1 $\frac{3x-1}{(1-2x)^2} \equiv \frac{A}{1-2x} + \frac{B}{(1-2x)^2}, |x| < \frac{1}{2}$

a Find the values of A and B. **(3)**

b Hence, or otherwise, expand $\frac{3x-1}{(1-2x)^2}$ in ascending powers of x, as far as the term in x^3. Give each coefficient as a simplified fraction. **(6)**

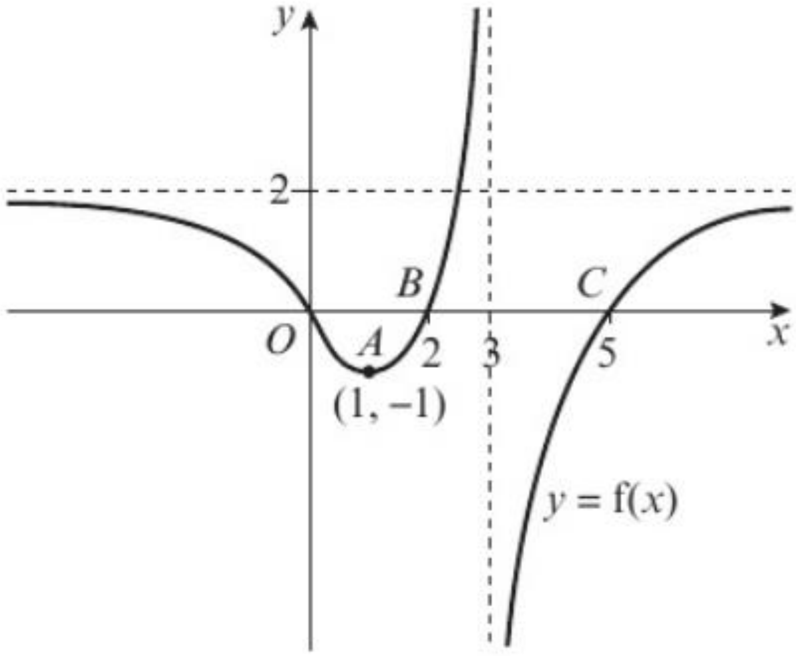
2 The second term of a geometric sequence is 256. The eighth term of the same sequence is 900. The common ratio is r, $r > 0$.

a Show that r satisfies the equation

$6 \ln r + \ln\left(\frac{64}{225}\right) = 0$ **(3)**

b Find the value of r correct to 3 significant figures. **(3)**

3



The diagram shows a sketch of the graph of $y = f(x)$.

The curve has a minimum at the point $A(1, -1)$, passes through x-axis at the origin, and the points $B(2, 0)$ and $C(5, 0)$; the asymptotes have equations $x = 3$ and $y = 2$.

a Sketch, on separate axes, the graphs of:

i $y = |f(x)|$ **(2)**

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

iii $y = f(-2x)$ **(2)**

b State the number of solutions to each equation.

i $3|f(x)| = 2$ **(2)**

ii $2|f(x)| = 3$. **(2)**

4 The functions p and q are defined by:

$p(x) = 3x + b, x \in \mathbb{R}$

$q(x) = 1 - 2x, x \in \mathbb{R}$

Given that $pq(x) = qp(x)$,

a show that $b = -\frac{2}{3}$ **(3)**

b find $p^{-1}(x)$ and $q^{-1}(x)$ **(3)**

c show that $p^{-1}q^{-1}(x) = q^{-1}p^{-1}(x) = \frac{ax + b}{c}$, where a, b and c are integers to be found. **(4)**

5 Prove by contradiction that $\sqrt{2}$ is an irrational number.