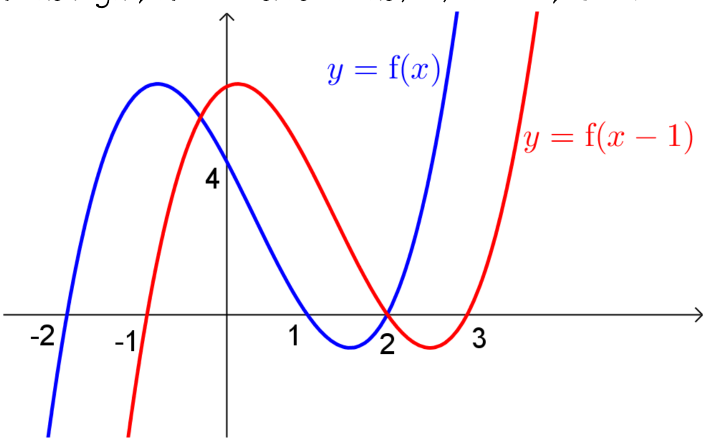
[2]

3. (i) $y = (x-2)(x-1)(x+2)$

When $x = 0$, $y = 4$

When $y = 0$, $x = -2, 1$ or 2

$y = f(x-1)$ is a translation of the above graph horizontally through 1 unit to the right, so it intersects the x-axis at -1, 2 and 3.



[4]

(ii) $y = f(x-1)$
$= (x-1-2)(x-1-1)(x-1+2)$
$= (x-3)(x-2)(x+1)$

[1]

(iii) At intersections, $(x-2)(x-1)(x+2) = (x-3)(x-2)(x+1)$

$$(x-2)(x-1)(x+2) - (x-3)(x-2)(x+1) = 0$$
$$(x-2)[(x-1)(x+2) - (x-3)(x+1)] = 0$$
$$(x-2)\left[(x^2 + x - 2 - (x^2 - 2x - 3)\right] = 0$$
$$(x-2)(3x+1) = 0$$
$$x = 2 \text{ or } -\tfrac{1}{3}$$

[4]

4. (i) $y = g(x+1)$
$= (x+1)^2 - 2(x+1) + 4$
$= x^2 + 2x + 1 - 2x - 2 + 4$
$= x^2 + 3$

[2]

(ii) $y = 2g(x)$
$= 2(x^2 - 2x + 4)$
$= 2x^2 - 4x + 8$

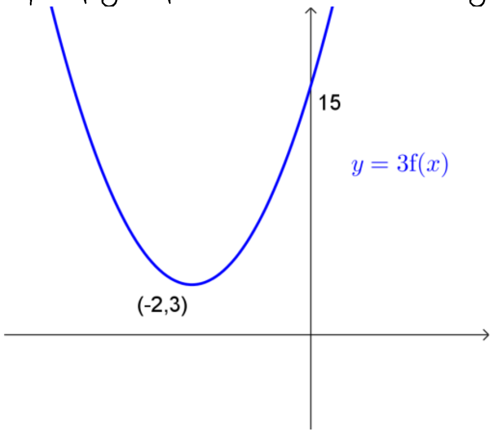
[2]

(iii) $y = g(-x)$
$= (-x)^2 - 2(-x) + 4$
$= x^2 + 2x + 4$

[2]

5. (i) $y = 3f(x)$

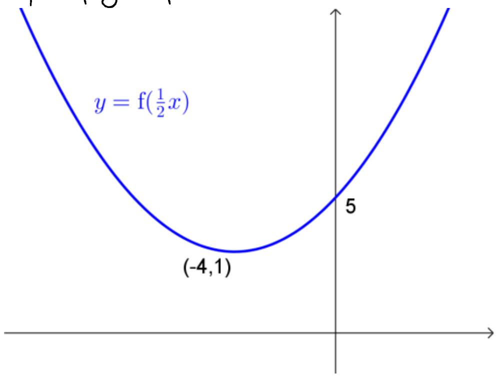
The graph of y = f(x) is stretched in the y direction, scale factor 3.



[3]

(ii) $y = f(\frac{1}{2}x)$

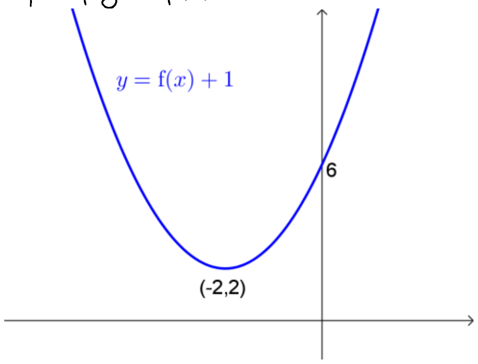
The graph of $y = f(x)$ is stretched in the x direction, scale factor 2.



[3]

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

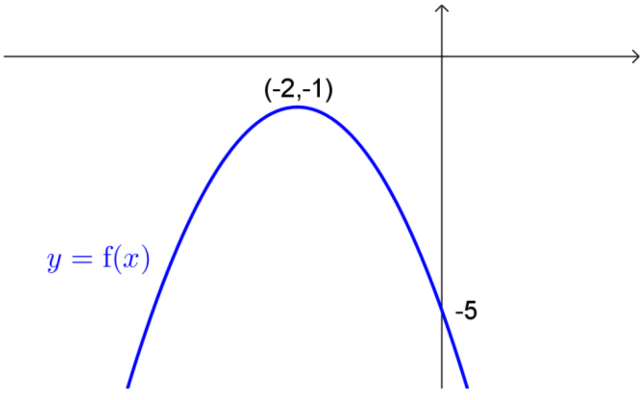
The graph of $y = f(x)$ is translated 1 unit upwards.



[3]

(iv) $y = -f(x)$

The graph of $y = f(x)$ is reflected in the y-axis.



[3]

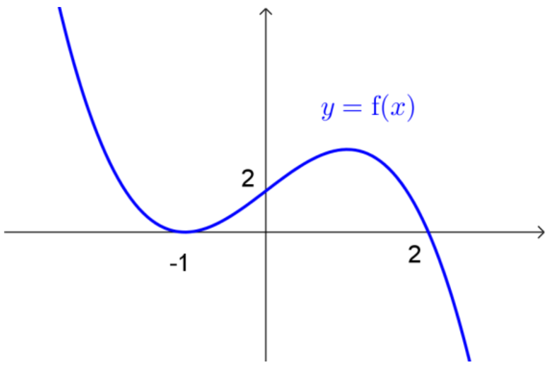
6. (i) $y = (x+1)^2(2-x)$

When $x = 0$, $y = 2$

When $y = 0$, $x = -1$ (repeated) or 2.

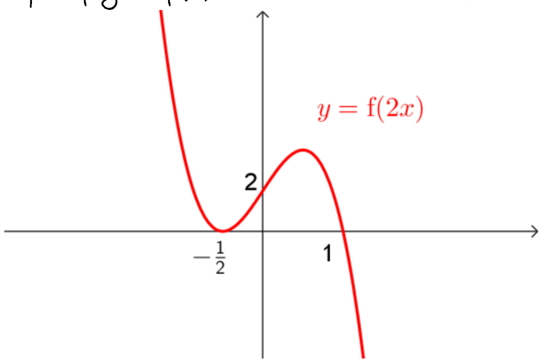
When x is large and positive, y is large and negative.

When x is large and negative, y is large and positive.



[3]

(ii) The graph of $y = f(x)$ is stretched in the x direction, scale factor $\frac{1}{2}$.



[3]

(iii) $y = (2x+1)^2(2-2x)$

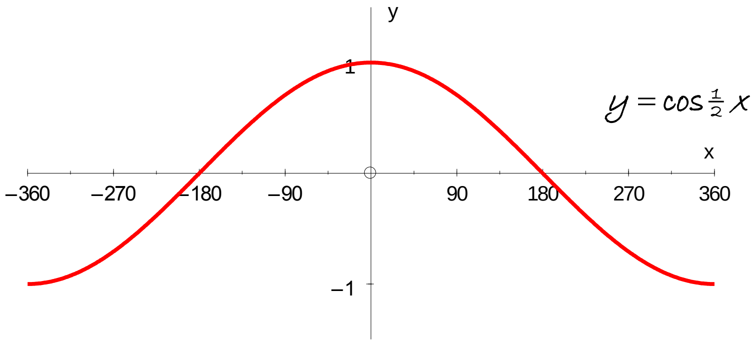
$= (4x^2+4x+1)(2-2x)$

$= 8x^2+8x+2-8x^3-8x^2-2x$

$= -8x^3+6x+2$

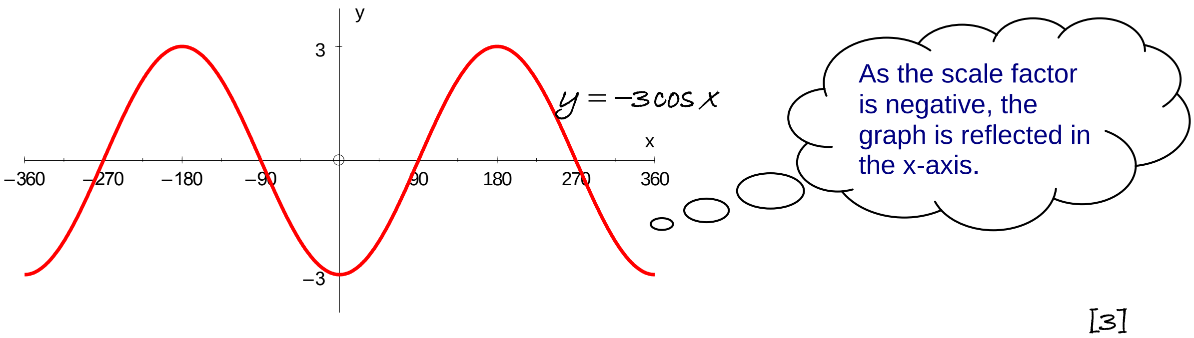
[3]

7. (i) The graph of $y = \cos x$ is stretched, scale factor 2, parallel to the x axis.



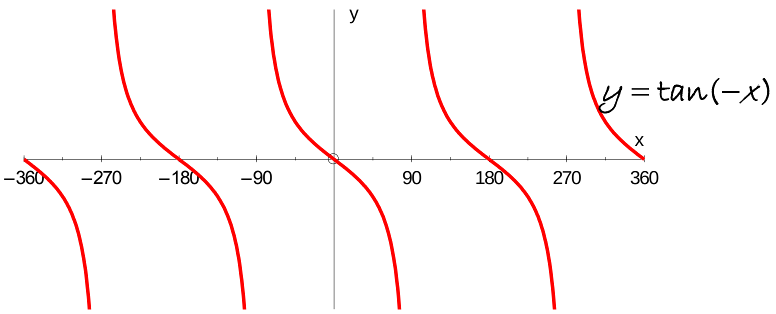
[3]

(ii) The graph of $y = \cos x$ is stretched, scale factor -3, parallel to the y-axis.



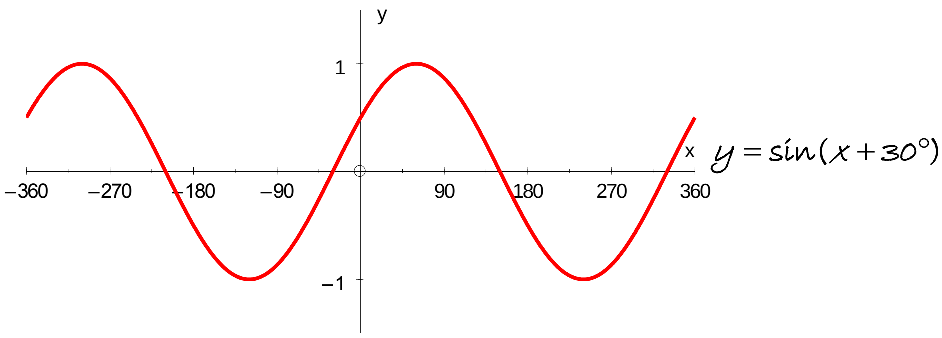
[3]

(iii) The graph of $y = \tan x$ is reflected in the y-axis.



[2]

(iv) The graph of $y = \sin x$ is translated through 30° to the left.



[3]