



Rewarding Learning

ADVANCED
General Certificate of Education
2022 Reserve Series

Centre Number

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Candidate Number

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Mathematics

Assessment Unit A2 1

assessing

Pure Mathematics



[AMT11]

AMT11

MONDAY 27 JUNE, MORNING

TIME

2 hours 30 minutes.

INSTRUCTIONS TO CANDIDATES

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

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

Do not write outside the boxed area on each page or on blank pages or tracing paper.

Complete in black ink only. **Do not write with a gel pen.**

Questions which require drawing or sketching should be completed using an HB 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 down the right-hand side of pages 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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36AMT1101

1 (a) State whether the following sequences converge, diverge or oscillate.

(i) $\frac{2n^2}{n+3}$ [1]

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(ii) $\cos\left(\frac{n\pi}{3}\right)$ [1]

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(iii) $\frac{5n}{3n-1}$ [1]

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(b) Find $\sum_{r=1}^{\infty} 3\left(\frac{2}{5}\right)^r$

[5]

[Turn over

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36AMT1103

(c) The first three terms of an arithmetic progression are

$$x, 3x + 1, 3x^2 \quad \text{where } x > 0$$

(i) Find the value of x .

[4]

[illegible]

[4]

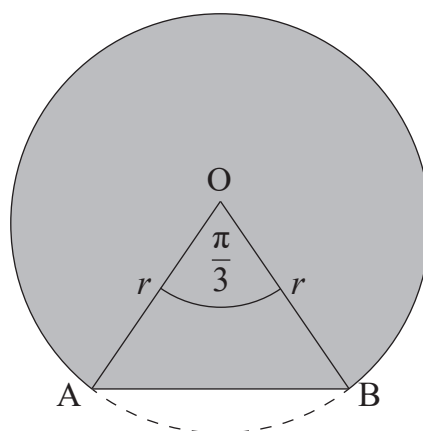
[Turn over

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36AMT1105

- 2 The shaded region R, as shown in **Fig. 1** below, is the major segment of a circle of radius r cm with angle $\text{AOB} = \frac{\pi}{3}$ radians.



- (i) Find the perimeter of R in terms of r .

[3]

This image shows a full page of white paper with horizontal dashed lines, typical of primary school handwriting practice paper. The lines are evenly spaced and run across the entire width of the page. There are no margins, text, or other markings present.

(ii) Find the value of r .

[2]

[5]

[Turn over

3 (a) Simplify as far as possible

$$\frac{4x^2 - 25}{3x^2 + 14x + 8} \div \frac{6x - 15}{x + 4} \quad [5]$$

[illegible]

[illegible]

[illegible]

[illegible][illegible][illegible][illegible][illegible][illegible]

- 4 (a) The graph of the function $y = f(x)$ is shown in **Fig. 2** below.

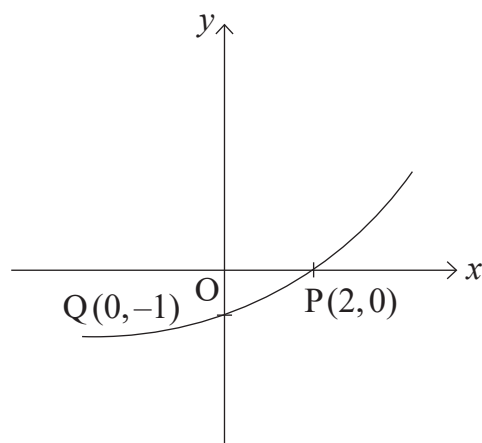
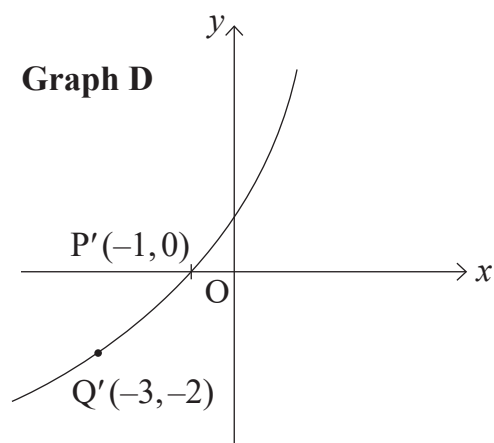
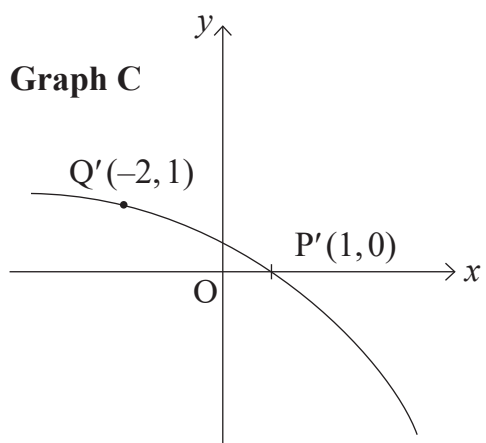
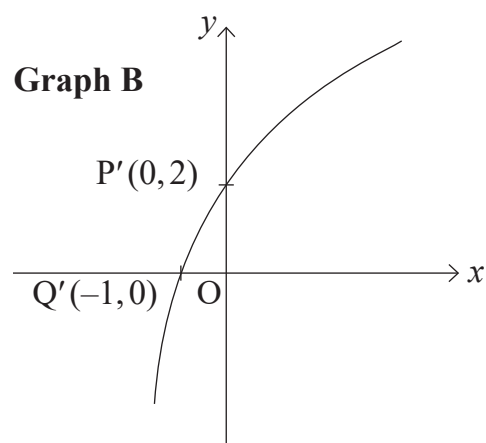
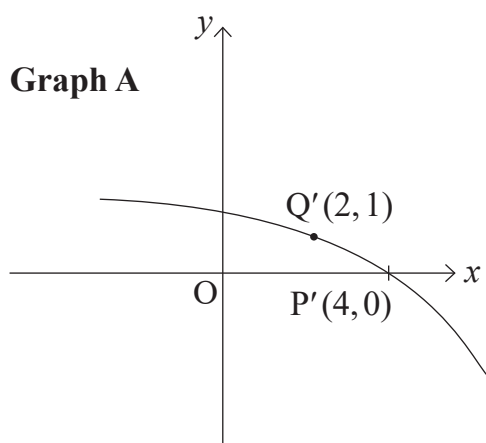


Fig. 2

The curve cuts the axes at $P(2, 0)$ and $Q(0, -1)$.

Fig. 3 below shows five different transformations of $y = f(x)$.



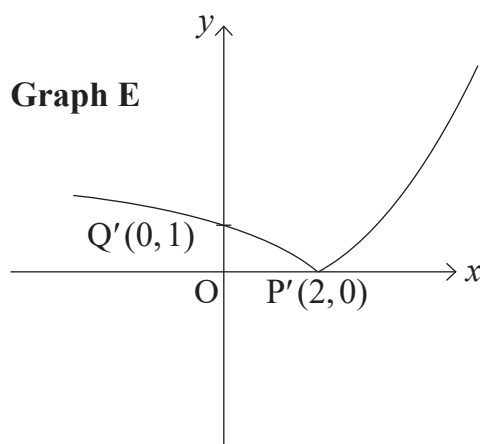


Fig. 3

Complete the following statements:

(i) $y = 2f(x + 3)$ is represented by Graph [1]

(ii) $y = -f(x - 2)$ is represented by Graph [1]

(iii) $y = |f(x)|$ is represented by Graph [1]

(iv) $y = f^{-1}(x)$ is represented by Graph [1]

[Turn over]



$$h(x) = \frac{1}{1+x} \quad x \in \mathbb{R} \quad x \neq -1$$

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[4]

[Turn over

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36AMT1113

5 The points of intersection of the curves

$$y = \operatorname{cosec}^2 3x$$

and

$$y = x^2 + 1$$

can be found by solving the equation

$$\operatorname{cosec}^2 3x - x^2 - 1 = 0$$

- (i) Show that this equation has a root between $x = 0.3$ and $x = 0.5$ [3]

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[illegible]

- [6]

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36AMT1115

6 (a) Prove that

$$\frac{\cos 2\theta - \cos \theta + 1}{\sin 2\theta - \sin \theta} \equiv \cot \theta \quad [6]$$



(b) Solve the equation

$$\tan(\theta - 45^\circ) = 6 \tan \theta \quad \text{where } 0^\circ \leq \theta \leq 360^\circ \quad [7]$$

[7]

[Turn over



[Turn over

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36AMT1119

(b) A curve is given by the equation

$$3x + 5xy^2 - 16 = 2(x + y)^2$$

Find the equation of the tangent to the curve at the point $(1, 3)$.

Leave your answer in the form $ax + by + c = 0$, where a , b and c are integers. [9]

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[Turn over

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36AMT1121

- 8 (a)** The curved surface of a glass bowl can be modelled by rotating the curve

$$y = 3 \tan 4x$$

between $x = 0$ and $x = \frac{\pi}{16}$ through 2π radians about the x -axis.

Find, in terms of π , the maximum volume of liquid that the bowl can contain. [9]

[illegible]

[Turn over

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36AMT1123

(b) Find $\int x e^{2x} dx$

[7]



[Turn over

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36AMT1125

(c) Using the substitution

$$u = x - 3$$

find the exact value of

$$\int_4^6 \frac{x(x-5)}{(x-3)^2} \, dx$$

[9]

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[Turn over

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36AMT1127

9 (i) Show that $(x + 3)$ is a factor of

$$2x^3 + 11x^2 + 12x - 9$$

[3]



[15]

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36AMT1129



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At time $t = 0$, $A = 190$

(ii) Show that

$$A = 200 - 10e^{0.25t} \qquad [2]$$

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They plan to manage this by simply reducing the amount of biological substance in the tank at time $t = 0$

- (iv) Find the maximum amount of biological substance at time $t = 0$ which makes this change feasible, giving your answer to 1 decimal place. [5]

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THIS IS THE END OF THE QUESTION PAPER

DO NOT WRITE ON THIS PAGE

For Examiner's use only	
Question Number	Marks
1	
2	
3	
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6	
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8	
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10	

Total Marks	
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Examiner Number

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