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Other names

Pearson Edexcel
Level 3 GCE

Centre Number

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Candidate Number

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Mathematics

Advanced

Paper 2: Pure Mathematics 2

Specimen Paper

Time: 2 hours

Paper Reference

9MA0/02

You must have:

Mathematical Formulae and Statistical Tables, calculator

Total Marks

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided
– *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 14 questions in this question paper. The total mark for this paper is 100.
- The marks for each question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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Answer ALL questions. Write your answers in the spaces provided.

1.

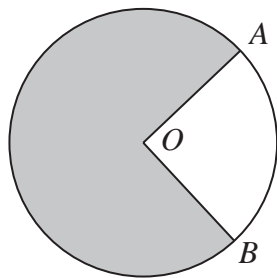


Figure 1

Figure 1 shows a circle with centre O . The points A and B lie on the circumference of the circle.

The area of the major sector, shown shaded in Figure 1, is 135 cm^2 .

The reflex angle AOB is 4.8 radians.

Find the exact length, in cm, of the minor arc AB , giving your answer in the form $a\pi + b$, where a and b are integers to be found.

(4)

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Question 3 continued

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(Total for Question 3 is 4 marks)



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4. (a) Sketch the graph with equation

$$y = |2x - 5|$$

stating the coordinates of any points where the graph cuts or meets the coordinate axes.

(2)

(b) Find the values of x which satisfy

$$|2x - 5| > 7$$

(2)

(c) Find the values of x which satisfy

$$|2x - 5| > x - \frac{5}{2}$$

Write your answer in set notation.

(2)



5. The line l has equation

$$3x - 2y = k$$

where k is a real constant.

Given that the line l intersects the curve with equation

$$y = 2x^2 - 5$$

at two distinct points, find the range of possible values for k .

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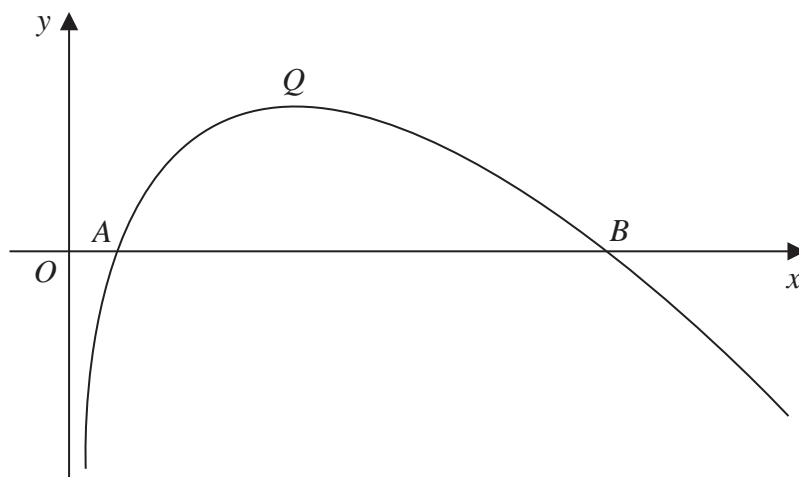


Figure 2

Figure 2 shows a sketch of the curve with equation $y = f(x)$, where

$$f(x) = (8 - x) \ln x, \quad x > 0$$

The curve cuts the x -axis at the points A and B and has a maximum turning point at Q , as shown in Figure 2.

(a) Find the x coordinate of A and the x coordinate of B . (1)

(b) Show that the x coordinate of Q satisfies

$$x = \frac{8}{1 + \ln x} \quad (4)$$

(c) Show that the x coordinate of Q lies between 3.5 and 3.6 (2)

(d) Use the iterative formula

$$x_{n+1} = \frac{8}{1 + \ln x_n} \quad n \in \mathbb{N}$$

with $x_1 = 3.5$ to

(i) find the value of x_5 to 4 decimal places,

(ii) find the x coordinate of Q accurate to 2 decimal places. (2)



Question 6 continued

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Horizontal lines for writing answers.

(Total for Question 6 is 9 marks)



7. A bacterial culture has area $p \text{ mm}^2$ at time t hours after the culture was placed onto a circular dish.

A scientist states that at time t hours, the rate of increase of the area of the culture can be modelled as being proportional to the area of the culture.

(a) Show that the scientist's model for p leads to the equation

$$p = ae^{kt}$$

where a and k are constants.

(4)

The scientist measures the values for p at regular intervals during the first 24 hours after the culture was placed onto the dish.

She plots a graph of $\ln p$ against t and finds that the points on the graph lie close to a straight line with gradient 0.14 and vertical intercept 3.95

(b) Estimate, to 2 significant figures, the value of a and the value of k .

(3)

(c) Hence show that the model for p can be rewritten as

$$p = ab^t$$

stating, to 3 significant figures, the value of the constant b .

(2)

With reference to this model,

(d) (i) interpret the value of the constant a ,

(ii) interpret the value of the constant b .

(2)

(e) State a long term limitation of the model for p .

(1)



Question 7 continued

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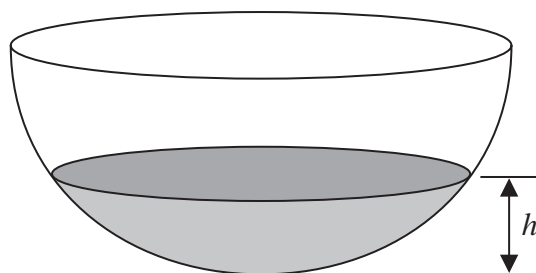


Figure 3

A bowl is modelled as a hemispherical shell as shown in Figure 3.

Initially the bowl is empty and water begins to flow into the bowl.

When the depth of the water is h cm, the volume of water, V cm³, according to the model is given by

$$V = \frac{1}{3} \pi h^2 (75 - h), \quad 0 \leq h \leq 24$$

The flow of water into the bowl is at a constant rate of 160π cm³ s⁻¹ for $0 \leq h \leq 12$

- (a) Find the rate of change of the depth of the water, in cm s⁻¹, when $h = 10$ (5)

Given that the flow of water into the bowl is increased to a constant rate of 300π cm³ s⁻¹ for $12 < h \leq 24$

- (b) find the rate of change of the depth of the water, in cm s⁻¹, when $h = 20$ (2)



9. A circle with centre $A(3, -1)$ passes through the point $P(-9, 8)$ and the point $Q(15, -10)$

(a) Show that PQ is a diameter of the circle.

(2)

(b) Find an equation for the circle.

(3)

A point R also lies on the circle.

Given that the length of the chord PR is 20 units,

(c) find the length of the shortest distance from A to the chord PR .

Give your answer as a surd in its simplest form.

(2)

(d) Find the size of angle ARQ , giving your answer to the nearest 0.1 of a degree.

(2)

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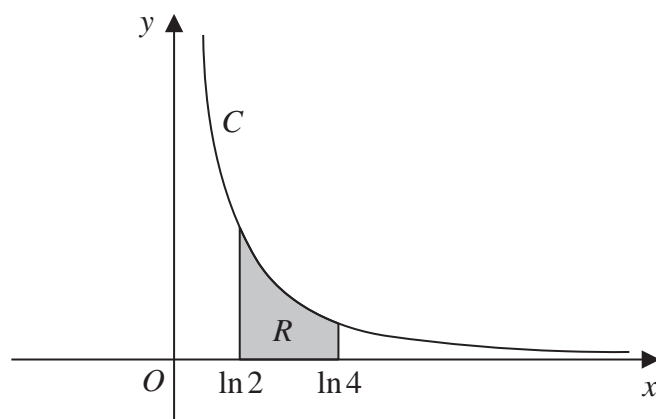


Figure 4

Figure 4 shows a sketch of the curve C with parametric equations

$$x = \ln(t + 2), \quad y = \frac{1}{t + 1}, \quad t > -\frac{2}{3}$$

(a) State the domain of values of x for the curve C .

(1)

The finite region R , shown shaded in Figure 4, is bounded by the curve C , the line with equation $x = \ln 2$, the x -axis and the line with equation $x = \ln 4$

(b) Use calculus to show that the area of R is $\ln\left(\frac{3}{2}\right)$.

(8)



11. The second, third and fourth terms of an arithmetic sequence are $2k$, $5k - 10$ and $7k - 14$ respectively, where k is a constant.

Show that the sum of the first n terms of the sequence is a square number.

(5)

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12. A curve C is given by the equation

$$\sin x + \cos y = 0.5 \quad -\frac{\pi}{2} \leq x < \frac{3\pi}{2}, -\pi < y < \pi$$

A point P lies on C .

The tangent to C at the point P is parallel to the x -axis.

Find the exact coordinates of all possible points P , justifying your answer.

(Solutions based entirely on graphical or numerical methods are not acceptable.)

(7)

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Question 12 continued

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(Total for Question 12 is 7 marks)



13. (a) Show that

$$\operatorname{cosec} 2x + \cot 2x \equiv \cot x, \quad x \neq 90n^\circ, n \in \mathbb{Z} \quad (5)$$

(b) Hence, or otherwise, solve, for $0 \leq \theta < 180^\circ$,

$$\operatorname{cosec}(4\theta + 10^\circ) + \cot(4\theta + 10^\circ) = \sqrt{3}$$

You must show your working.

(Solutions based entirely on graphical or numerical methods are not acceptable.)

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Question 13 continued

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(Total for Question 13 is 10 marks)



14. (i) Kayden claims that

$$3^x \geq 2^x$$

Determine whether Kayden's claim is always true, sometimes true or never true, justifying your answer.

(2)

(ii) Prove that $\sqrt{3}$ is an irrational number.

(6)

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Question 14 continued

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Question 14 continued

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(Total for Question 14 is 8 marks)

TOTAL FOR PAPER IS 100 MARKS

