Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International GCSE

Tuesday 29th October 2024

Morning (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 ▶

P73585A

P 7 3 5 8 5 A 0 1 3 2

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: $a^2 = b^2 + c^2 - 2bc\cos A$

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

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

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

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

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) $2x - 5y + 10 = 0$

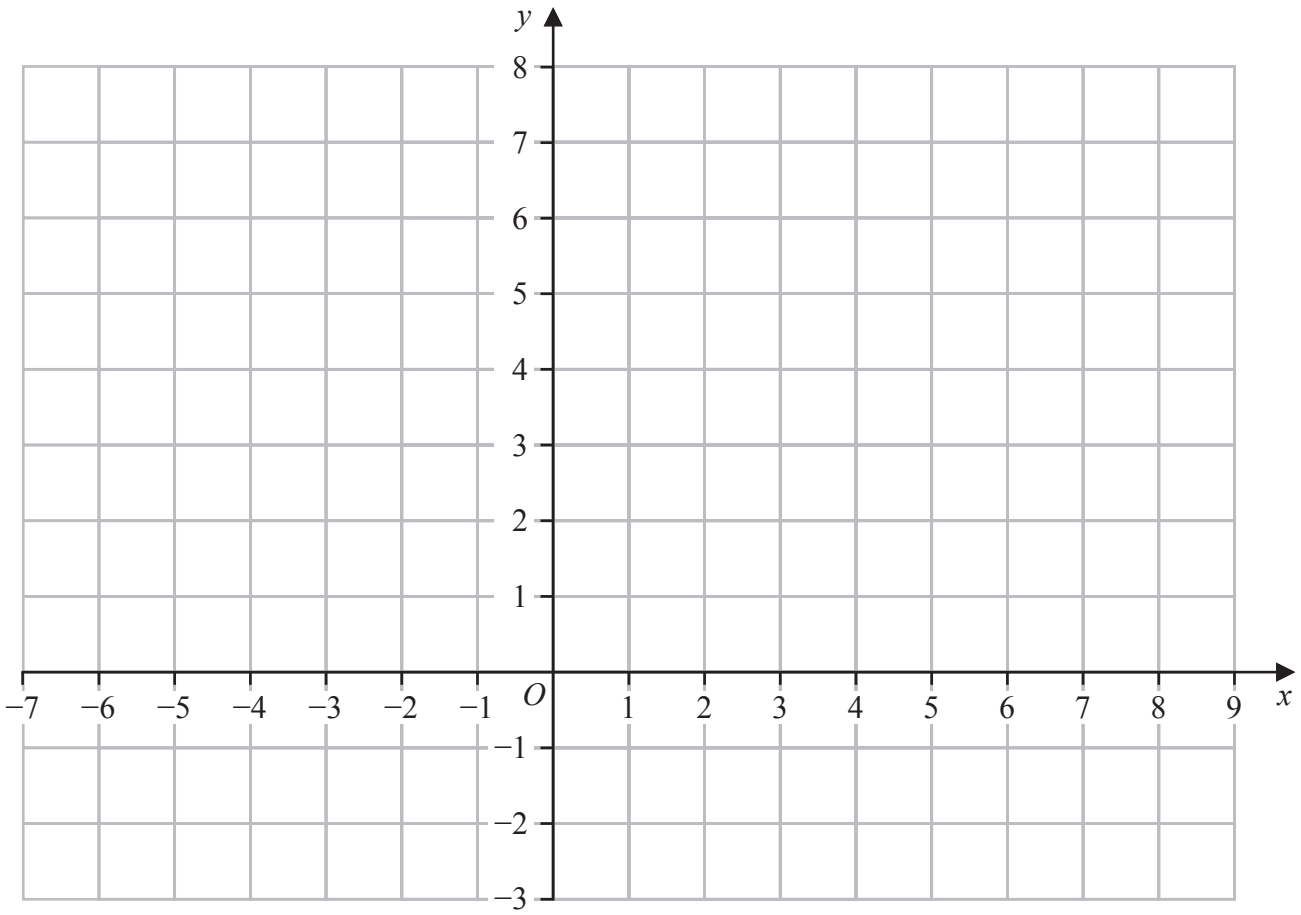
(2)

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

$3x + 4y \leqslant 24$ $2x - 5y + 10 \geqslant 0$ $y \leqslant 5$ $x \geqslant -1$

Label the region R

(2)



Question 1 continued

(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 nth 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

(Total for Question 2 is 13 marks)

3 Triangle ABC is such that

$$AC = 10\,\text{cm} \qquad BC = 7\text{cm} \qquad \text{angle } CAB = 25°$$

Given that angle ABC is obtuse,

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

(5)

Question 3 continued

(Total for Question 3 is 5 marks)

4

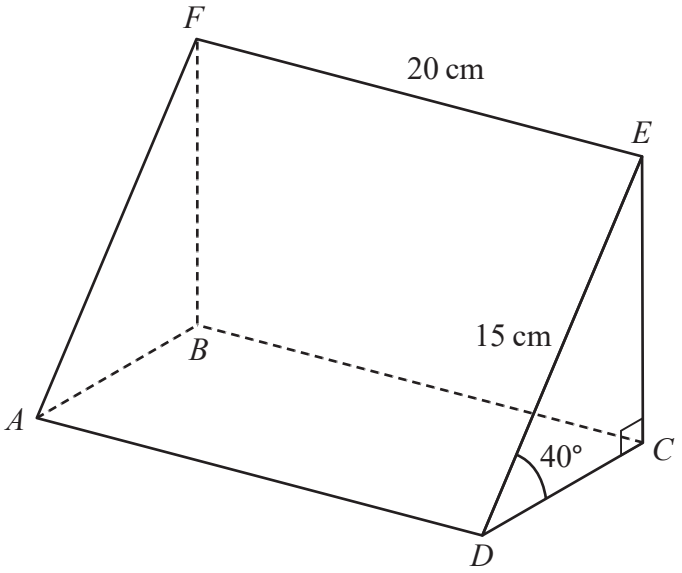

Diagram **NOT** accurately drawn

Figure 1

Figure 1 shows a right prism *ABCDEF*
Triangle *CDE* is a cross section of the prism.

- $\angle DCE = \angle ABF = 90^\circ$
- $\angle EDC = \angle FAB = 40^\circ$
- $DE = AF = 15\,\text{cm}$
- $EF = DA = CB = 20\,\text{cm}$

Find, in degrees to one decimal place, the size of the angle between the line *FD* and the plane *DCBA*

(6)

Question 4 continued

(Total for Question 4 is 6 marks)

5 A particle P is moving along a straight line.

At time t seconds $(t \geqslant 0)$, 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/s^2

(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 $1 \leqslant t \leqslant 4$

(5)

Question 5 continued

(Total for Question 5 is 10 marks)

6 (a) Show that

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

(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

Question 6 continued

Question 6 continued

(Total for Question 6 is 12 marks)

7

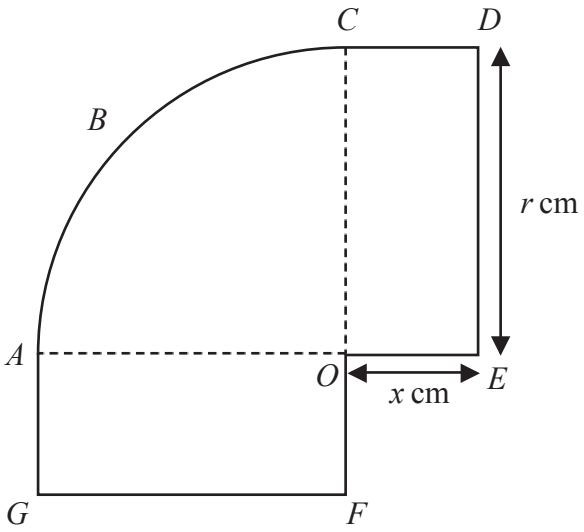

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Figure 2

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

Question 7 continued

Question 7 continued

(Total for Question 7 is 11 marks)

8 (i) (a) Using a formula given on page 2, show that

$$\tan 2A = \frac{2\tan A}{1-\tan^2 A}$$

(2)

(b) Hence, solve the equation

$$\tan A° - \tan 2A° = 0 \qquad \text{for } 0 \leqslant A \leqslant 180$$

(5)

(ii) Using a formula given on page 2, solve, giving your solutions as exact values

$$\cos\left(x - \frac{\pi}{6}\right) = \sin x \qquad \text{for } -\pi \leqslant x \leqslant 2\pi$$

(4)

Question 8 continued

Question 8 continued

Question 8 continued

(Total for Question 8 is 11 marks)

9

Diagram **NOT** accurately drawn

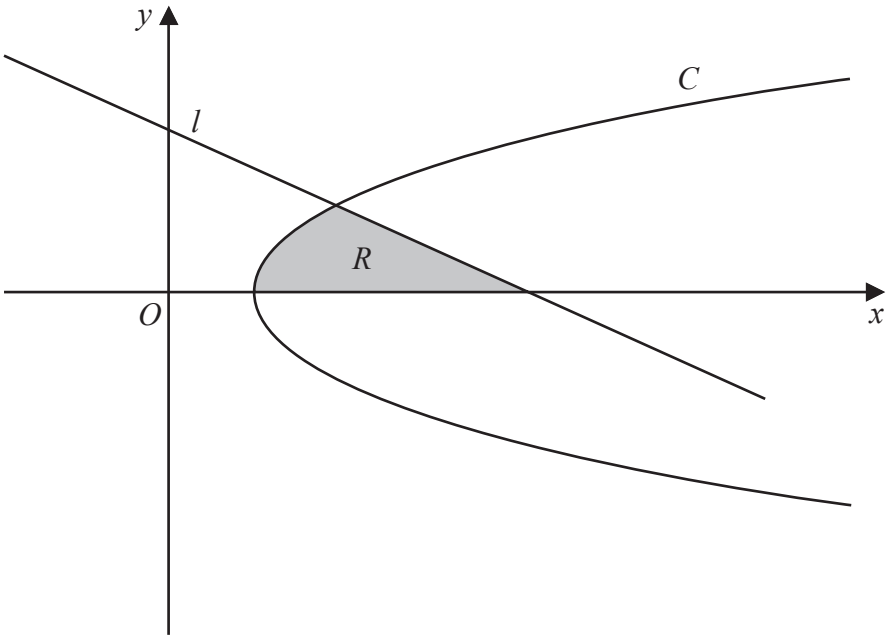

Figure 3

Figure 3 shows part of the curve C with equation $y^2 = x - 1$ and part of the line l with equation $2y + x - 4 = 0$

The region R, bounded by the x-axis, the curve C and the line l, is rotated through 360° about the x-axis.

Using algebraic integration, find the exact value of the volume of the solid generated.

(10)

Question 9 continued

Question 9 continued

Question 9 continued

(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)

$g(x) = 3x^2 + qx + r$ where q and r 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)

Question 10 continued

Question 10 continued

(Total for Question 10 is 18 marks)

TOTAL FOR PAPER IS 100 MARKS