

1. The curve C has equation $y = f(x)$ where

$$f(x) = \frac{4x + 1}{x - 2}, \quad x > 2$$

(a) Show that

$$f'(x) = \frac{-9}{(x - 2)^2}$$

(3)

Given that P is a point on C such that $f'(x) = -1$,

(b) find the coordinates of P .

(3)



Question 1 continued

Horizontal lines for writing.

(Total 6 marks)

Q1



Question 2 continued

(This section contains 30 horizontal lines for the student's answer.)

Q2

(Total 6 marks)



4.

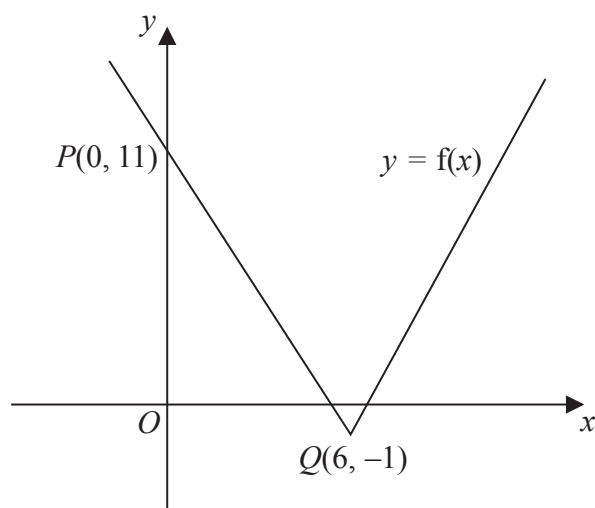


Figure 1

Figure 1 shows part of the graph with equation $y = f(x)$, $x \in \mathbb{R}$.

The graph consists of two line segments that meet at the point $Q(6, -1)$.

The graph crosses the y -axis at the point $P(0, 11)$.

Sketch, on separate diagrams, the graphs of

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

(b) $y = 2f(-x) + 3$ **(3)**

On each diagram, show the coordinates of the points corresponding to P and Q .

Given that $f(x) = a|x - b| - 1$, where a and b are constants,

(c) state the value of a and the value of b . **(2)**



Question 4 continued



Question 4 continued



Question 4 continued

Lined area for writing the answer to Question 4.

(Total 7 marks)

Q4



6.

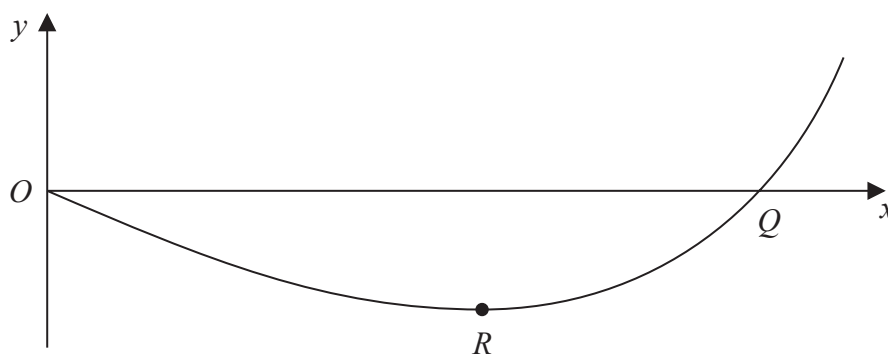


Figure 2

Figure 2 shows a sketch of part of the curve with equation

$$y = 2 \cos\left(\frac{1}{2}x^2\right) + x^3 - 3x - 2$$

The curve crosses the x -axis at the point Q and has a minimum turning point at R .

(a) Show that the x coordinate of Q lies between 2.1 and 2.2 (2)

(b) Show that the x coordinate of R is a solution of the equation

$$x = \sqrt{1 + \frac{2}{3}x \sin\left(\frac{1}{2}x^2\right)}$$

(4)

Using the iterative formula

$$x_{n+1} = \sqrt{1 + \frac{2}{3}x_n \sin\left(\frac{1}{2}x_n^2\right)}, \quad x_0 = 1.3$$

(c) find the values of x_1 and x_2 to 3 decimal places. (2)



7. (a) Show that

$$\operatorname{cosec} 2x + \cot 2x = \cot x, \quad x \neq 90n^\circ, \quad n \in \mathbb{Z}$$

(5)

(b) Hence, or otherwise, solve, for $0 \leq \theta < 180^\circ$,

$$\operatorname{cosec} (4\theta + 10^\circ) + \cot (4\theta + 10^\circ) = \sqrt{3}$$

You must show your working.

(Solutions based entirely on graphical or numerical methods are not acceptable.)

(5)



8. A rare species of primrose is being studied. The population, P , of primroses at time t years after the study started is modelled by the equation

$$P = \frac{800e^{0.1t}}{1 + 3e^{0.1t}}, \quad t \geq 0, \quad t \in \mathbb{R}$$

- (a) Calculate the number of primroses at the start of the study. **(2)**
- (b) Find the exact value of t when $P = 250$, giving your answer in the form $a \ln(b)$ where a and b are integers. **(4)**
- (c) Find the exact value of $\frac{dP}{dt}$ when $t = 10$. Give your answer in its simplest form. **(4)**
- (d) Explain why the population of primroses can never be 270 **(1)**



