Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International GCSE

Tuesday 20 May 2025

Afternoon (Time: 2 hours)

Paper reference **4PM1/01**

Further Pure Mathematics

PAPER 1

Calculators may be used.

Total Marks

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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P 7 2 8 6 5 A 0 1 3 6

Pearson

International GCSE in Further Pure Mathematics Formulae sheet

Mensuration

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

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

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

Series

Arithmetic series

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

Geometric series

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

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

Binomial series

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

Calculus

Quotient rule (differentiation)

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

Trigonometry

Cosine rule
In triangle ABC: $a^2 = b^2 + c^2 - 2bc\cos A$

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

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

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

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

Logarithms

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

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There are no questions on this page.

Answer all ELEVEN questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 A particle P moves in a straight line. At time t seconds, the velocity, v m/s, of P is given by

$$v = 3t^2 - 9t + 7$$

(a) Show that P never comes to rest.

(2)

(b) Find the acceleration of P, in m/s^2, when $t = 4$

(2)

Using algebra

(c) find the distance, in m, that P travels in the interval $0 \leqslant t \leqslant 5$

(3)

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Question 1 continued

(Total for Question 1 is 7 marks)

2 The point A has coordinates $(3, 2)$, the point B has coordinates $(8, 3)$ and the point C has coordinates $(4, 7)$

(a) Show that ABC is an isosceles triangle.

(2)

The midpoint of BC is M

(b) Find an equation of the line that passes through A and M

Give your answer in the form $y = mx + c$

(3)

The points A, C and D are collinear such that $AD = kAC \quad (k > 1)$

Given that $\angle ABD = 90^\circ$

(c) find the coordinates of D
Show your working clearly.

(8)

Question 2 continued

Question 2 continued

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Question 2 continued

(Total for Question 2 is 13 marks)

3

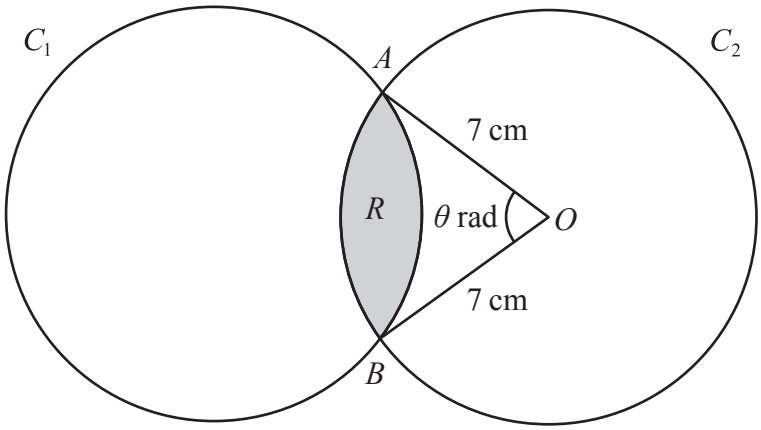


Diagram **NOT** accurately drawn

Figure 1

Figure 1 shows circle C_1 with radius 7 cm and circle C_2 with centre O and radius 7 cm

The circles C_1 and C_2 intersect at the point A and at the point B

The size of angle AOB is θ radians

The perimeter of the region R shown shaded in Figure 1 is $\frac{28\pi}{9}$ cm

(a) Find the exact value of θ

(2)

(b) Find the area, in cm^2 to 3 significant figures, of the region R

(4)

Question 3 continued

(Total for Question 3 is 6 marks)

4 (a) On the grid opposite, draw the graph of the line with equation

(i) $3x + 2y = 18$ (ii) $x + 3y - 6 = 0$ (iii) $y = 3x$

(3)

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

$3x + 2y \leqslant 18$ $x + 3y - 6 \geqslant 0$ $y \leqslant 3x$

(1)

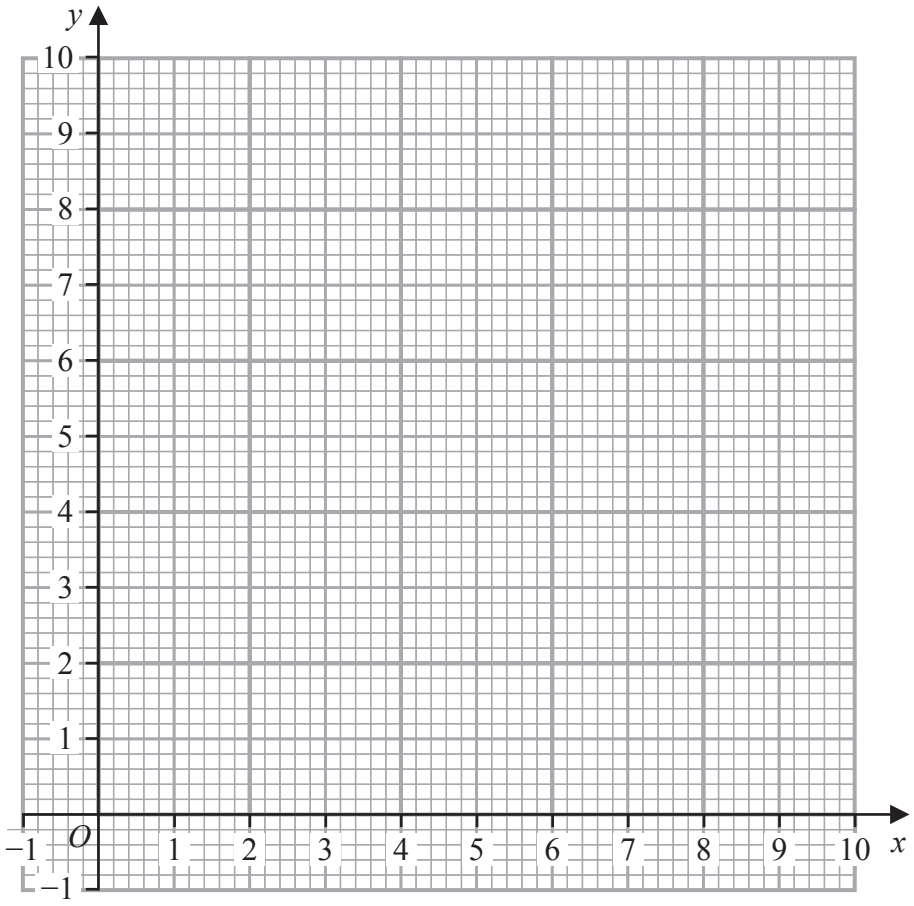
For all points in R, with coordinates (x, y)

$$P = 2x - y$$

(c) find the least value of P

(4)

Question 4 continued



Turn over for a spare grid if you need to redraw your graph.

Question 4 continued

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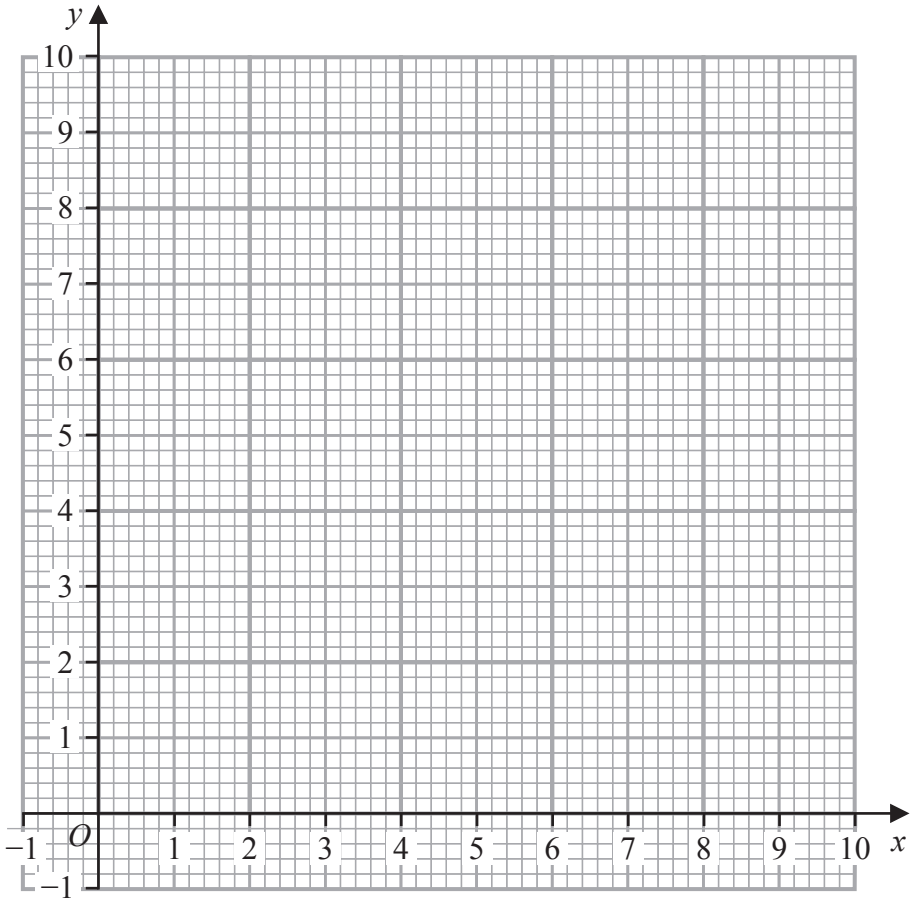
Question 4 continued

Only use this grid if you need to redraw your graph.



(Total for Question 4 is 8 marks)

5 (a) Show that $(\alpha+\beta)^3-3\alpha\beta(\alpha+\beta)=\alpha^3+\beta^3$

(2)

The quadratic equation $2x^2-6x-7=0$ has roots α and β

Without solving the equation

(b) form a quadratic equation, with integer coefficients, which has roots $\frac{\alpha^2}{\beta}$ and $\frac{\beta^2}{\alpha}$

(6)

Question 5 continued

(Total for Question 5 is 8 marks)

6 (a) Show that $\sqrt{4-x} = A\left(1-\frac{x}{B}\right)^{\frac{1}{2}}$ where A and B are integers to be found.

(2)

(b) Hence expand $\sqrt{4-x}$ in ascending powers of x up to and including the term in x^3
Give each coefficient as an exact fraction in its lowest terms.

(3)

(c) Use your expansion with a suitable value of x to obtain an estimate of $\frac{\sqrt{305}}{10}$

Give your answer correct to 5 decimal places.

(3)

Question 6 continued

(Total for Question 6 is 8 marks)

7

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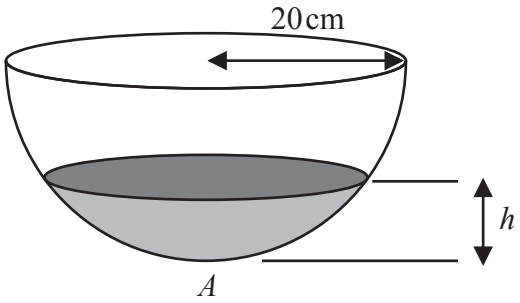

Figure 2

Figure 2 shows a hollow hemisphere with radius 20 cm

The hemisphere contains liquid, which is dripping out of a small hole at the lowest point A at a constant rate of k cm^3/s

At time t seconds after the liquid starts to drip from the hemisphere, the height of the liquid is h cm above A

The volume V cm^3 of liquid in the hemisphere is given by

$$V = \frac{\pi}{3}h^2(60 - h)$$

When $h = 12$, the height of the liquid is decreasing at a rate of $\frac{1}{60}$ cm/s

Find the value of k
Give your answer in terms of π

(6)

Question 7 continued

Question 7 continued

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Question 7 continued

(Total for Question 7 is 6 marks)

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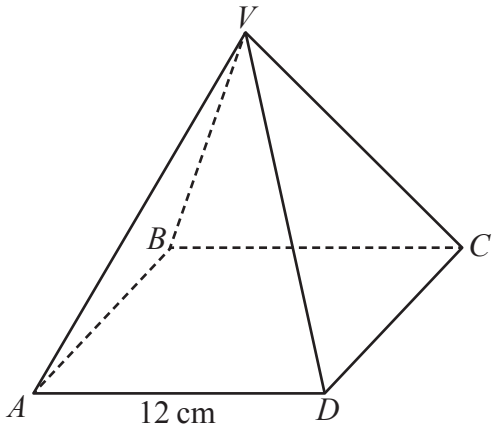

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Figure 3

Figure 3 shows a right pyramid with vertex V and square base, $ABCD$, of side 12 cm

The size of the angle between the plane VAB and the base $ABCD$ is $30°$

(a) Show that the height of the pyramid is $2\sqrt{3}$ cm

(2)

(b) Find, in cm, the exact length of VA

(3)

(c) Find, in cm^2, the exact area of triangle VAD

(3)

(d) Find, in cm, the exact length of the perpendicular from D to VA

(2)

(e) Find, in degrees to one decimal place, the size of the obtuse angle between the plane VAB and the plane VAD

(3)

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Question 8 continued

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Question 8 continued

(Total for Question 8 is 13 marks)

9

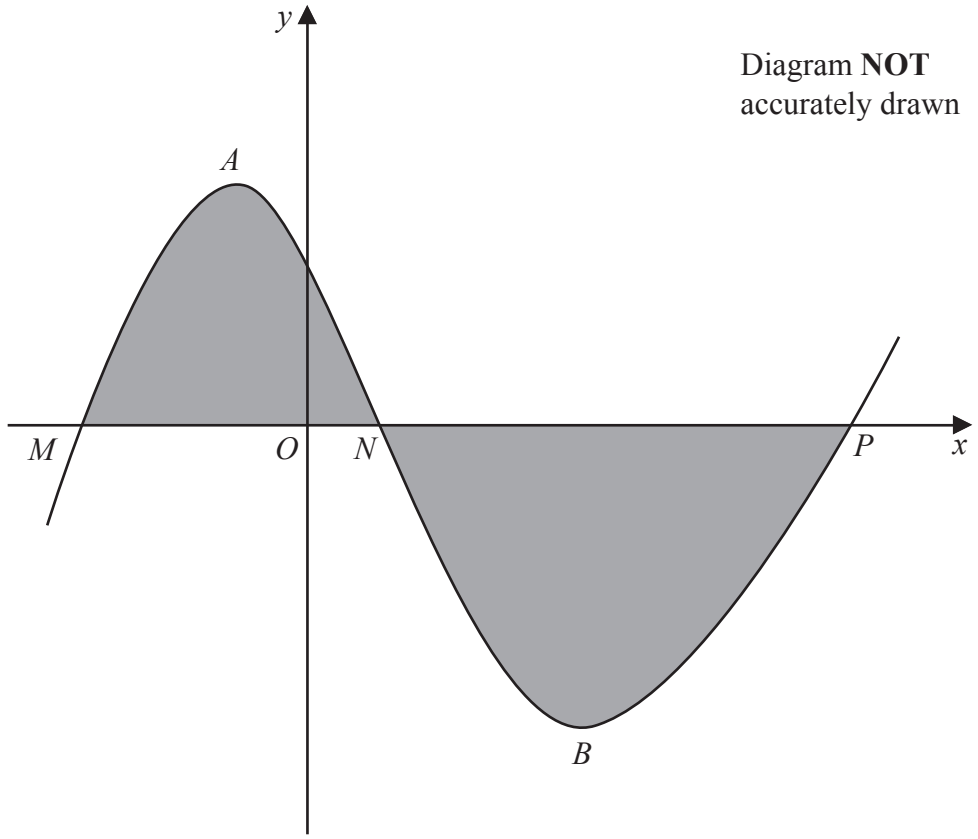

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Figure 4

Figure 4 shows a sketch of part of the curve C with equation $y = \mathrm{f}(x)$ where

$$\mathrm{f}(x) = 2x^3 + ax^2 + bx + c$$

The curve C has a maximum at the point A with coordinates $\left(-\frac{1}{3}, \frac{100}{27}\right)$ and a minimum at the point B with coordinates $(2, -9)$

Given that a, b and c are integers

(a) show that $a = -5, b = -4$ and $c = 3$

(5)

(b) (i) Show that $(x+1)$ is a factor of $\mathrm{f}(x)$

(1)

(ii) Hence, or otherwise, use algebra to factorise $\mathrm{f}(x)$ completely.

(3)

The curve C crosses the x-axis at the points M, N and P
The finite regions shown shaded in Figure 4 are bounded by the curve C and parts of the x-axis from M to N and from N to P

(c) Use algebraic integration to determine the total area of the shaded regions. Give your answer as an exact fraction.

(4)

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Question 9 continued

Question 9 continued

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Question 9 continued

(Total for Question 9 is 13 marks)

10 Solve the equation

(i) $\log_4(6y-5)=3$

(2)

(ii) $\log_4(4-3x)^2-\log_2(x^2-5)-3=0$
Show clear algebraic working.
Give your answer to 3 significant figures.

(9)

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Question 10 continued

(Total for Question 10 is 11 marks)

11

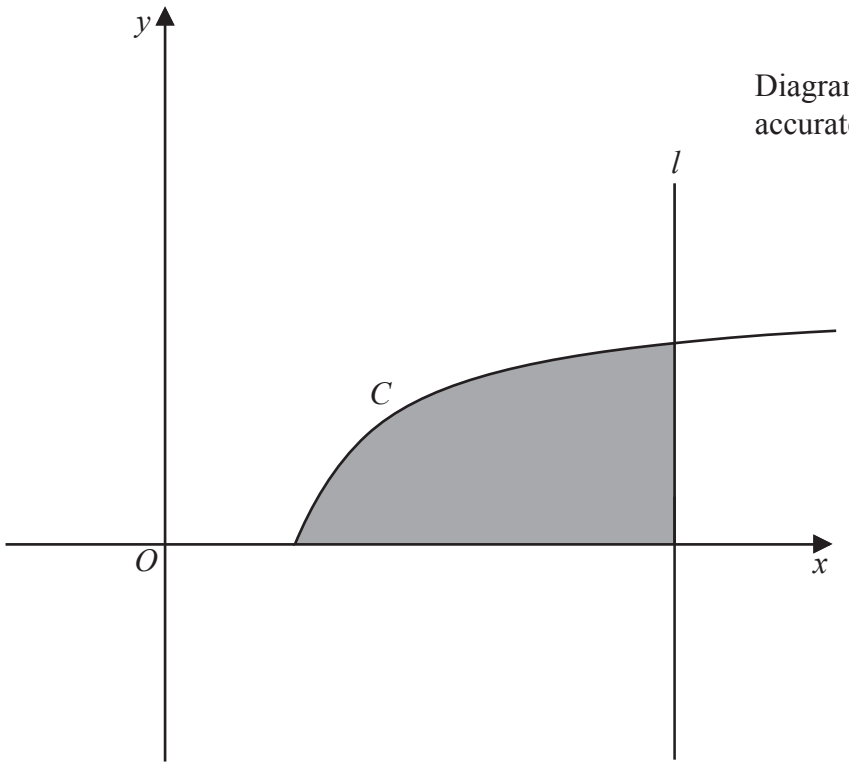

Figure 5

Figure 5 shows part of the curve C with equation $y = \sqrt{4x - 8}$ and the line l with equation $x = b$ where $b > 0$

The finite region bounded by the curve C, the x-axis and the line l, shown shaded in Figure 5, is rotated through $360°$ about the x-axis.

Given that the volume of the solid formed is 50π units^3

find the value of b

(7)

Question 11 continued

Question 11 continued

(Total for Question 11 is 7 marks)

TOTAL FOR PAPER IS 100 MARKS