

1.

Figure 1

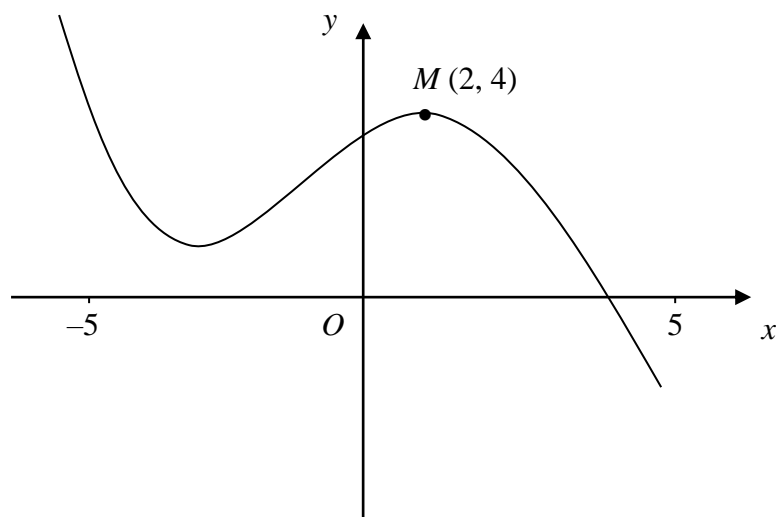


Figure 1 shows the graph of $y = f(x)$, $-5 \leq x \leq 5$.

The point $M(2, 4)$ is the maximum turning point of the graph.

Sketch, on separate diagrams, the graphs of

(a) $y = f(x) + 3$, (2)

(b) $y = |f(x)|$, (2)

(c) $y = f(|x|)$. (3)

Show on each graph the coordinates of any maximum turning points.

2. Express

$$\frac{2x^2 + 3x}{(2x + 3)(x - 2)} - \frac{6}{x^2 - x - 2}$$

as a single fraction in its simplest form.

(7)

3. The functions f and g are defined by

$$f: x \mapsto 2x + \ln 2, \quad x \in \mathbb{R},$$

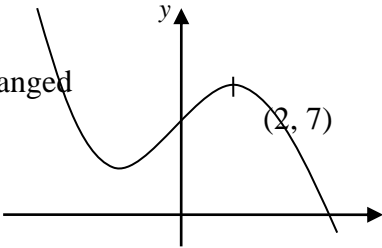
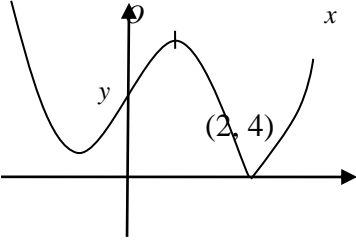
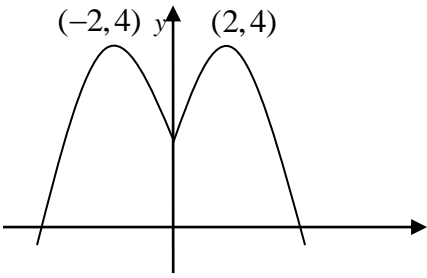
$$g: x \mapsto e^{2x}, \quad x \in \mathbb{R}.$$

(a) Prove that the composite function gf is

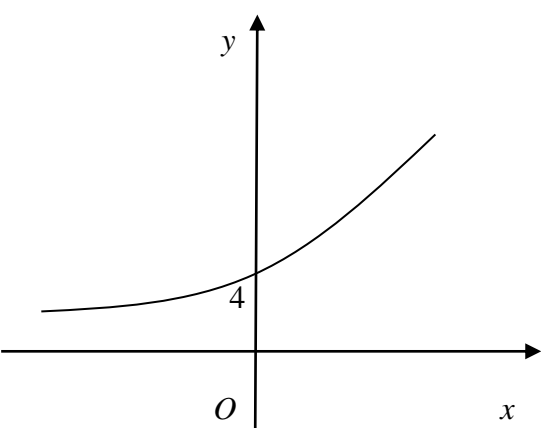
$$gf: x \mapsto 4e^{4x}, \quad x \in \mathbb{R}. \quad (4)$$

(b) Sketch the curve with equation $y = gf(x)$, and show the coordinates of the point where the curve cuts the y -axis. (1)

(c) Write down the range of gf . (1)

Question Number	Scheme	Marks
<p>1.</p>	<p>(a)</p> <p>Shape unchanged</p> <p>Point</p> 	<p>B1</p> <p>B1 (2)</p>
	<p>(b)</p> <p>Shape</p> <p>Point</p>  <p style="text-align: center;"><i>O</i> <i>x</i></p>	<p>B1</p> <p>B1 (2)</p>
	<p>(c)</p> <p>Shape</p> <p>(2, 4)</p> <p>(-2, 4)</p>  <p style="text-align: center;"><i>O</i> <i>x</i></p>	<p>B1</p> <p>B1</p> <p>B1 (3)</p> <p>[7]</p>

Question Number	Scheme	Marks
2.	<p style="text-align: center;">$x^2 - x - 2 = (x-2)(x+1)$</p> <p>At any stage</p> $\frac{2x^2 + 3x}{(2x+3)(x-2)} = \frac{x(2x+3)}{(2x+3)(x-2)} = \frac{x}{x-2}$ $\frac{2x^2 + 3x}{(2x+3)(x-2)} - \frac{6}{x^2 - x - 2} = \frac{x(x+1) - 6}{(x-2)(x+1)}$ $= \frac{x^2 + x - 6}{(x-2)(x+1)}$ $= \frac{(x+3)(x-2)}{(x-2)(x+1)}$ $= \frac{x+3}{x+1}$	<p>B1</p> <p>B1</p> <p>M1</p> <p>A1</p> <p>M1 A1</p> <p>A1 (7)</p>

Question Number	Scheme	Marks
3.	<p>(a)</p> $\begin{aligned} \text{gf}(x) &= e^{2(2x+\ln 2)} \\ &= e^{4x} e^{2\ln 2} \\ &= e^{4x} e^{\ln 4} \\ &= 4e^{4x} \end{aligned}$ <p style="text-align: right;">Give mark</p> <p>at this point, cso</p> <p style="text-align: center;">(Hence $\text{gf} : x \mapsto 4e^{4x}, x \in \mathbb{R}$)</p> <p>(b)</p> <p>Shape and point</p>  <p>(c) Range is \mathbb{R}_+</p> <p>$\text{gf}(x) > 0, y > 0$</p> <p style="text-align: right;">Accept</p>	<p>M1</p> <p>M1</p> <p>M1</p> <p>A1 (4)</p> <p>B1 (1)</p> <p>B1 (1)</p>

