

Candidate Number

ADVANCED General Certificate of Education

Mathematics

Assessment Unit A2 1 assessing **Pure Mathematics**

AMT11

[AMT11] Assessment

TIME

Assessment Level of Control: Tick the relevant box (✓)

2 hours 30 minutes.

Controlled Conditions Other

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 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.

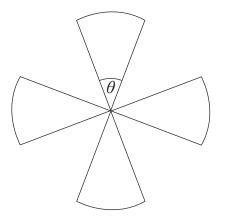
A copy of the Mathematical Formulae and Tables booklet is provided.

Throughout the paper the logarithmic notation used is $\ln z$ where it is noted that $\ln z \equiv \log_2 z$ 12355

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1 Fig. 1 below shows the rotor blades for the propeller of a boat.





They are made up of four equal sectors of a circle of radius 30 cm.

(i) If the total area of the blades is 300π cm², find the exact value of θ in radians. [3]

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| Hence find the total perimeter of the blades. [3] |
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| (i) | $\frac{n}{n^2+1}$ |
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| (ii | $\int \sin(n\pi)$ |
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| (II | $\int \sin\left(\frac{1}{6}\right)$ |
| (II | $(1) \sin\left(\frac{\pi}{6}\right)$ |
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| | $\sqrt{1-3x}$ |
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| [4 | in ascending powers of x up to and including the term in x^3 |
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| (ii) | State the range of values of x for which the expansion is valid. [1] |
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| 3 | (a) | Use the Trapezium | Rule with 3 | ordinates to | find an | approximate value for | |
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| $\int_{2}^{4} x \cos x \mathrm{d}x$ | [5] |
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| 4 (a) E | ind $\frac{dy}{dx}$ for each of the following: | |
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| 4 (a) Fi | $\frac{dx}{dx}$ for each of the following: | |
| (i) | $y = \sec^5(2x)$ | [4] |
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| $y = \frac{\cot x}{e^{4x}}$ | [2 |
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(b) A vase is modelled by rotating the curve

$$y = \sqrt{x} + 2$$

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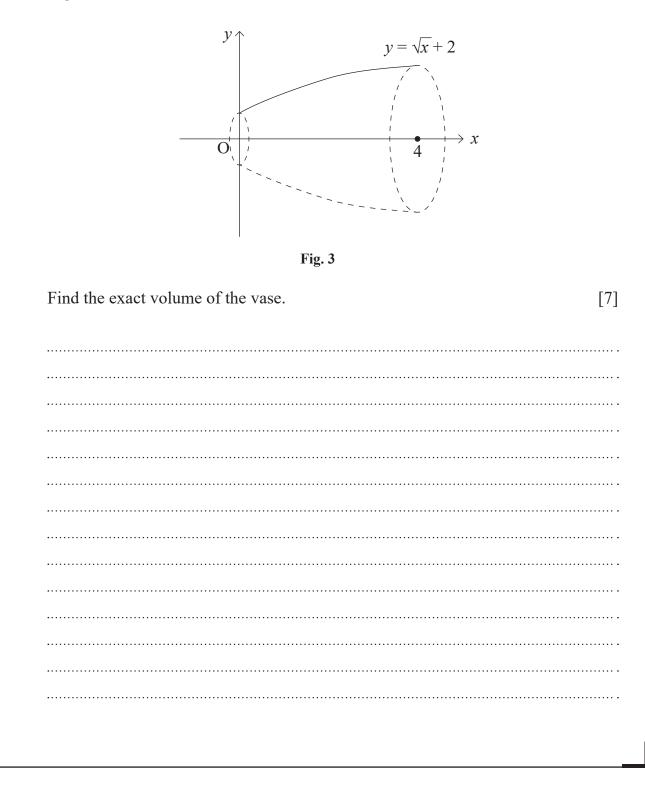
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between the lines x = 0 and x = 4 through 2π radians about the x-axis, as shown in **Fig. 3** below.





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| ··· ··· ··· ··· ··· | $\frac{3x^2 - 10x + 5}{(x+1)(x-2)^2}$ [6] |
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| (ii) | Hence show that $\int_0^1 \frac{3x^2 - 10x + 5}{(x+1)(x-2)^2} \mathrm{d}x = \ln 2 - \frac{1}{2} $ [6] |
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| 6 | (a) | Sketch the graph of $y = \sin^{-1}(x)$ on the axes below for $-1 \le x \le 1$ | [2] |
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| | (b) | Express | |
| | (b) | Express $\cos x - \sqrt{3} \sin x$ | |
| | (b) | | [7] |
| | (b) | $\cos x - \sqrt{3}\sin x$ | [7] |
| | (b) | $\cos x - \sqrt{3}\sin x$ | [7] |
| | (b) | $\cos x - \sqrt{3}\sin x$ | |
| | (b) | $\cos x - \sqrt{3} \sin x$ in the form $R \cos(x + \alpha)$ where <i>R</i> is an integer and $0 < \alpha < 90^{\circ}$ | |
| | (b) | $\cos x - \sqrt{3} \sin x$ in the form $R \cos(x + \alpha)$ where <i>R</i> is an integer and $0 < \alpha < 90^{\circ}$ | |
| | (b) | $\cos x - \sqrt{3} \sin x$ in the form $R \cos(x + \alpha)$ where <i>R</i> is an integer and $0 < \alpha < 90^{\circ}$ | |
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| | (b) | $\cos x - \sqrt{3} \sin x$ in the form $R \cos(x + \alpha)$ where R is an integer and $0 < \alpha < 90^{\circ}$ | |



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| | $\sin 3\theta \equiv 3\sin\theta - 4\sin^3\theta$ | |
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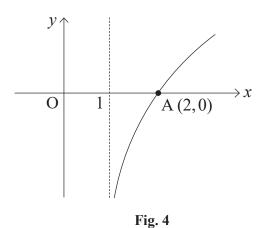
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| [4 | Solve the inequality |
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(b) The graph of the function y = f(x) is sketched below in Fig. 4 The graph cuts the *x*-axis at A(2, 0) and has an asymptote of x = 1

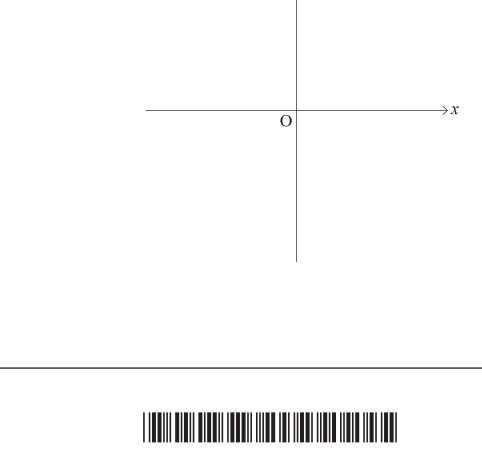


(i) On the axes below, sketch the graph of

y = f(2x) + 3

 $y\uparrow$

and clearly label the image of A and the asymptote.



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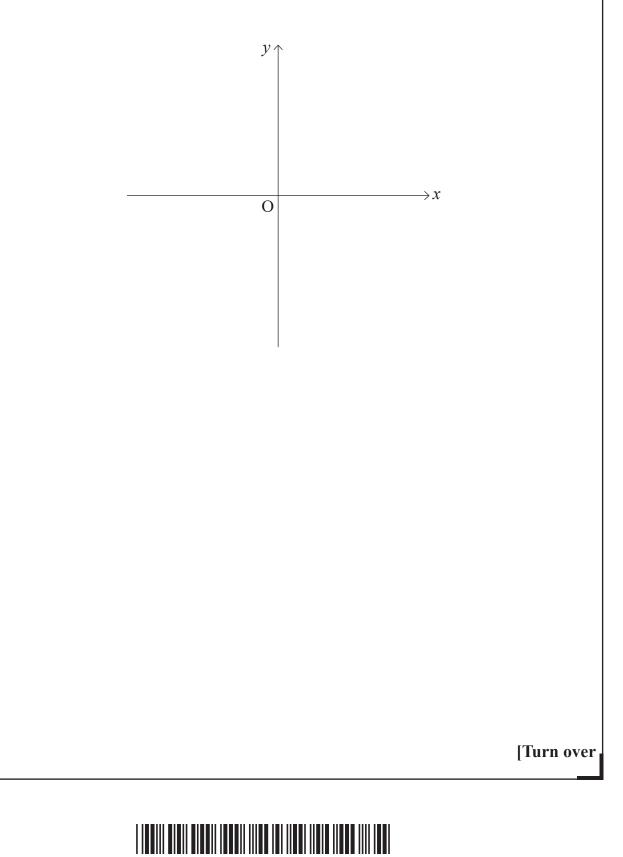
[3]

(ii) On the axes below, sketch the graph of

$$y = -f(x+2)$$

and clearly label the image of A and the asymptote.

[3]



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| e functions f and g are defined as: | |
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| $f(x) = \frac{10}{x - 1} \qquad x \in \mathbb{R}, x > 1$ | |
| $g(x) = e^{3x} \qquad x \in \mathbb{R}, x > 0$ | |
| State the range of $f(x)$ and the range of $g(x)$. | [2] |
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| Find the inverse $f^{-1}(x)$, stating its domain. | [4] |
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| | $f(x) = \frac{10}{x-1} \qquad x \in \mathbb{R}, x > 1$ $g(x) = e^{3x} \qquad x \in \mathbb{R}, x > 0$ State the range of f(x) and the range of g(x). |

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| (iii) | Find the composite function $fg(x)$, stating its domain. [3] | |
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| 9 (a) | Find $\int \ln x dx$ | [5] |
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| (b) | Using the substitution $x = \frac{2}{3}\sin\theta$ evaluate | |
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| | $\int_{0}^{\frac{1}{3}} \sqrt{4 - 9x^2} \mathrm{d}x $ [1] | 2] |
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| $y = \sqrt{2} e^{-x} \cos x$ |
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| has stationary points in the range $0 < x < 4\pi$ |
| Write your values in ascending order. |
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| Show that the corresponding y values of the stationary points found in (i) form the first four terms of a geometric progression. | [|
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| | For the geometric progression defined in (ii), find an exact value for the sum to infinity. [2] | to infinity. [2] | For the geometric progression defined in (ii), find an exact value for the sum to infinity. [2] | For the geometric progression defined in (ii), find an exact value for the sum to infinity. [2] | For the geometric progression defined in (ii), find an exact value for the sum to infinity. [2] | For the geometric progression defined in (ii), find an exact value for the sum to infinity. [2] |
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| | $x = 2t^2 + 4t \text{and} y = \sin 2t$ |
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| (i) | Find the co-ordinates of the stationary point on this curve for $0 < t < \frac{\pi}{2}$ [6] |
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| i) | Using $\frac{d^2y}{dx^2}$ classify this stationary point. |
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| 12 | Water leaks out of a small hole in the bottom of a paddling pool. |
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| | The rate at which the water leaves the pool is proportional to the square root of the volume of water that remains in the pool. |
| | The initial volume of water is V_0 |
| | If $\frac{5}{9}$ of the initial volume leaks out in the first hour, find how long it takes for |
| | the pool to empty. [10] |
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| Question Number | Marks | |
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