



1.

$$g(x) = \frac{6x + 12}{x^2 + 3x + 2} - 2, \quad x \geq 0$$

(a) Show that  $g(x) = \frac{4 - 2x}{x + 1}, \quad x \geq 0$

(3)

(b)

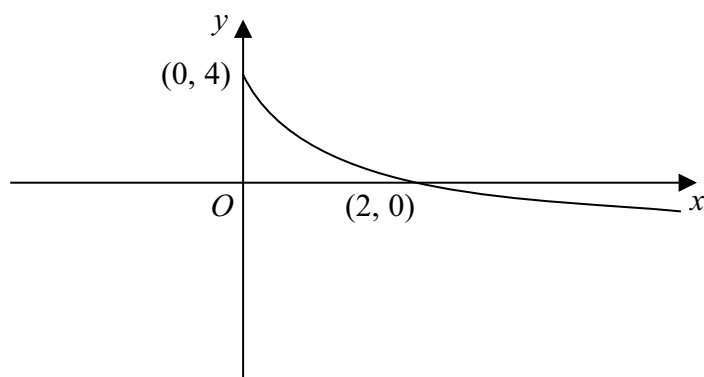


Figure 1

Figure 1 shows a sketch of the curve with equation  $y = g(x), \quad x \geq 0$

The curve meets the  $y$ -axis at  $(0, 4)$  and crosses the  $x$ -axis at  $(2, 0)$ .

On separate diagrams sketch the graph with equation

(i)  $y = 2g(2x),$

(ii)  $y = g^{-1}(x).$

Show on each sketch the coordinates of each point at which the graph meets or crosses the axes.

(5)

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**Question 1 continued**

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**Question 1 continued**

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**(Total 8 marks)**

**Q1**



2. Given that  $\tan 40^\circ = p$ , find in terms of  $p$

(a)  $\cot 40^\circ$

**(1)**

(b)  $\sec 40^\circ$

**(2)**

(c)  $\tan 85^\circ$

**(2)**

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**Question 2 continued**

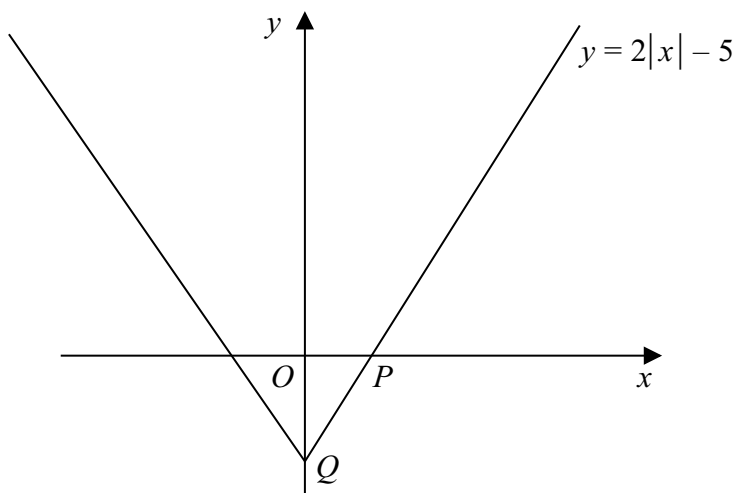
Lined writing area consisting of approximately 27 horizontal lines for student response.

**(Total 5 marks)**

**Q2**



3.



**Figure 2**

Figure 2 shows a sketch of the graph with equation  $y = 2|x| - 5$ .

The graph intersects the positive  $x$ -axis at the point  $P$  and the negative  $y$ -axis at the point  $Q$ .

(a) State the coordinates of  $P$  and the coordinates of  $Q$ . (2)

(b) Solve the equation  $2|x| - 5 = 3 - x$  (3)

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**Question 3 continued**

Lined area for writing the answer to Question 3.

**Q3**

**(Total 5 marks)**



P 4 1 8 2 6 A 0 9 3 2

4. (a) On the same diagram, sketch and clearly label the graphs with equations

$$y = e^x \quad \text{and} \quad y = 10 - x$$

Show on your sketch the coordinates of each point at which the graphs cut the axes. **(3)**

- (b) Explain why the equation  $e^x - 10 + x = 0$  has only one solution. **(1)**

- (c) Show that the solution of the equation

$$e^x - 10 + x = 0$$

lies between  $x = 2$  and  $x = 3$  **(2)**

- (d) Use the iterative formula

$$x_{n+1} = \ln(10 - x_n), \quad x_1 = 2$$

to calculate the values of  $x_2$ ,  $x_3$  and  $x_4$ .

Give your answers to 4 decimal places. **(3)**





**Question 4 continued**

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P 4 1 8 2 6 A 0 1 1 3 2





**Question 4 continued**

Lined writing area with 27 horizontal lines.

**Q4**

**(Total 9 marks)**



5. (i) (a) Show that  $\frac{d}{dx}\left(x^{\frac{1}{2}} \ln x\right) = \frac{\ln x}{2\sqrt{x}} + \frac{1}{\sqrt{x}}$

**(3)**

The curve with equation  $y = x^{\frac{1}{2}} \ln x$ ,  $x > 0$  has one turning point at the point  $P$ .

(b) Find the exact coordinates of  $P$ . Give your answer in its simplest form.

**(4)**

(ii) A curve  $C$  has equation  $y = \frac{x-k}{x+k}$ , where  $k$  is a positive constant.

Find  $\frac{dy}{dx}$ , and show that  $C$  has no turning points.

**(4)**

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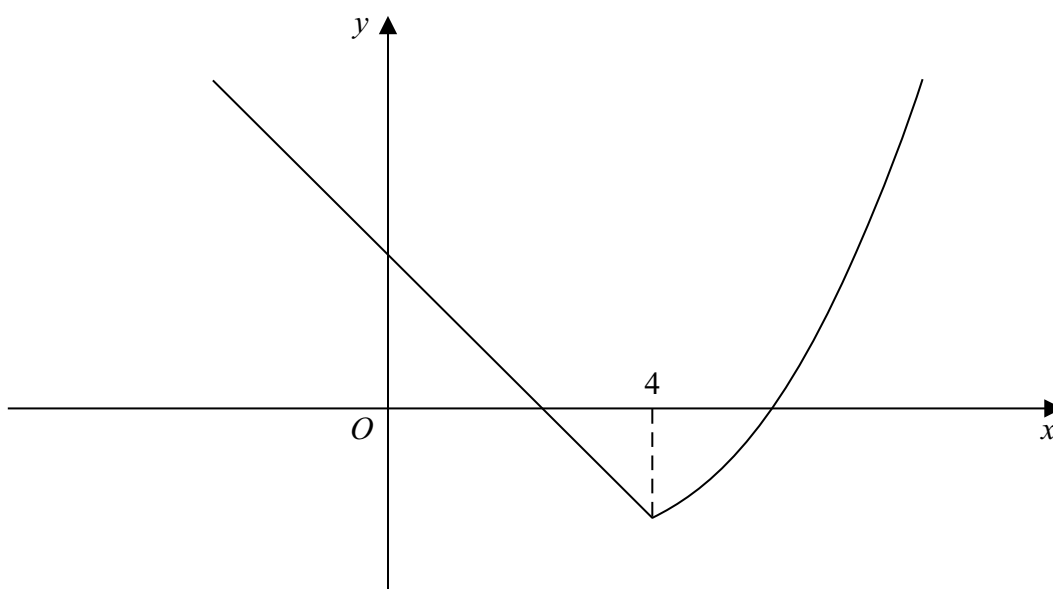








6.



**Figure 3**

Figure 3 shows a sketch of the graph of  $y = f(x)$  where

$$f(x) = \begin{cases} 5 - 2x, & x \leq 4 \\ e^{2x-8} - 4, & x > 4 \end{cases}$$

(a) State the range of  $f(x)$ . (1)

(b) Determine the exact value of  $ff(0)$ . (2)

(c) Solve  $f(x) = 21$   
Give each answer as an exact answer. (5)

(d) Explain why the function  $f$  does not have an inverse. (1)

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**Question 7 continued**

Lined writing area for the answer to Question 7.

**(Total 8 marks)**

**Q7**



8. (a) Express  $9 \cos \theta - 2 \sin \theta$  in the form  $R \cos(\theta + \alpha)$ , where  $R > 0$  and  $0 < \alpha < \frac{\pi}{2}$ .

Give the exact value of  $R$  and give the value of  $\alpha$  to 4 decimal places.

(3)

- (b) (i) State the maximum value of  $9 \cos \theta - 2 \sin \theta$

(ii) Find the value of  $\theta$ , for  $0 < \theta < 2\pi$ , at which this maximum occurs.

(3)

Ruth models the height  $H$  above the ground of a passenger on a Ferris wheel by the equation

$$H = 10 - 9 \cos\left(\frac{\pi t}{5}\right) + 2 \sin\left(\frac{\pi t}{5}\right)$$

where  $H$  is measured in metres and  $t$  is the time in minutes after the wheel starts turning.



- (c) Calculate the maximum value of  $H$  predicted by this model, and the value of  $t$ , when this maximum first occurs. Give your answers to 2 decimal places.

(4)

- (d) Determine the time for the Ferris wheel to complete two revolutions.

(2)

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**Question 8 continued**

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Horizontal lines for writing the answer to Question 8.

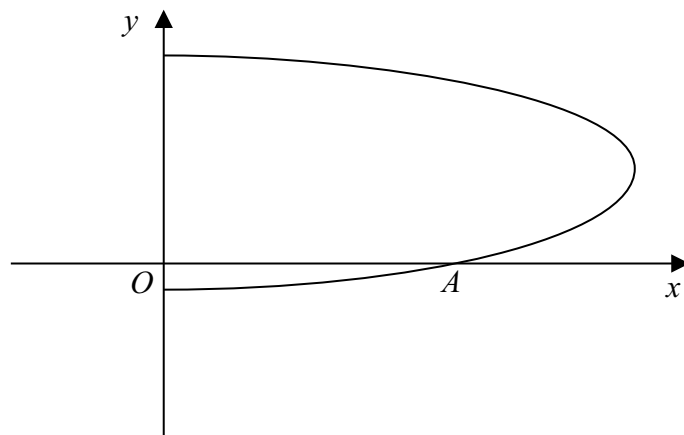
**(Total 12 marks)**

**Q8**

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9.



**Figure 4**

Figure 4 shows a sketch of the curve with equation  $x = (9 + 16y - 2y^2)^{\frac{1}{2}}$ .

The curve crosses the  $x$ -axis at the point  $A$ .

- (a) State the coordinates of  $A$ . (1)
- (b) Find an expression for  $\frac{dx}{dy}$ , in terms of  $y$ . (3)
- (c) Find an equation of the tangent to the curve at  $A$ . (4)

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