

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 International GCSE

Tuesday 29th October 2024

Morning (Time: 2 hours)	Paper reference	4PM1/01
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Further Pure Mathematics

PAPER 1



Calculators may be used.	Total Marks
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Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Without sufficient working, correct answers may be awarded no marks.
- Answer the questions in the spaces provided
– *there may be more space than you need.*
- You must **NOT** write anything on the formulae page.
Anything you write on the formulae page will gain **NO** credit.

Information

- 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.
- Check your answers if you have time at the end.

Turn over ►

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International GCSE in Further Pure Mathematics Formulae sheet

Mensuration

$$\text{Surface area of sphere} = 4\pi r^2$$

$$\text{Curved surface area of cone} = \pi r \times \text{slant height}$$

$$\text{Volume of sphere} = \frac{4}{3}\pi r^3$$

Series**Arithmetic series**

$$\text{Sum to } n \text{ terms, } S_n = \frac{n}{2}[2a + (n-1)d]$$

Geometric series

$$\text{Sum to } n \text{ terms, } S_n = \frac{a(1-r^n)}{(1-r)}$$

$$\text{Sum to infinity, } S_\infty = \frac{a}{1-r} \quad |r| < 1$$

Binomial series

$$(1+x)^n = 1 + nx + \frac{n(n-1)}{2!}x^2 + \dots + \frac{n(n-1)\dots(n-r+1)}{r!}x^r + \dots \quad \text{for } |x| < 1, n \in \mathbb{Q}$$

Calculus**Quotient rule (differentiation)**

$$\frac{d}{dx} \left(\frac{f(x)}{g(x)} \right) = \frac{f'(x)g(x) - f(x)g'(x)}{[g(x)]^2}$$

Trigonometry**Cosine rule**

$$\text{In triangle } ABC: a^2 = b^2 + c^2 - 2bc \cos A$$

$$\tan \theta = \frac{\sin \theta}{\cos \theta}$$

$$\sin(A+B) = \sin A \cos B + \cos A \sin B$$

$$\sin(A-B) = \sin A \cos B - \cos A \sin B$$

$$\cos(A+B) = \cos A \cos B - \sin A \sin B$$

$$\cos(A-B) = \cos A \cos B + \sin A \sin B$$

$$\tan(A+B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$$

$$\tan(A-B) = \frac{\tan A - \tan B}{1 + \tan A \tan B}$$

Logarithms

$$\log_a x = \frac{\log_b x}{\log_b a}$$

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Answer all TEN questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 (a) On the grid below, draw the line with equation

(i) $3x + 4y = 24$ (ii) $2x - 5y + 10 = 0$

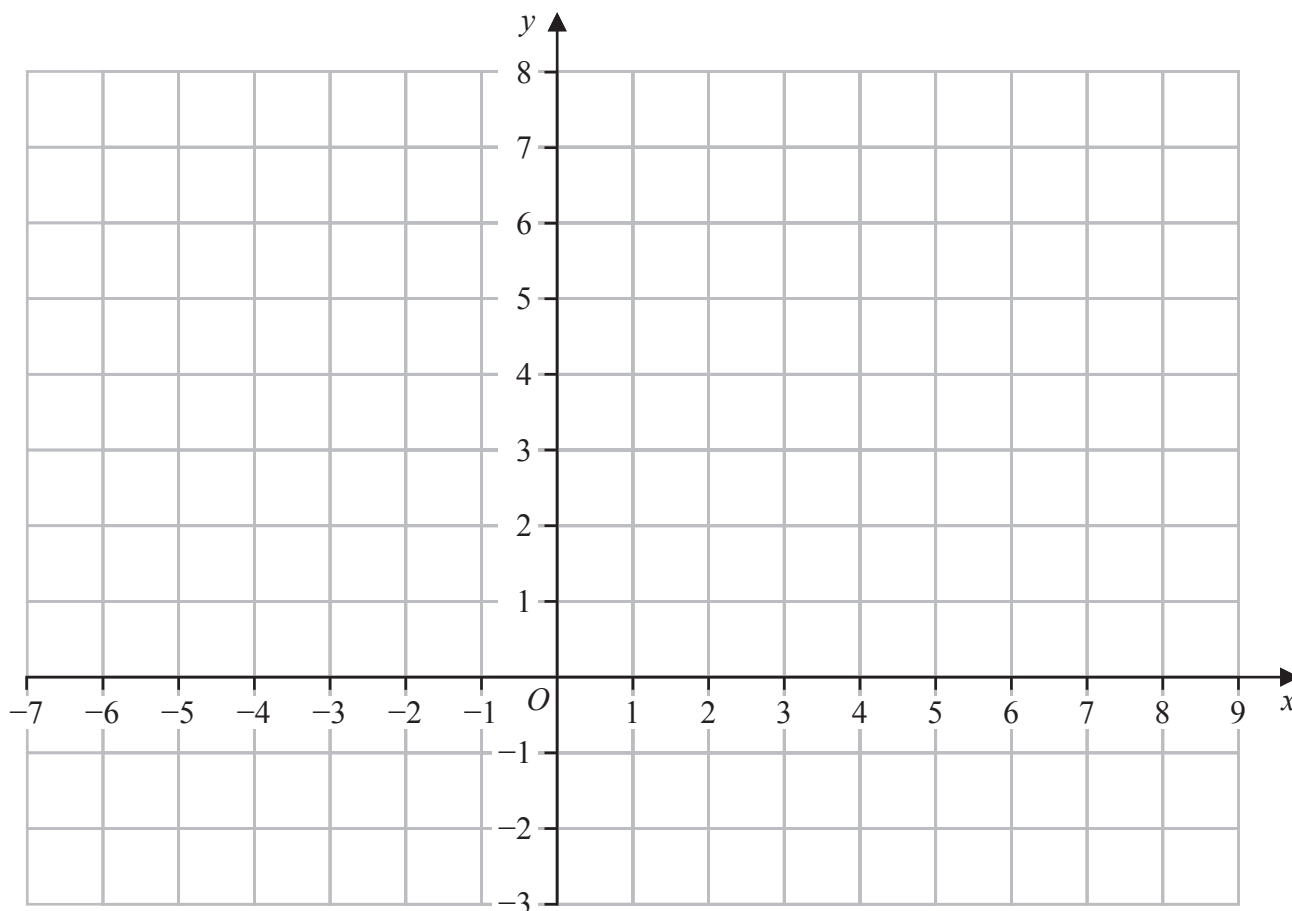
(2)

(b) Show, by shading on the grid, the region R defined by the inequalities

$3x + 4y \leq 24$ $2x - 5y + 10 \geq 0$ $y \leq 5$ $x \geq -1$

Label the region R

(2)



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Question 1 continued

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(Total for Question 1 is 4 marks)



- 2 The sum of the fifth, sixth and seventh terms of an arithmetic series A is nine times the sum of the first and second terms.
The third term of A is 12

(a) Find the first term and common difference of A

(5)

The n th term of A is u_n

(b) Find the value of $\sum_{r=15}^{60} u_r$

(4)

The sum to n terms of A is S_n

Given that $2S_n - 5u_n = 10$

(c) find the value of n

(4)

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Question 2 continued

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(Total for Question 2 is 13 marks)



3 Triangle ABC is such that

$$AC = 10\text{cm} \quad BC = 7\text{cm} \quad \text{angle } CAB = 25^\circ$$

Given that angle ABC is obtuse,

find, in cm to one decimal place, the length of AB

(5)

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Question 3 continued

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(Total for Question 3 is 5 marks)



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Question 4 continued

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(Total for Question 4 is 6 marks)



5 A particle P is moving along a straight line.

At time t seconds ($t \geq 0$), the velocity, v m/s, of P is given by

$$v = 3t^2 - 16t + 5$$

(a) Find the values of t when P is instantaneously at rest.

(3)

At time t seconds the acceleration of P is a m/s²

(b) Find the range of values of t for which $a > 0$

(2)

(c) Find the distance, in m, that P travels in the interval $1 \leq t \leq 4$

(5)

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Question 5 continued

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(Total for Question 5 is 10 marks)



6 (a) Show that

$$\frac{a}{\sqrt{4+bx}} = \frac{a}{2} \left(1 + \frac{bx}{4}\right)^{\frac{1}{2}} \text{ where } a \text{ and } b \text{ are positive integers.} \quad (2)$$

The expansion of $\frac{a}{\sqrt{4+bx}}$ in ascending powers of x can be written as

$$P + Qx + Rx^2 + Sx^3$$

where P , Q , R and S are rational numbers.

(b) Show that $Q = -\frac{ab}{16}$ and $S = -\frac{5ab^3}{2048}$
and find P and R in terms of a and b , as fractions in their lowest terms. (4)

Given that $Q = \frac{128}{5}S$ and $R = \frac{9}{256}$

(c) show that $a = 3$ and $b = 1$ (3)

(d) Hence, using an appropriate value of x , find, to 3 decimal places, an approximate value for $\frac{\sqrt{6}}{2}$ (3)

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Question 6 continued

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Question 6 continued

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(Total for Question 6 is 12 marks)



7

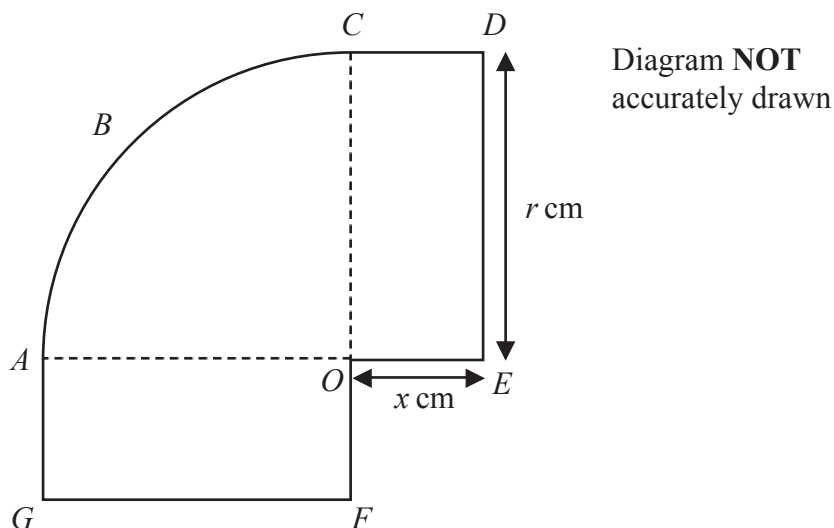


Figure 2

Figure 2 shows a shape *ABCDEOFG*

ABCO is a quarter circle with radius r cm

CDEO and *AOFG* are congruent rectangles of length r cm and width x cm

The total area of the shape is 100 cm^2

The perimeter of the shape is P cm

(a) Show that $P = \frac{200}{r} + 2r$ (4)

(b) Use calculus to find the value of r for which P is a minimum, justifying that this value of r gives a minimum value of P (5)

(c) Find the minimum value of P (2)

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Question 7 continued

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Question 7 continued

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Question 7 continued

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(Total for Question 7 is 11 marks)



Question 8 continued

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Question 8 continued

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(Total for Question 8 is 11 marks)



Question 9 continued

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Question 9 continued

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(Total for Question 9 is 10 marks)



10

$$f(x) = 3 - 4x - 9x^2$$

Given that $f(x)$ can be expressed in the form $A - B(x + C)^2$ where A , B and C are positive constants

(a) find the value of A , the value of B and the value of C (4)

(b) Hence write down the maximum value of $f(x)$ (1)

The equation $f(x) = 0$ has roots α and β

Without solving the equation $f(x) = 0$

(c) form a quadratic equation, with integer coefficients, that has roots $\frac{3\alpha}{\beta}$ and $\frac{3\beta}{\alpha}$ (6)

(d) Show that $(x + y)^3 = x^3 + y^3 + 3xy(x + y)$ (1)

$$g(x) = 3x^2 + qx + r \text{ where } q \text{ and } r \text{ are constants}$$

The equation $g(x) = 0$ has roots $\alpha^2 - \beta$ and $\beta^2 - \alpha$ where α and β are the roots of the equation $f(x) = 0$

(e) Using your answer to part (d), find in simplified exact form, the value of q and the value of r (6)

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Question 10 continued

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