



MATHEMALEX



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Pearson Edexcel Level 3 GCE (Style)

MATHEMATICS



Advanced – Paper 1: Pure Mathematics 1

PRACTICE PAPER 1 (9MA0/01 STYLE)



Time: 2 hours



Total marks: 100

Instructions

- Answer all questions.
- Show sufficient working to make your methods clear.
- Give answers to three significant figures unless otherwise stated.
- You may use a calculator.



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EXAM
FOCUSED



CONCEPT
CLARITY



ACHIEVE
EXCELLENCE

$$f(x) = 2x^3 + ax^2 + bx - 2$$

Given that $(x - 2)$ is a factor of $f(x)$, and that $f(x)$ leaves a remainder of -18 when divided by $(x + 1)$,

- (a) Find the value of a and the value of b .

[illegible]

- (b) Hence factorise $f(x)$ completely.

(Total for Question 1 is 6 marks)

Question 2

- (a) Find, in ascending powers of x , up to and including the term in x^2 , the binomial expansion of

$$(8 - 12x)^{-\frac{1}{3}}$$

giving each coefficient as a simplified fraction.

- (b) State the range of values of x for which the expansion is valid.

(Total for Question 2 is 4 marks)

(a) Prove that

$$\frac{\cos \theta}{1 - \sin \theta} + \frac{\cos \theta}{1 + \sin \theta} \equiv \frac{2}{\cos \theta}$$

[illegible]
$$0 \leq \theta < 2\pi$$
$$\frac{\cos \theta}{1 - \sin \theta} + \frac{\cos \theta}{1 + \sin \theta} = 4$$

4

$$\cos \theta \neq 0$$

[illegible]

(Total for Question 3 is 6 marks)

(a) Given that

use differentiation from first principles to show that

$$\frac{dy}{dx} = 3x^2$$

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$$x = -2$$

(Total for Question 4 is 5 marks)

The function f is defined by

(a) Sketch the graph of $y = f(x)$, stating the coordinates of the vertex and any points where the graph meets the coordinate axes.

[illegible]

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

[illegible]

(Total for Question 5 is 7 marks)

The second term of a geometric series is -8 and the sum to infinity of the series is 18 .

$$9r^2 - 9r - 4 = 0$$
[illegible]

(c) Find the smallest value of n for which the sum of the first n terms is within 0.01 of the sum to infinity.

(Total for Question 6 is 8 marks)

The points

$$A(-1, 2), \quad B(5, 4), \quad C(3, -2)$$

lie on a circle.

- (a) Show that angle ABC is a right angle.

[illegible]

- (b) Hence explain why AC is a diameter, and find the equation of the circle in the form

$$(x - a)^2 + (y - b)^2 = r^2$$

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

- (c) Find an equation of the tangent to the circle at the point B , giving your answer in the form

$$px + qy + s = 0$$

where p, q, s are integers.

(Total for Question 7 is 8 marks)

The temperature, $\theta^{\circ}\text{C}$, of a cup of coffee t minutes after it is poured is modelled by

where A and k are positive constants.

When the coffee is poured its temperature is 90°C . After 5 minutes the temperature has fallen to 70°C .

- (a) Find the value of A and show that

$$k = \frac{1}{5} \ln \left(\frac{68}{48} \right)$$

[illegible]

(b) Find, according to the model, the rate at which the temperature is decreasing at the instant $t = 5$.

Give your answer to 3 significant figures.

(c) Explain why, according to the model, the temperature of the coffee never falls below 22°C .

(Total for Question 8 is 7 marks)

Question 9

The functions f and g are defined by

$$f(x) = \frac{3}{x-2}, \quad x \in \mathbb{R}, \ x \neq 2$$

and

$$g(x) = x^2 + 4x + 7, \quad x \in \mathbb{R}$$

- (a) Find the range of g .

- (b) Find $f^{-1}(x)$ and state its domain.

(c) Show that the equation

$$fg(x) = 1$$

has no real solutions.

(d) Solve the equation

$$gf(x) = 7$$

(Total for Question 9 is 10 marks)

Question 10

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

Solutions relying entirely on calculator technology are not acceptable.

A curve C has parametric equations

$$x = 2 \cos \theta$$

$$y = \sin^2 \theta, \quad 0 \leq \theta \leq \frac{\pi}{2}$$

(a) Find

$$\frac{dy}{dx}$$

in terms of θ , and hence find the exact coordinates of the point on C at which the tangent is parallel to the x -axis.

(b) Show that a Cartesian equation of C may be written as

$$y^2 = x^2 \left(1 - \frac{x^2}{4} \right)$$

(Total for Question 10 is 8 marks)

(b) Using $p = 4$, find

$$\sum_{n=1}^4 a_n$$

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

(Total for Question 11 is 6 marks)

(a) Express

in the form

where $R > 0$ and

Give α in radians to 3 decimal places.

[illegible]

The depth of water, D metres, in a harbour t hours after midnight is modelled by

$$D = 18 + 5 \sin(0.5t) - 12 \cos(0.5t)$$

- (b) Find the maximum depth of water predicted by the model and the value of t , for

$$0 \leq t < 12$$

at which it first occurs.

Give t to 2 decimal places.

(c) Find, to the nearest minute, the first time after midnight at which the depth is equal to 25 metres.

(Total for Question 12 is 8 marks)

Question 13

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

- (a) Use integration by parts to show that

$$\int x^2 \ln x \, dx = \frac{x^3}{3} \ln x - \frac{x^3}{9} + c$$

(Total for Question 13 is 7 marks)

A spherical mint is dissolving.

At time t minutes after dissolving begins, the radius is r mm.

(a) Show that

$$r^3 = 125 - \frac{61}{2}t$$

[illegible]

(b) Find, according to the model, the time at which the mint completely dissolves.
Give your answer to the nearest second.

(Total for Question 14 is 5 marks)

1. Prove by contradiction that

is irrational.

You may assume that if 3 divides n^2 , then 3 divides n .

[illegible]

2. Prove that for all integers n , the expression

$$n^3 - n$$

is divisible by 6.

[illegible]

(Total for Question 15 is 5 marks)

END OF PAPER

TOTAL FOR PAPER: 100 MARKS