Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel International GCSE

Centre Number	Candidate Number

Time 2 hours

Paper reference **4PM1/02**

Further Pure Mathematics

PAPER 2

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.
- Good luck with your examination.

Turn over

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

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

Answer all ELEVEN questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 Find the set of values for x for which

(a) $8x - 7 < 5x + 5$

(2)

(b) $2x^2 - 5x - 3 > 0$

(3)

(c) **both** $8x - 7 < 5x + 5$ **and** $2x^2 - 5x - 3 > 0$

(1)

(Total for Question 1 is 6 marks)

2 $$f(x) = 2 + \frac{4}{5}x - \frac{1}{25}x^2$$

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

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

(4)

(b) Hence write down

(i) the maximum value of $f(x)$,

(ii) the value of x for which this maximum occurs.

(2)

Question 2 continued

(Total for Question 2 is 6 marks)

3

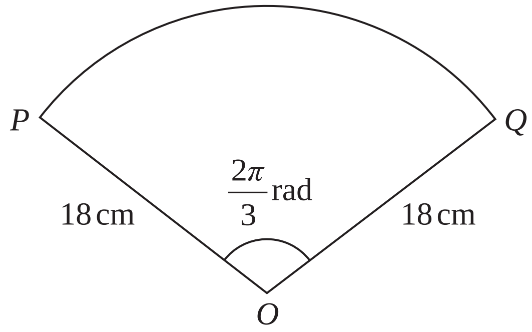

Diagram **NOT** accurately drawn

Figure 1

Figure 1 shows a sector *OPQ* of a circle with centre *O*.

The radius of the circle is 18 cm and the angle *POQ* is $\frac{2\pi}{3}$ radians.

(a) Find the length of the arc *PQ*, giving your answer as a multiple of π

(2)

Figure 2 below shows the sector *OPQ* and the kite *OPTQ*.

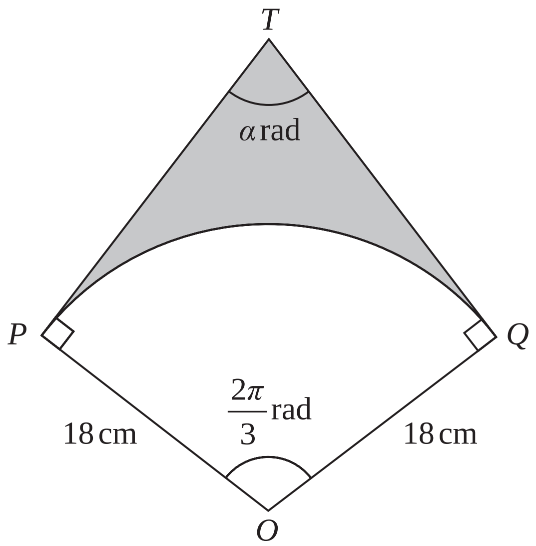

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Figure 2

PT is the tangent to the circle at *P* and *QT* is the tangent at *Q*, such that angle *PTQ* = α radians.

(b) (i) Find α in terms of π

(1)

(ii) Calculate, to 3 significant figures, the area of the region, shown shaded in Figure 2, which is bounded by the arc *PQ* and the tangents *PT* and *QT*.

(6)

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Question 3 continued

Question 3 continued

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Question 3 continued

(Total for Question 3 is 9 marks)

4 The point A has coordinates $(-4, -10)$ and the point B has coordinates $(3, 11)$
The line l passes through A and B.

(a) Find an equation of l.

(2)

The point P lies on l such that $AP : PB = 3 : 4$

(b) Find the coordinates of P.

(2)

The point Q with coordinates (m, n), where $m < 0$, lies on the line through P that is perpendicular to l.

Given that the length of PQ is $\sqrt{10}$

(c) find the coordinates of Q.

(6)

The point R has coordinates $(-11, -21)$

(d) Show that

(i) AB and RQ are equal in length,

(ii) AB and RQ are parallel.

(4)

(e) Find the area of the quadrilateral $ABQR$.

(2)

Question 4 continued

Question 4 continued

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Question 4 continued

(Total for Question 4 is 16 marks)

5 The nth term of a geometric series with common ratio r is u_n

Given that $u_2 + u_4 = 212.5$ and that $u_3 + u_4 = 62.5$

(a) find the two possible values of r.

(5)

Given that the series is convergent with sum to infinity S,

(b) find the exact value of S.

(2)

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Question 5 continued

(Total for Question 5 is 7 marks)

6
$$f(x) = x^3 + (p + 1)x^2 - 10x + q$$

where p and q are integers.

Given that $(x - 3)$ is a factor of $f(x)$

(a) show that $9p + q + 6 = 0$

(3)

Given that $(x + p)$, where $p > 0$, is also a factor of $f(x)$

(b) show that $p^2 + 10p + q = 0$

(3)

(c) Hence find the value of p and the value of q.

(5)

(d) Using your values of p and q, factorise $f(x)$ completely.

(2)

Question 6 continued

Question 6 continued

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Question 6 continued

(Total for Question 6 is 13 marks)

7 (a) Complete the table of values for $y = 3^{\frac{x}{4}} + 2$

Give your answers to 2 decimal places where appropriate.

(2)

x	0	1	2	3	4	5
y	3	3.32				5.95

(b) On the grid opposite, draw the graph of

$$y = 3^{\frac{x}{4}} + 2 \qquad \text{for} \quad 0 \leqslant x \leqslant 5$$

(2)

(c) By drawing a suitable straight line on the grid, obtain an estimate, to one decimal place, of the root of the equation

$$\log_3(6 - 2x)^4 - x = 0$$

in the interval $0 \leqslant x \leqslant 5$

(5)

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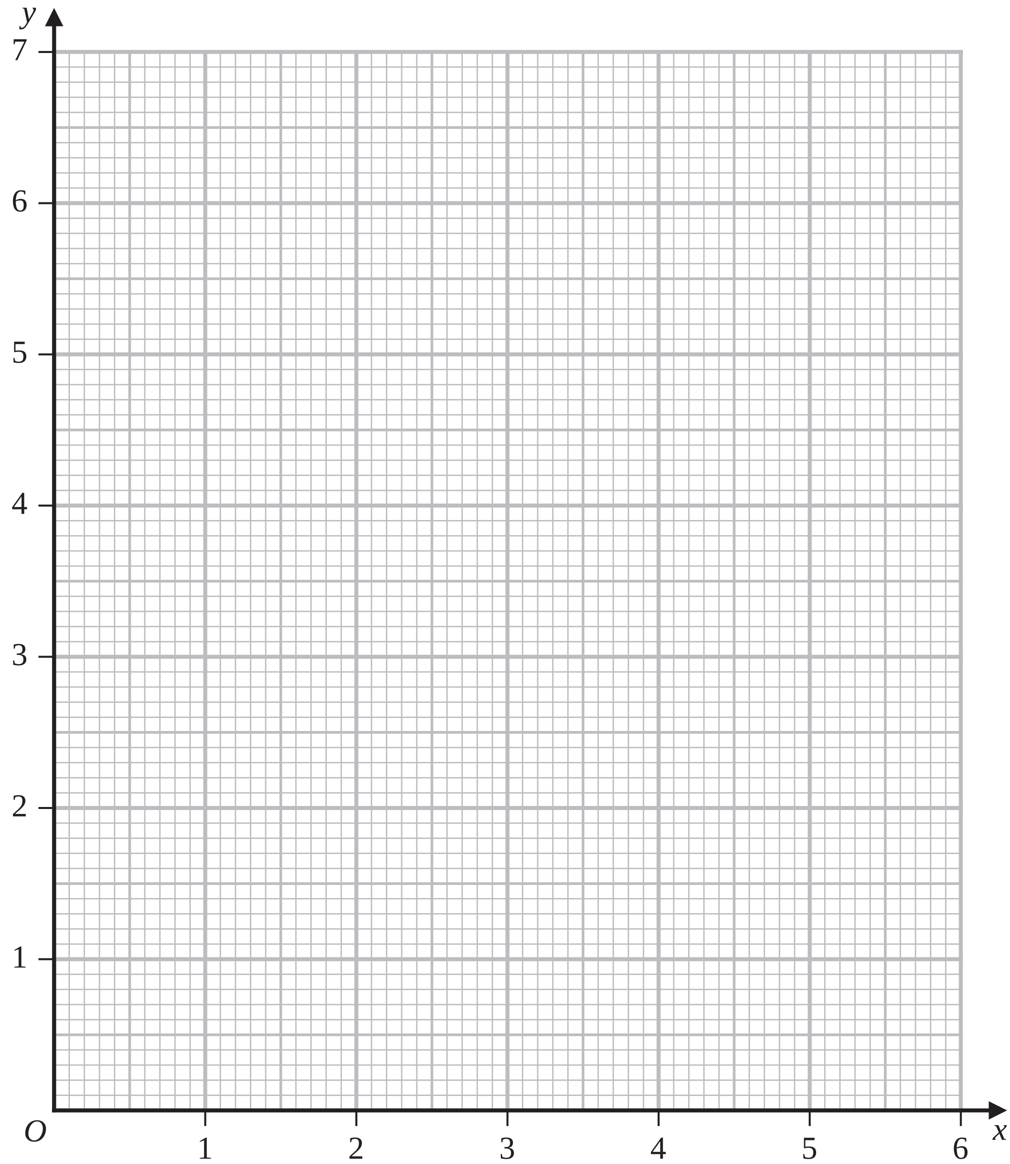
Question 7 continued

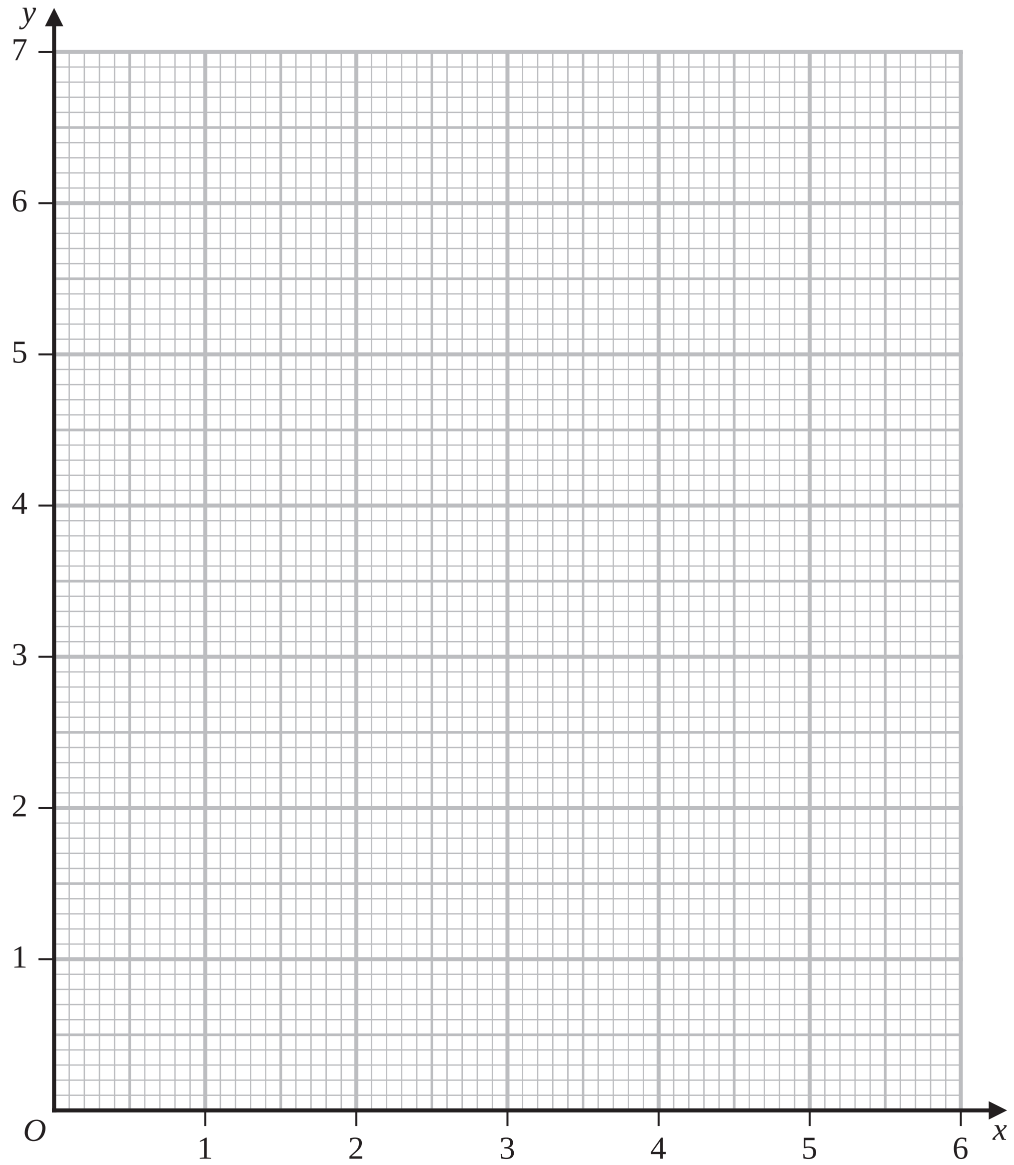


Turn over for a spare grid if you need to redraw your graph.

Question 7 continued

Question 7 continued

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



(Total for Question 7 is 9 marks)

8 Use an algebraic method to solve the simultaneous equations

$$\log_4 a + 3\log_8 b = \frac{5}{2}$$

$$2^a = \frac{16^4}{4^{b^2}}$$

(8)

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Question 8 continued

(Total for Question 8 is 8 marks)

9

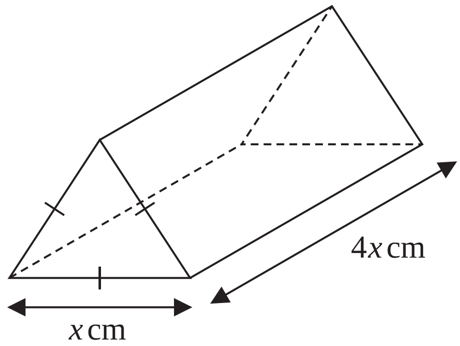

Diagram **NOT** accurately drawn

Figure 3

Figure 3 shows a metal solid S.

The solid is a right triangular prism.

The cross section of S is an equilateral triangle with sides of length x cm.
The length of S is $4x$ cm.

The prism is being heated so that the cross sectional area is increasing at a constant rate of 0.03 cm^2/s.

(a) Find, giving your answer to 3 significant figures, $\dfrac{dx}{dt}$ when $x = 2$
(5)

(b) Find the rate of increase, in cm^3/s, of the volume of S when $x = 2$
(3)

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Question 9 continued

Question 9 continued

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Question 9 continued

(Total for Question 9 is 8 marks)

10 (a) Solve the equation

$$\tan x° = -3 \qquad \text{for } 0 \leqslant x < 360$$

Give your solutions to the nearest whole number.

(3)

Given that

$$7\sin^2\theta + \sin\theta\cos\theta = 6$$

(b) show that

$$\tan^2\theta + \tan\theta - 6 = 0$$

(3)

(c) Hence solve the equation

$$7\sin^2 y° + \sin y°\cos y° = 6 \qquad \text{for } 0 \leqslant y < 360$$

Give your solutions to the nearest whole number.

(4)

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Question 10 continued

Question 10 continued

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Question 10 continued

(Total for Question 10 is 10 marks)

11

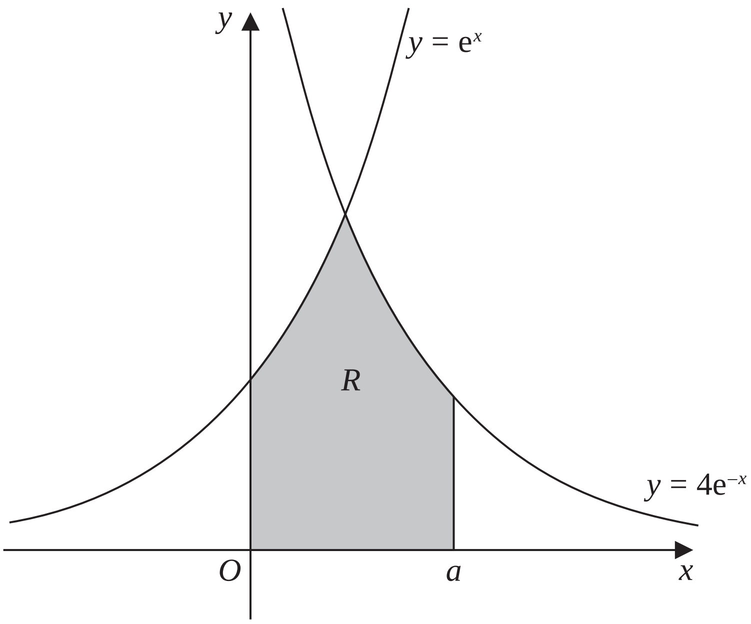

Diagram **NOT** accurately drawn

Figure 4

The region R, shown shaded in Figure 4, is bounded by the curve with equation $y = e^x$, the curve with equation $y = 4e^{-x}$, the straight line with equation $x = a$, the x-axis and the y-axis.

When the region R is rotated through 360° about the x-axis, the volume of the solid generated is

$$k - 8\pi e^{-4}$$

where k is a constant.

Using algebraic integration, find a possible value of a and the exact corresponding value of k.

(8)

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Question 11 continued

Question 11 continued

(Total for Question 11 is 8 marks)

TOTAL FOR PAPER IS 100 MARKS