



Rewarding Learning

ADVANCED
General Certificate of Education
2023

Centre Number

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Candidate Number

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Mathematics

Assessment Unit A2 1

assessing

Pure Mathematics

MV18

[AMT11]

TUESDAY 6 JUNE, AFTERNOON

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 eleven** 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 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

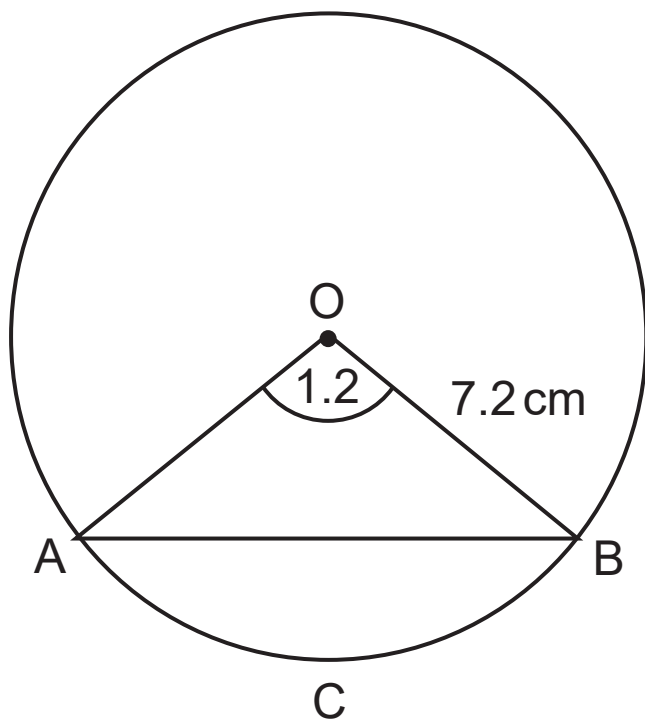
Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.

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 $\ln z \equiv \log_e z$

- 1 The diagram in **Fig. 1** below shows the sector AOB of a circle with centre O and radius 7.2 cm. The angle AOB is 1.2 radians.

Fig. 1



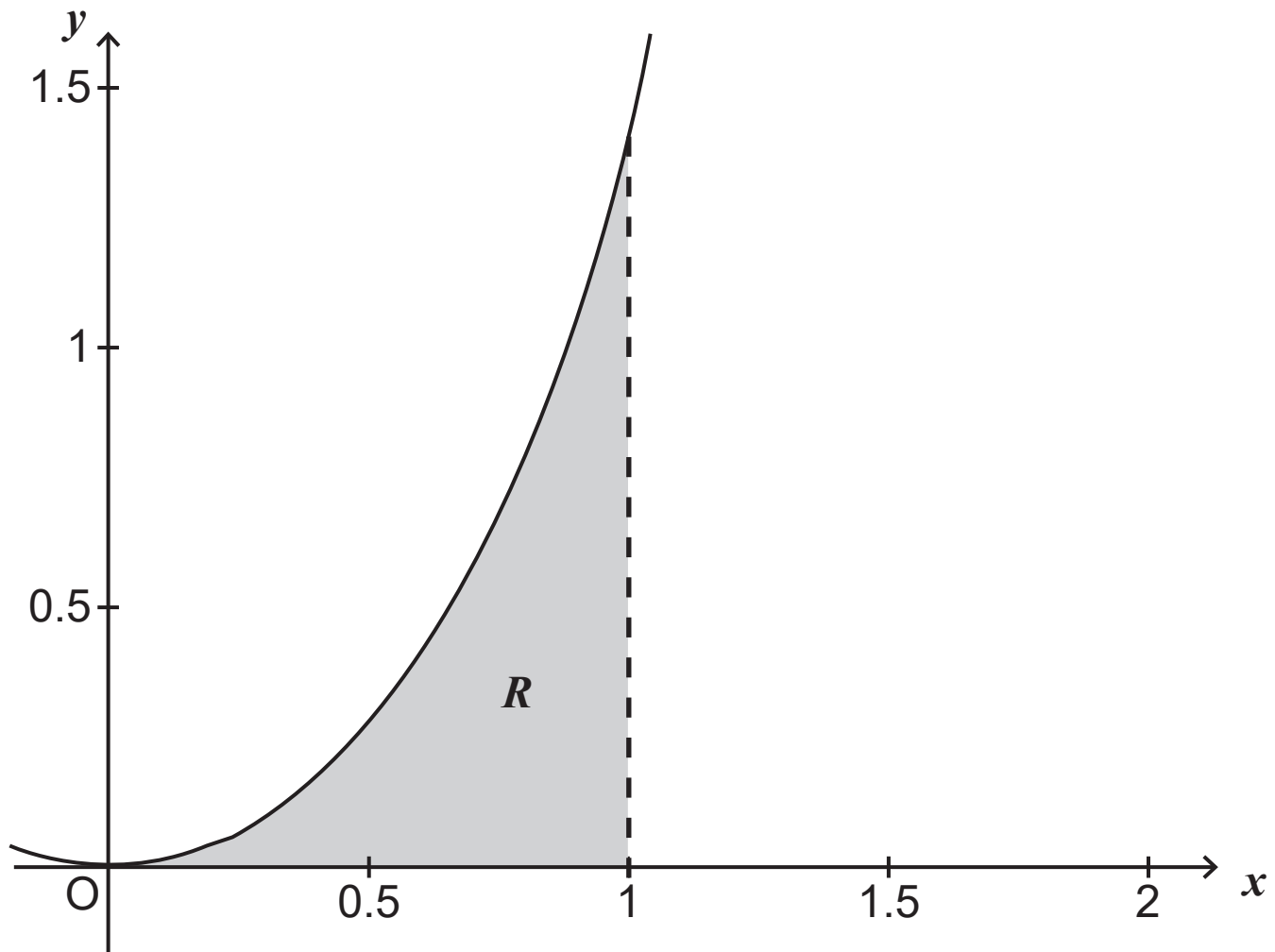
- (i) Calculate the area of the minor sector AOB. [2 marks]

(ii) Find the length of the chord AB. [3 marks]

(ii) State the range of values of x for which this binomial expansion is valid. [1 mark]

3 The graph in **Fig. 2** below shows the function $y = x^2 \sqrt{x^3 + 1}$

Fig. 2



The region R is the area enclosed between the curve $y = x^2 \sqrt{x^3 + 1}$, the x -axis and the line $x = 1$

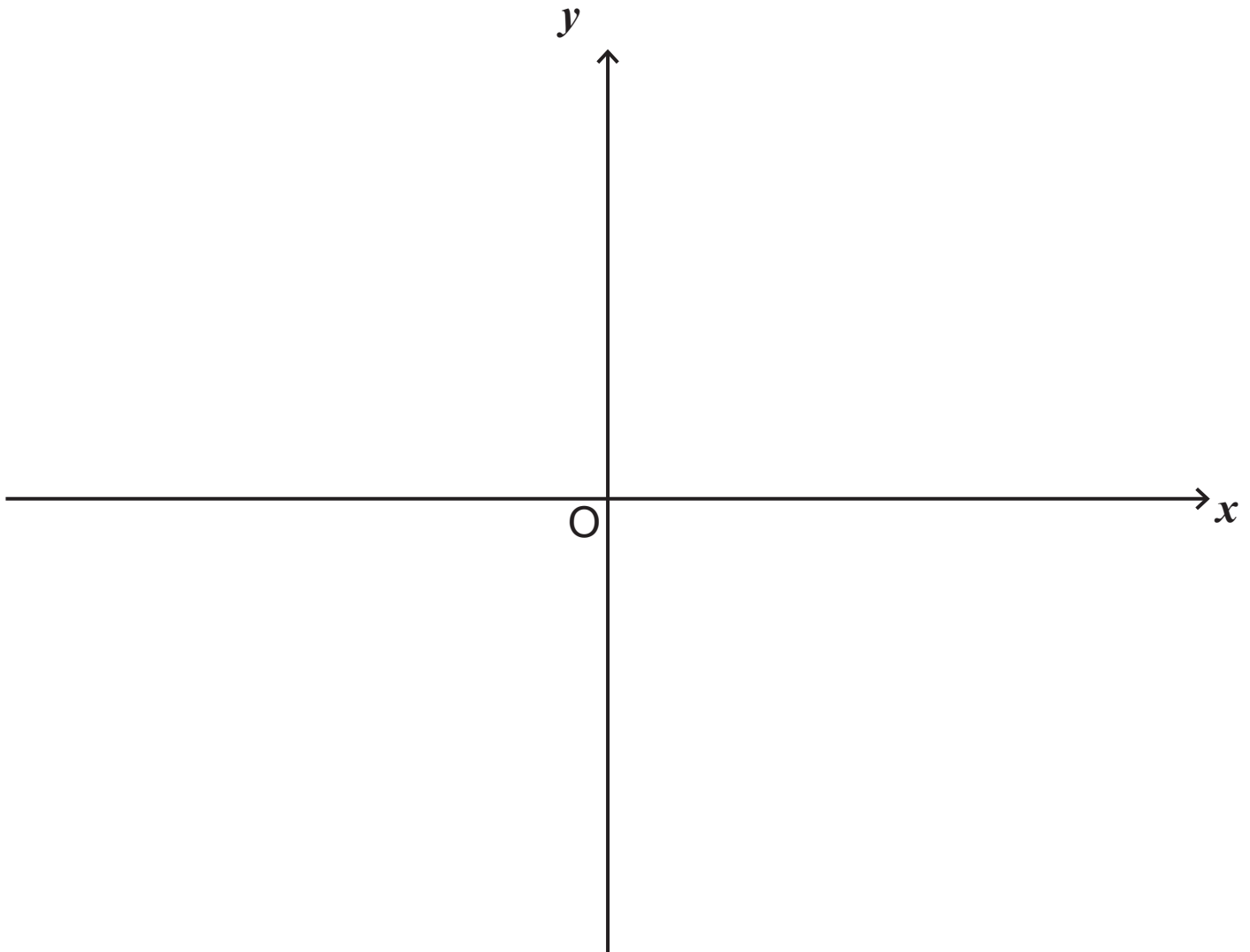
- (i) Find an approximation for the shaded area R using the trapezium rule with 4 strips. [5 marks]

The region R in **Fig. 2** forms a solid when rotated through 2π radians about the x -axis.

(ii) Find the volume of this solid. [6 marks]

4 The function $f(x) = \sin^{-1}x$

(i) Sketch the graph of $y = f(x)$ [3 marks]



(ii) State clearly the domain and range for this function.
[2 marks]

(iii) State two successive transformations which map the graph of the function $f(x)$ to the graph of the function

$$g(x) = 3 + 2 \sin^{-1} x \quad [3 \text{ marks}]$$

6 In round one of a game show contestants get a prize of £100 for their first correct answer.

With each subsequent correct answer the prize money per question increases by £50

Mandy won a total of £3,250

(i) How many questions did she get correct? [5 marks]

In round two of the game the prize values are different but are awarded in the same way.

John answered 6 questions correctly and won £2,325

Martha answered 3 questions correctly and won £825

(ii) Find the amount each contestant won for their first question and the increase in prize money per question in round two. [6 marks]

(ii) Hence find the solution of

$$2 \cos 2x + 5 \sin 2x = 3 \quad \text{for} \quad 0 \leq x \leq 180^\circ$$

[4 marks]

8 (a) A curve is defined by the equation

$$3y^2 + 2x - \frac{3x}{y} = 5$$

Find $\frac{dy}{dx}$ in terms of x and y . [8 marks]

9 (a) The graphs of the functions $f(x) = e^x$ and $g(x) = x + 4$ intersect at the point where $x = a$.

(i) Show that the value of a lies between $x = 1$ and $x = 2$ [4 marks]

(ii) Starting with $x_0 = 1.5$ use the Newton-Raphson method twice to find a better approximation for the value of a . [6 marks]

(b) A curve has the parametric equations

$$x = \operatorname{cosec}^2 t, \quad y = \cot t$$

where $0 < t < \pi$

Find an expression for $\frac{dy}{dx}$ in terms of t . [7 marks]

10 A cylindrical water tank is leaking water. A student believes that the rate of change of depth, D metres, of water in the tank is proportional to the square of the depth at time t minutes.

(i) Using this model, form a differential equation.
[2 marks]

11 (a) Find the exact value of

$$\int_0^{\frac{\pi}{6}} (\sin x + \cos x)^2 dx \quad [7 \text{ marks}]$$

(b) The graphs of the functions

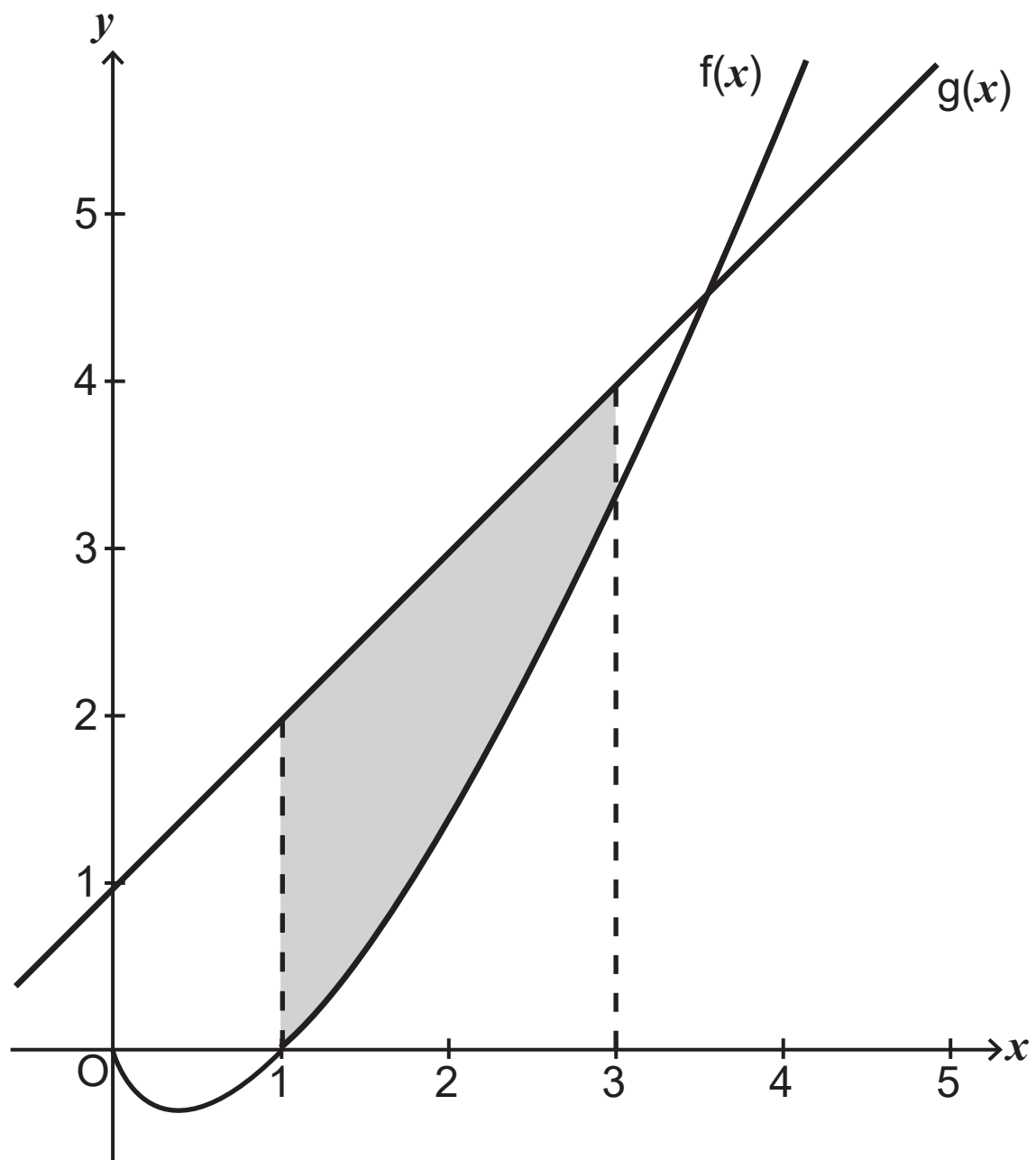
$$f(x) = x \ln x$$

and

$$g(x) = x + 1$$

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

Fig. 3



This is the end of the question paper

SOURCES

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Question Number	Marks
1	
2	
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8	
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11	
Total Marks	

Examiner Number

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