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1. (a) Show that

$$\frac{\sin 2\theta}{1 + \cos 2\theta} = \tan \theta$$

(2)

(b) Hence find, for  $-180^\circ \leq \theta < 180^\circ$ , all the solutions of

$$\frac{2 \sin 2\theta}{1 + \cos 2\theta} = 1$$

Give your answers to 1 decimal place.

(3)

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Question 2 continued

Lined area for writing the answer to Question 2.

(Total 7 marks)

Q2

Small box for marking the question.



H 3 5 3 8 5 A 0 5 2 8







**Question 3 continued**

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Lined area for writing the answer to Question 3, containing approximately 35 horizontal lines.







4. The function  $f$  is defined by

$$f : x \mapsto |2x - 5|, \quad x \in \mathbb{R}$$

(a) Sketch the graph with equation  $y = f(x)$ , showing the coordinates of the points where the graph cuts or meets the axes. (2)

(b) Solve  $f(x) = 15 + x$ . (3)

The function  $g$  is defined by

$$g : x \mapsto x^2 - 4x + 1, \quad x \in \mathbb{R}, \quad 0 \leq x \leq 5$$

(c) Find  $fg(2)$ . (2)

(d) Find the range of  $g$ . (3)





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**Question 4 continued**

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**Question 4 continued**

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(Total 10 marks)

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5.

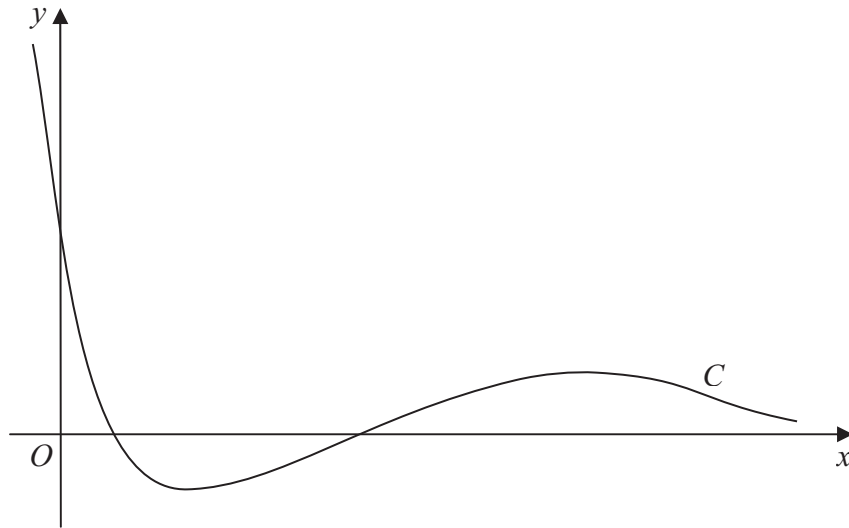


Figure 1

Figure 1 shows a sketch of the curve  $C$  with the equation  $y = (2x^2 - 5x + 2)e^{-x}$ .

- (a) Find the coordinates of the point where  $C$  crosses the  $y$ -axis. (1)
- (b) Show that  $C$  crosses the  $x$ -axis at  $x = 2$  and find the  $x$ -coordinate of the other point where  $C$  crosses the  $x$ -axis. (3)
- (c) Find  $\frac{dy}{dx}$ . (3)
- (d) Hence find the exact coordinates of the turning points of  $C$ . (5)

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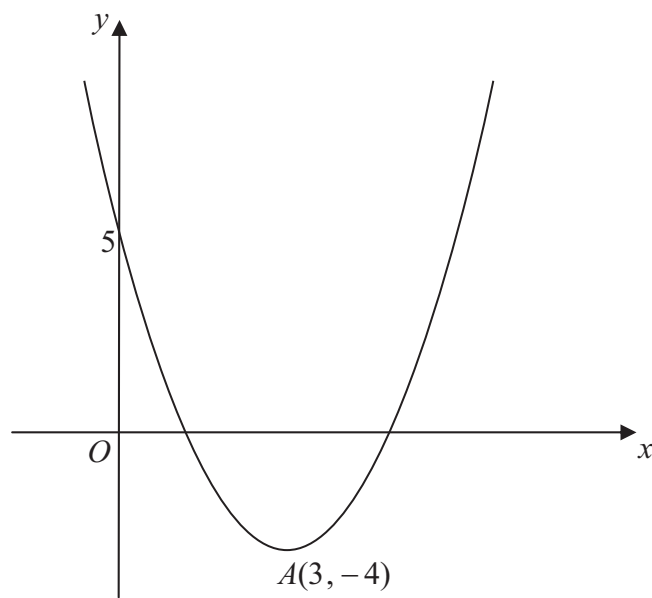








6.



**Figure 2**

Figure 2 shows a sketch of the curve with the equation  $y = f(x)$ ,  $x \in \mathbb{R}$ .  
The curve has a turning point at  $A(3, -4)$  and also passes through the point  $(0, 5)$ .

(a) Write down the coordinates of the point to which  $A$  is transformed on the curve with equation

(i)  $y = |f(x)|$ ,

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

**(4)**

(b) Sketch the curve with equation

$$y = f(|x|)$$

On your sketch show the coordinates of all turning points and the coordinates of the point at which the curve cuts the  $y$ -axis.

**(3)**

The curve with equation  $y = f(x)$  is a translation of the curve with equation  $y = x^2$ .

(c) Find  $f(x)$ .

**(2)**

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

**(1)**







**Question 6 continued**

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Handwritten answer for Question 6 continued:

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7. (a) Express  $2 \sin \theta - 1.5 \cos \theta$  in the form  $R \sin(\theta - \alpha)$ , where  $R > 0$  and  $0 < \alpha < \frac{\pi}{2}$ .

Give the value of  $\alpha$  to 4 decimal places.

(3)

(b) (i) Find the maximum value of  $2 \sin \theta - 1.5 \cos \theta$ .

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

(3)

Tom models the height of sea water,  $H$  metres, on a particular day by the equation

$$H = 6 + 2 \sin\left(\frac{4\pi t}{25}\right) - 1.5 \cos\left(\frac{4\pi t}{25}\right), \quad 0 \leq t < 12,$$

where  $t$  hours is the number of hours after midday.

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

(3)

(d) Calculate, to the nearest minute, the times when the height of sea water is predicted, by this model, to be 7 metres.

(6)

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**Question 8 continued**

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**(Total 7 marks)**

**Q8**

**TOTAL FOR PAPER: 75 MARKS**

**END**

