



Rewarding Learning

ADVANCED  
General Certificate of Education  
2019

Centre Number

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Candidate Number

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## Mathematics

Assessment Unit A2 1

*assessing*

Pure Mathematics

<b>MV18</b>
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**[AMT11]****TUESDAY 28 MAY, MORNING**

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**Time**

2 hours 30 minutes, plus your additional time allowance.

**Instructions to Candidates**

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

You must answer **all twelve** questions in the spaces provided.

Do not write on blank pages or tracing paper.

Complete in black ink only.

Questions which require drawing or sketching should be completed using an H.B. pencil.

Show clearly the full development of your answers.

**Answers without working may not gain full credit.**

Answers should be given to three significant figures unless otherwise stated.

You are permitted to use a graphic or scientific calculator in this paper.

## Information for Candidates

The total mark for this paper is 150

Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.

A copy of the **Mathematical Formulae and Tables booklet** is provided.

Throughout the paper the logarithmic notation used is  $\ln z$ , where it is noted that  $\ln z \equiv \log_e z$

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**(Questions start overleaf)**



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3 A mirror ABCDE is designed in the form of a sector of a circle, centred at B, together with two congruent right-angled triangles, BAE and BCD, as shown in Fig. 1 below.

$AC = 80 \text{ cm}$

$AE = CD = 60 \text{ cm}$

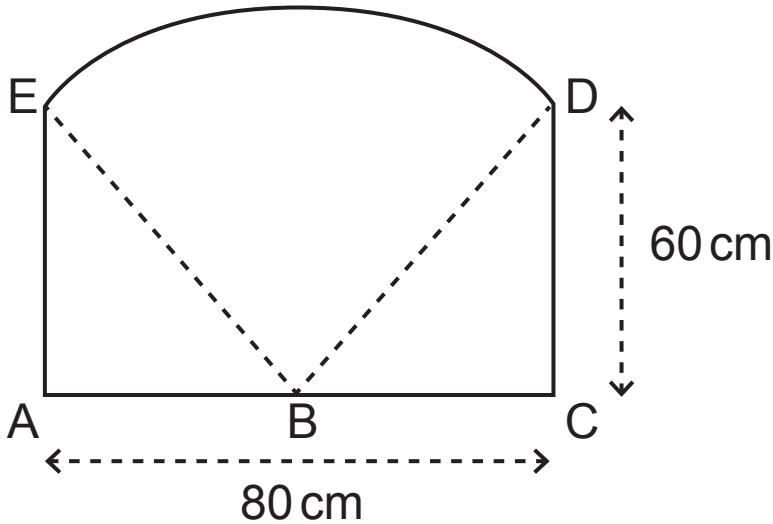


Fig. 1

(i) Find the angle EBD in radians. [5 marks]

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5 (a) A function  $f$  is defined by

$$f: x \rightarrow x^2 - 8, \quad x \in \mathbb{R}, \quad x \geq 0$$

(i) State the range of the function  $f(x)$ . [1 mark]

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(ii) Find the inverse function  $f^{-1}(x)$ , clearly stating its domain. [4 marks]

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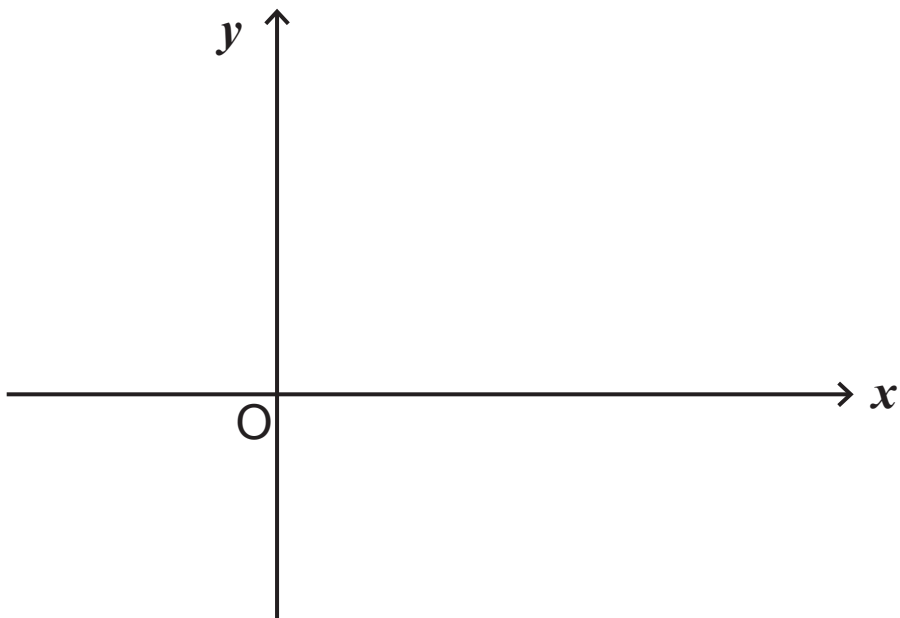
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A function  $g$  is defined by

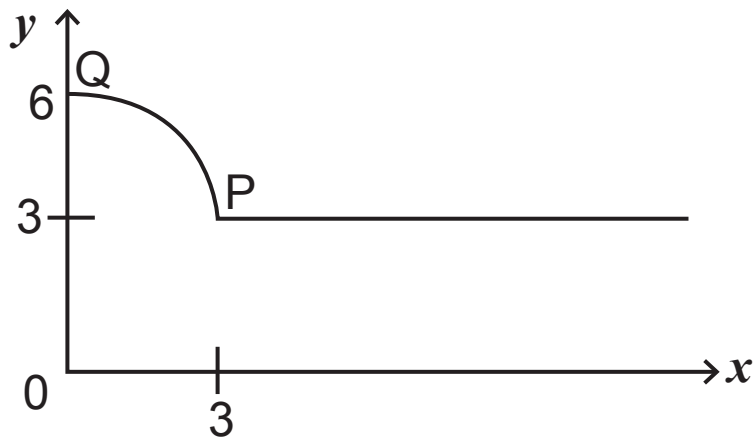
$$g: x \rightarrow |x - 3|, \quad x \in \mathbb{R}$$

(iii) On the axes below sketch the graph of  $y = g(x)$ .  
[2 marks]





(b) The graph of the function  $y = h(x)$  is sketched in Fig. 2 below.

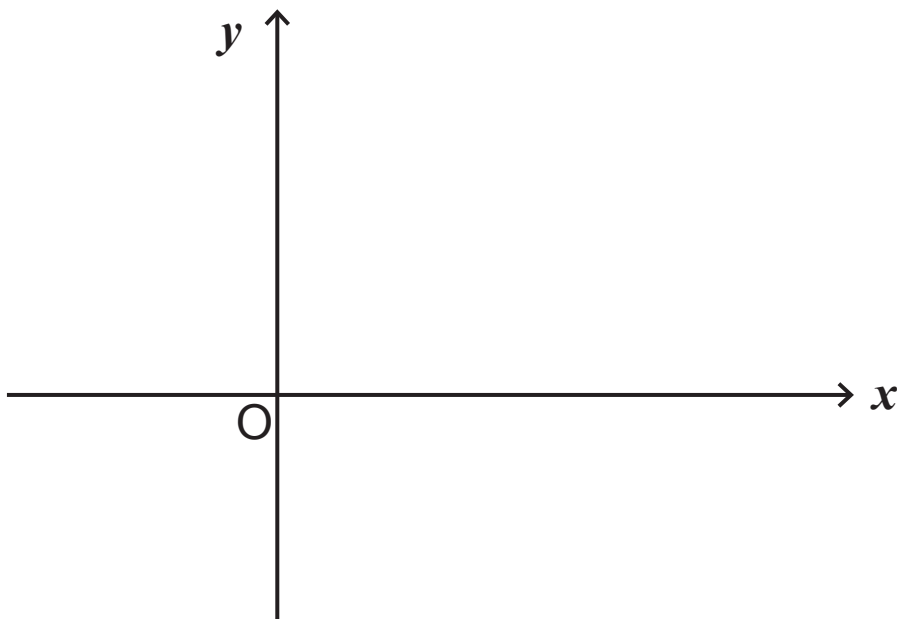


**Fig. 2**

(i) On the axes below sketch the graph of

$$y = \frac{1}{3}h(3x)$$

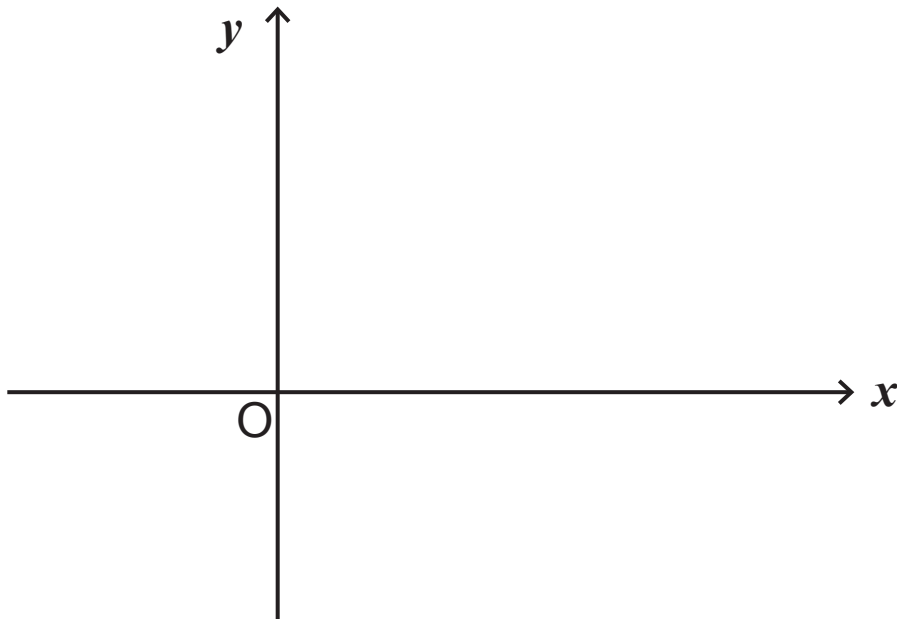
and clearly label the images of the points P and Q. [2 marks]



(ii) On the axes below sketch the graph of

$$y = 6 - h(x)$$

and clearly label the images of the points P and Q.  
[2 marks]





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(ii) Hence, or otherwise, determine the maximum value of

$$\frac{18}{8 \sin x + 15 \cos x + 23}$$

and find a corresponding value of  $x$ . [4 marks]

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(iii) Explain how the use of the Trapezium Rule in (i) could be modified to obtain a better approximation to the integral

$$\int_2^3 \frac{x^2}{(x+3)(x-1)} dx \quad [1 \text{ mark}]$$

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(b) Using the substitution  $u^2 = x^2 + 4$  , or otherwise, find the exact value of

$$\int_0^{\sqrt{5}} \frac{x^3}{\sqrt{x^2 + 4}} dx \quad [8 \text{ marks}]$$

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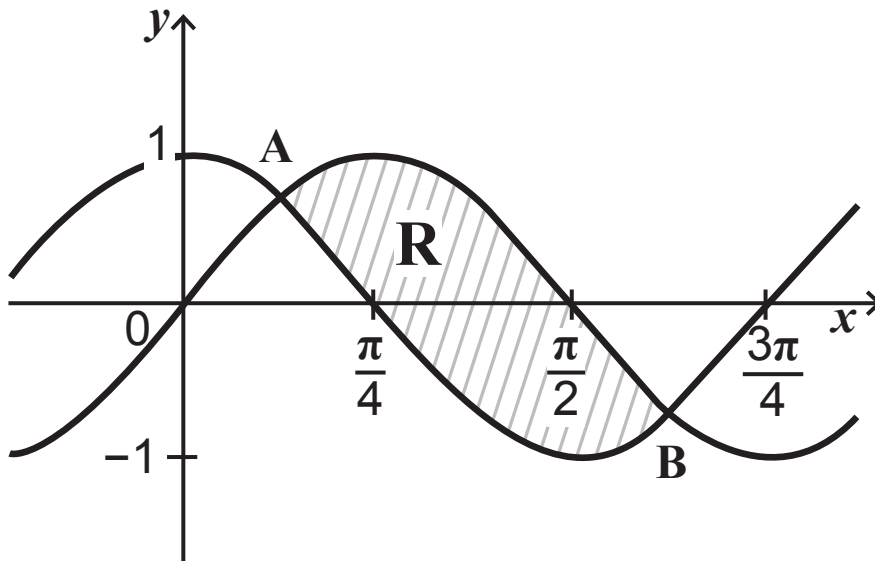
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11 The graphs of the curves

$$y = \sin 2x \text{ and } y = \cos 2x$$

are shown in **Fig. 3** below.

The curves intersect at the points **A** and **B**.



**Fig. 3**

- (i) Show that the  $x$ -coordinates of **A** and **B** are  $\frac{\pi}{8}$  and  $\frac{5\pi}{8}$   
[4 marks]

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The top section of a trophy is a flat metal sheet modelled in the shape of the shaded region **R**.

**(ii)** Calculate the area of this region. [6 marks]

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The first term of an arithmetic progression is 7 and the last term is 79

The sum of the progression is 1075

(ii) Find the number of terms. [3 marks]

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**(iii)** Find the common difference. [3 marks]

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(ii) Assuming that the man continues to invest in this way, form and sum a series to prove that he will have

$$£20\,000(1.02^n - 1)$$

in his account at the end of  $n$  years. [6 marks]

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(iii) Hence find the least number of years until his investment exceeds £7,000 [4 marks]

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<b>For Examiner's use only</b>	
<b>Question Number</b>	<b>Marks</b>
1	
2	
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10	
11	
12	

<b>Total Marks</b>	
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