

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

9MA0/02

Mathematics

Advanced

PAPER 2: Pure Mathematics 2

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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Pearson

1.

In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

(a) Find the values of x that satisfy

(i) $2x - 10 < 3(5 - x)$ (2)

(ii) $x^2 - 11x + 24 \leq 0$ (2)

(b) Hence find the values of x that satisfy both

$2x - 10 < 3(5 - x)$ and $x^2 - 11x + 24 \leq 0$ (1)



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Question 1 continued

Lined area for writing answers.

(Total for Question 1 is 5 marks)



2.

$$f(x) = x^3 - 5x^2 + \frac{3}{x} - 4 \quad x > 0$$

(a) Find $f'(x)$.

(2)

Given that $f(0.5) = 0.875$ and $f(0.6) = -0.584$ (b) explain why the equation $f(x) = 0$ has a root in the interval $[0.5, 0.6]$

(1)

Given that this root is α and using 0.5 as a first approximation to α (c) apply the Newton-Raphson method once to $f(x)$ to find a second approximation to α .
Give your answer to 3 decimal places.

(2)



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Question 2 continued

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(Total for Question 2 is 5 marks)



3.

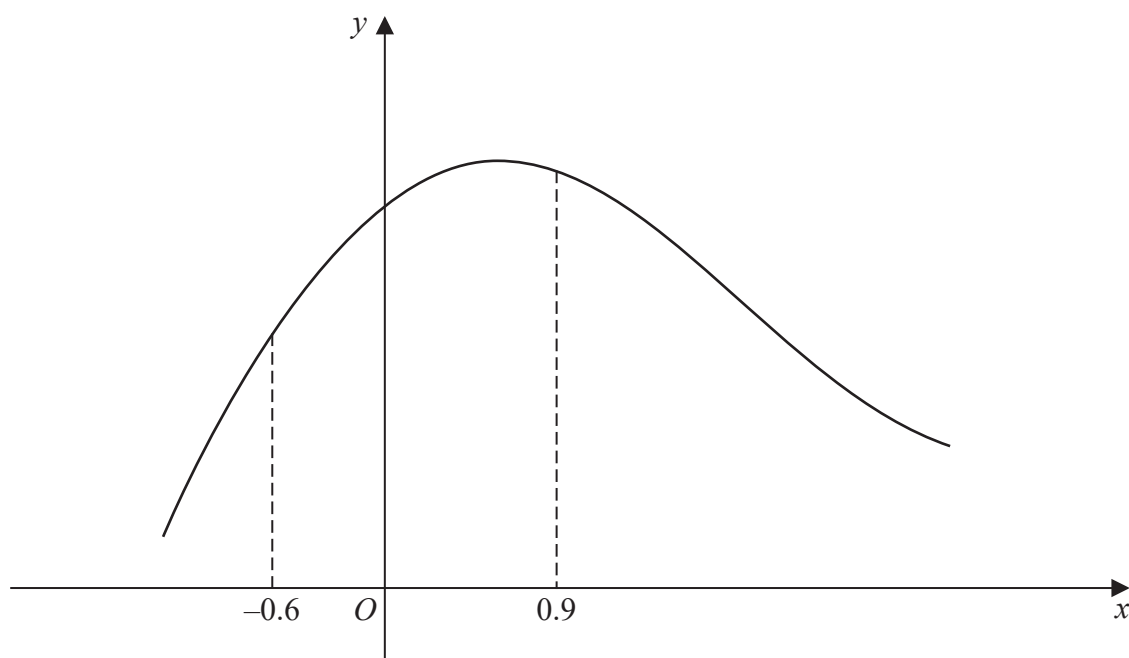
**Figure 1**

Figure 1 shows a sketch of part of the curve with equation $y = f(x)$.

The table shows corresponding values of x and y for this curve between $x = -0.6$ and $x = 0.9$

x	-0.6	-0.3	0	0.3	0.6	0.9
y	1.811	2.342	2.718	2.941	3.011	2.944

- (a) Use the trapezium rule, with all the values of y in the table, to find an estimate for

$$\int_{-0.6}^{0.9} f(x) \, dx$$

Give your answer to 3 significant figures.

(3)

- (b) State whether the answer to part (a) is an underestimate or overestimate of

$$\int_{-0.6}^{0.9} f(x) \, dx$$

justifying your answer.

(1)

- (c) Using the answer to part (a), find an estimate for

$$\int_{-0.6}^{0.9} (8 - 2f(x)) \, dx$$

(3)



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Question 3 continued

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(Total for Question 3 is 7 marks)



4.

$$f(x) = px^3 - 7x^2 - x + q$$

where p and q are constants.

Given that $(2x + 1)$ is a factor of $f(x)$

(a) show that

$$8q - p = 10$$

(2)

Given that $(x - 1)$ is also a factor of $f(x)$

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

(2)



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Question 4 continued

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(Total for Question 4 is 4 marks)



5. Given that θ is small and in radians, use the small angle approximations to find an approximate value of

$$\frac{\cos 9\theta - 1}{\theta \sin \theta}$$

(3)

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Question 5 continued

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(Total for Question 5 is 3 marks)



6. The curve C has equation

$$y = ax^3 + bx^2 + 12x + 2$$

where a and b are constants.

(a) Find, in terms of a and b ,

(i) $\frac{dy}{dx}$

(ii) $\frac{d^2y}{dx^2}$

(3)

Given that

- the point $P\left(\frac{3}{2}, \frac{13}{2}\right)$ lies on C
- $\frac{d^2y}{dx^2} = 0$ at P

(b) find the value of a and the value of b .

(2)

(c) Show that P is a point of inflection.

(2)



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Question 6 continued

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(Total for Question 6 is 7 marks)



7.

In this question you must show all stages of your working.**Solutions relying on calculator technology are not acceptable.**

Show that

$$\lim_{\delta x \rightarrow 0} \sum_{x=2}^3 \frac{(x-3)^2}{x^{\frac{3}{2}}} \delta x = p\sqrt{2} + q\sqrt{3}$$

where p and q are constants to be found.

(5)



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Question 7 continued

Lined area for writing the answer to Question 7.

(Total for Question 7 is 5 marks)



8. Lina has started a business selling candles.
In the first week of trading, Lina sold 150 candles.

In a model for future trading, Lina predicts that the number of candles sold each week will increase by a fixed number, d , so that

- $150 + d$ candles will be sold in week 2
- $150 + 2d$ candles will be sold in week 3

and so on.

- (a) Use the model with $d = 10$ to find
- (i) the number of candles sold in week 30
 - (ii) the **total** number of candles sold in the first 30 weeks of trading.
- (4)**

Lina must sell at least 15 000 candles in the first year of trading to make a profit. Given that Lina's business does make a profit in the first year,

- (b) find, according to the model, the smallest possible value of d . (2)
- (c) State a limitation of the model. (1)



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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 7 marks)



9.

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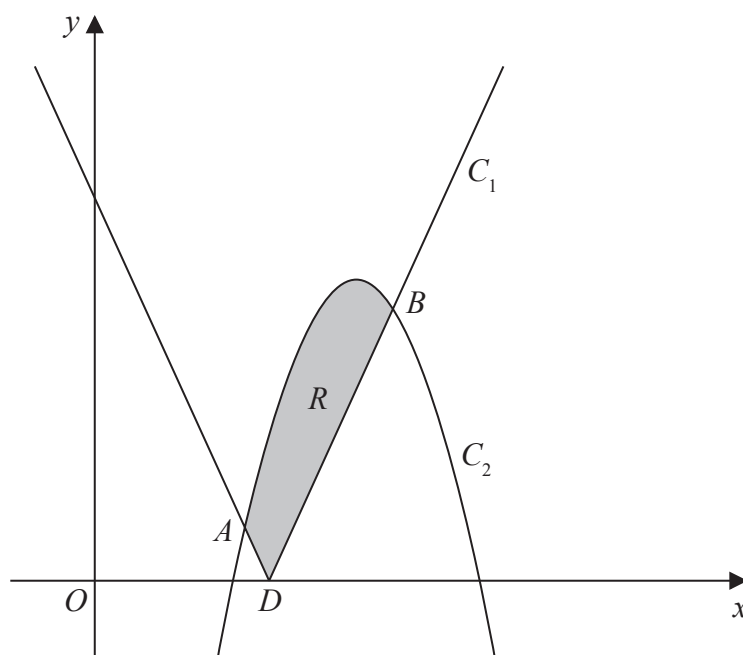


Figure 2

In Figure 2

- the graph C_1 has equation $y = |7 - 3x|$
- the curve C_2 has equation $y = -2x^2 + 14x - 19$
- C_1 intersects C_2 at the points A and B

Given that C_1 meets the x -axis at the point D , as shown in Figure 2,(a) find the x coordinate of D . (1)(b) Verify that the x coordinate of A is 2 (1)(c) Using algebra and showing your working, find the coordinates of B . (3)The region R , shown shaded in Figure 2, is bounded by C_1 and C_2 (d) Use algebraic integration to find the area of R . (5)

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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

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(Total for Question 9 is 10 marks)



10. The circle C_1 has Cartesian equation

$$x^2 + y^2 = 10x + k \quad x \in \mathbb{R} \quad y \in \mathbb{R}$$

where k is a constant.

The curve C_2 has parametric equations

$$x = t^2 \quad y = 2t \quad t \in \mathbb{R}$$

The curves C_1 and C_2 intersect at 4 distinct points.

Find the range of possible values for k , giving your answer in set notation.

(6)



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Question 10 continued

Lined area for writing the answer to Question 10.

(Total for Question 10 is 6 marks)



11. Prove, using algebra, that for all positive integers n that are **not** divisible by 3

$$n^2 - 1$$

is divisible by 3

(4)



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Question 11 continued

Lined area for writing the answer to Question 11.

(Total for Question 11 is 4 marks)



12.

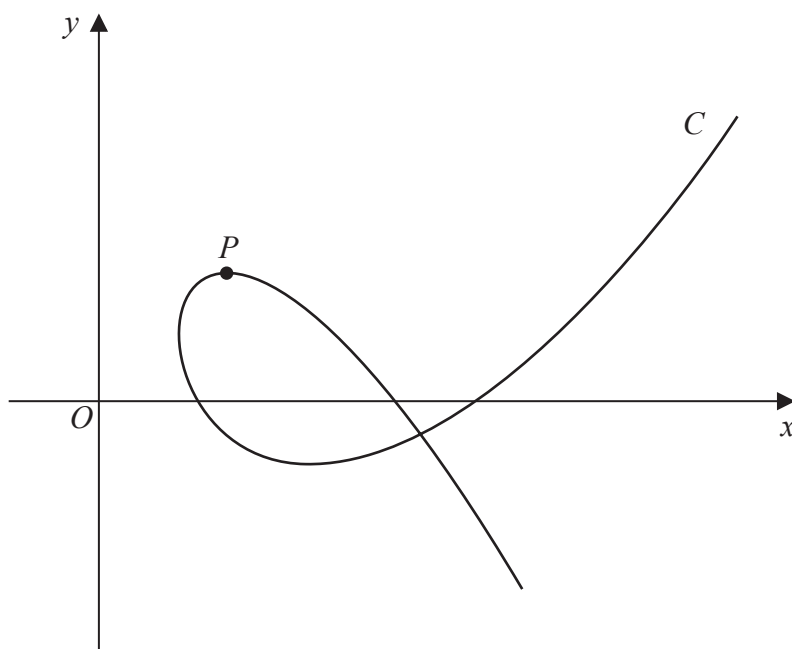


Figure 3

Figure 3 shows a sketch of the curve C with parametric equations

$$x = t^2 + t + 4 \quad y = t^3 - 12t + 5 \quad -5 \leq t \leq 5$$

- (a) Find $\frac{dy}{dx}$ in terms of t .

(2)

Given that the point P lies on C such that the tangent to C at P is parallel to the x -axis,

- (b) find the coordinates of P .

(2)

Given that this tangent meets C again at the point Q ,

- (c) find, using algebra, the coordinates of Q .

(3)



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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

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(Total for Question 12 is 7 marks)



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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 8 marks)



14. The curve C has equation

$$y = \frac{e^{2x}}{x^3 + 4} \quad x > -1$$

(a) Find $\frac{dy}{dx}$

(3)

The point P with x coordinate p lies on C .

The line l is the tangent to C at P .

Given that l passes through the origin,

(b) show that $x = p$ is a solution of the equation

$$x^4 - 2x^3 + 4x - 2 = 0$$

(3)

The iteration formula

$$x_{n+1} = \frac{2x_n^3 + 2}{x_n^3 + 4}$$

with $x_1 = 0.5$ is used to find an approximation for p .

(c) Use the iteration formula to find the value, to 4 decimal places, of

(i) x_2

$$(ii) \quad p$$

(3)

(d) Hence find the gradient of l , giving your answer to 2 decimal places.

(1)

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Question 14 continued

Lined area for writing the answer to Question 14.



Question 14 continued

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Question 14 continued

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(Total for Question 14 is 10 marks)



15. (a) Find the values of the constants A , B and C for which

$$\frac{u^2}{u^2 - 1} \equiv A + \frac{B}{u + 1} + \frac{C}{u - 1} \quad (3)$$

(b) Use the substitution $u = \sqrt{1 + e^{3x}}$ to show that

$$\int_{\frac{1}{2} \ln 3}^{\frac{1}{3} \ln 8} \sqrt{1 + e^{3x}} \, dx = k \int_{\alpha}^{\beta} \frac{u^2}{u^2 - 1} \, du$$

where k , α and β are constants to be found. (5)

(c) Using the answers from parts (a) and (b) and algebraic integration, show that

$$\int_{\frac{1}{3} \ln 3}^{\frac{1}{3} \ln 8} \sqrt{1 + e^{3x}} \, dx = p + q \ln r$$

where p, q and r are rational numbers to be found. (4)



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Question 15 continued

Lined area for writing the answer to Question 15.



Question 15 continued

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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 12 marks)

TOTAL FOR PAPER IS 100 MARKS

