

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Centre Number

Candidate Number

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Pearson Edexcel Level 3 GCE

Time 2 hours

Paper
reference

9MA0/01

Mathematics

Advanced

PAPER 1: Pure Mathematics 1

Mock set 4

You must have:

Mathematical Formulae and Statistical Tables (Green), calculator

Total Marks

Candidates may use any calculator allowed by Pearson regulations. 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.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 15 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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1. The point A has coordinates $(-3, -2)$
The point B has coordinates $(7, 5)$
The straight line l_1 passes through A and B .

(a) Find the gradient of l_1 giving your answer in simplest form. (2)

(b) Find an equation for l_1 giving your answer in the form $ax + by + c = 0$,
where a , b and c are integers to be found. (2)

Given that the line l_2 is perpendicular to l_1

(c) write down the gradient of l_2 (1)



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Question 1 continued

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(Total for Question 1 is 5 marks)



2. The sequence $u_1, u_2, u_3, \dots$ is defined by

$$u_{n+1} = pu_n + q$$

where p and q are constants.

Given that $u_1 = 4$

(a) write down u_2 in terms of p and q .

(1)

Given also that

- $u_2 = 10$
- $\sum_{r=1}^3 u_r = 42$

(b) find the value of p and the value of q .

(3)



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Question 2 continued

Lined area for writing the answer to Question 2.

(Total for Question 2 is 4 marks)



3. The functions f and g are defined by

$$\begin{aligned} f(x) &= e^{3x} + 2 & x &\in \mathbb{R} \\ g(x) &= \ln x & x &\in \mathbb{R} \quad x > 0 \end{aligned}$$

- (a) State the range of f (1)
- (b) Find $fg(x)$, giving your answer in simplest form. (2)
- (c) Find f^{-1} (3)



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Question 3 continued

Lined area for writing the answer to Question 3.

(Total for Question 3 is 6 marks)



4. Using the rules of logarithms, solve the equation

$$\log_2(x+2) + \log_2(x+3) - 2\log_2 x = 1$$

(4)

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Question 4 continued

Lined area for writing answers.

(Total for Question 4 is 4 marks)



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5. (a) Find the first 4 terms, in ascending powers of x , of the binomial expansion of

$$(2 + 3x)^6$$

giving each coefficient in simplest form.

(4)

- (b) Hence find the coefficient of x in the expansion of

$$\left(3x - \frac{1}{8x^2}\right)(2 + 3x)^6$$

(3)



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Question 5 continued

Lined area for writing the answer to Question 5.

(Total for Question 5 is 7 marks)



6. Prove by contradiction that for all positive real values of x

$$x + \frac{4}{x} \geq 4$$

(4)



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Question 6 continued

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(Total for Question 6 is 4 marks)



7. Relative to a fixed origin O

- the point A has position vector $8\mathbf{i} - 3\mathbf{j} + 2\mathbf{k}$
- the point B has position vector $t\mathbf{i} + 2t\mathbf{j} + 5t\mathbf{k}$

where t is a non-zero constant.

(a) Show that $\left| \overrightarrow{AB} \right|^2 = 30t^2 - 24t + 77$ (3)

(b) Hence find

- (i) the value of t when $\left| \overrightarrow{AB} \right|$ takes its minimum value,
- (ii) the minimum value of $\left| \overrightarrow{AB} \right|$, giving your answer as a simplified surd.
- (4)**

Given that

- $\left| \overrightarrow{AB} \right|$ takes its minimum value
- the point C lies on AB such that C divides AB in the ratio 5 : 3

(c) find the coordinates of C (2)



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Question 7 continued

Lined area for writing the answer to Question 7.



Question 7 continued

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Question 7 continued

Lined area for writing the answer to Question 7.

(Total for Question 7 is 9 marks)



8.

In this question you must show all stages of your working.**Solutions relying entirely on calculator technology are not acceptable.**(a) Given that $\cos 2\theta + \cos \theta + 1 \neq 0$, show that

$$\frac{\sin 2\theta + \sin \theta}{\cos 2\theta + \cos \theta + 1} \equiv \tan \theta \quad (3)$$

(b) Hence solve, for $0 < x < \pi$

$$\frac{\sin 2x + \sin x}{\cos 2x + \cos x + 1} = 2 \cos x$$

Give your answers to 3 decimal places.

(5)



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Question 8 continued

Lined area for writing the answer to Question 8.



Question 8 continued

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Question 8 continued

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(Total for Question 8 is 8 marks)



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Question 9 continued

Lined area for writing the answer to Question 9.



Question 9 continued

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Question 9 continued

Lined area for writing the answer to Question 9.

(Total for Question 9 is 9 marks)



10. A geometric series has

- first term $4 + k$
- second term $8 - 2k$

where k is a positive constant.

(a) Explain why the series does **not** converge when $k = 20$

(1)

Given that the series does converge,

(b) find the range of possible values of k .

(4)



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Question 10 continued

Lined area for writing the answer to Question 10.

(Total for Question 10 is 5 marks)



11. The global yearly energy output from onshore wind farms was first measured in 1996. The equation

$$E = ab^t \quad \text{where } a \text{ and } b \text{ are constants}$$

models the global yearly energy output, E gigawatts (GW), from onshore wind farms t years after 1996.

Given that the global yearly energy output from onshore wind farms was

- 74 GW in 2006
- 198 GW in 2010

- (a) (i) find the value of b to 3 decimal places,
(ii) find the value of a to one decimal place.

(4)

- (b) With reference to the model

- (i) interpret the value of a ,
- (ii) interpret the value of b .

(2)

Using the model,

- (c) find the predicted global yearly energy output from onshore wind farms in 2025.

(2)



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Question 11 continued

Lined area for writing the answer to Question 11.

(Total for Question 11 is 8 marks)



12. (a) Find

$$\int x^2 e^{x^3} dx$$

(2)

(b) Using the substitution $u = x^3$ or otherwise, show by integration that

$$\int x^8 e^{x^3} dx = \frac{1}{3} e^{x^3} (x^6 + Ax^3 + B) + c$$

where A and B are constants to be found and c is an arbitrary constant.

(5)



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Question 12 continued

Lined area for writing the answer to Question 12.



Question 12 continued

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Question 12 continued

Lined area for writing the answer to Question 12.

(Total for Question 12 is 7 marks)



13. (a) Express $\frac{1}{x(100-x)}$ in partial fractions.

(2)

A scientist is studying the spread of a fungus in a field.
The field has an area of 100 m^2

The area of the field affected by the fungus, $x\text{ m}^2$, is modelled by the differential equation

$$500 \frac{dx}{dt} = x(100 - x)$$

where t days is the time after the start of the study.

Given that at the start of the study 5 m^2 of the field was affected by the fungus,

- (b) solve the differential equation to show that

$$x = \frac{A}{1 + Be^{-\frac{1}{5}t}}$$

where A and B are constants to be found.

(6)

- (c) Hence find the area of the field affected by the fungus 10 days after the start of the study.

(2)



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Question 13 continued

Lined area for writing the answer to Question 13.



Question 13 continued

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Question 13 continued

Lined area for writing the answer to Question 13.

(Total for Question 13 is 10 marks)



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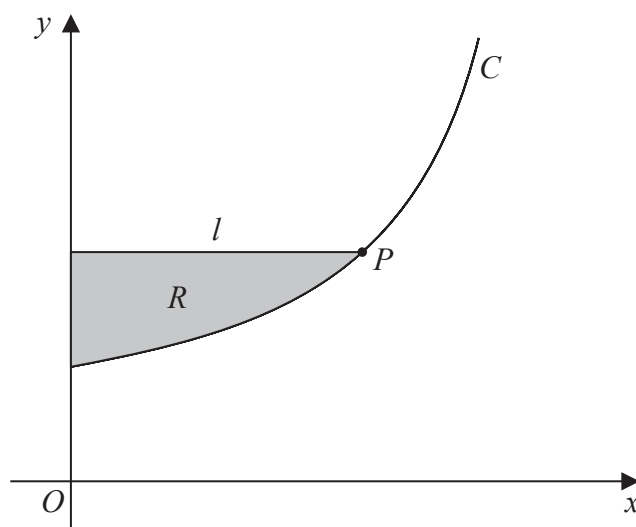


Figure 1

Figure 1 shows a sketch of the curve C with parametric equations

$$x = \frac{1}{2} \theta \sin \theta \quad y = \frac{1}{3} \sec \theta \quad 0 \leq \theta \leq \frac{5\pi}{12}$$

The point P lies on C where $\theta = \frac{\pi}{3}$

(a) Find, in simplest form, the exact Cartesian coordinates of P

(2)

The line l meets C at P and is parallel to the x -axis.

The region R shown shaded in Figure 1 is bounded by C , the y -axis and l .

(b) Show that the area of R is given by

$$A\pi\sqrt{3} - B \int_0^{\frac{\pi}{3}} (\tan \theta + \theta) \, d\theta$$

where A and B are rational numbers to be found.

(5)

(c) Hence, use algebraic integration to find the exact area of R

(3)



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Question 14 continued

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Question 14 continued

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Question 14 continued

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(Total for Question 14 is 10 marks)



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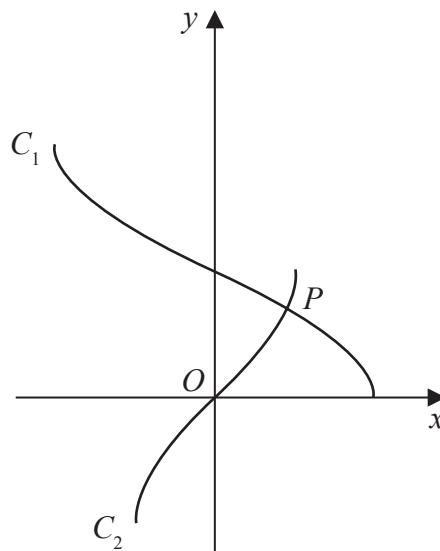


Figure 2

Figure 2 shows a sketch of

- the curve C_1 with equation $y = \arccos \frac{1}{2}x$
- the curve C_2 with equation $y = \arcsin x$

The curves meet at the point P as shown in Figure 2.

(a) Show that at P

$$\tan y = 2 \tag{2}$$

(b) Hence, or otherwise, find the exact x coordinate of P (2)

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Question 15 continued

Lined area for writing the answer to Question 15.



Question 15 continued

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(Total for Question 15 is 4 marks)

TOTAL FOR PAPER IS 100 MARKS

