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 ▶

P 6 6 0 2 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 $= \dfrac{4}{3}\pi r^3$

Series

Arithmetic series

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

Geometric series

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

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

Binomial series

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

Calculus

Quotient rule (differentiation)

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

Trigonometry

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

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

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

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

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

Logarithms

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

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)

(Total for Question 2 is 6 marks)

3

Diagram **NOT** accurately drawn

P Q

$\dfrac{2\pi}{3}$ rad

18 cm 18 cm

O
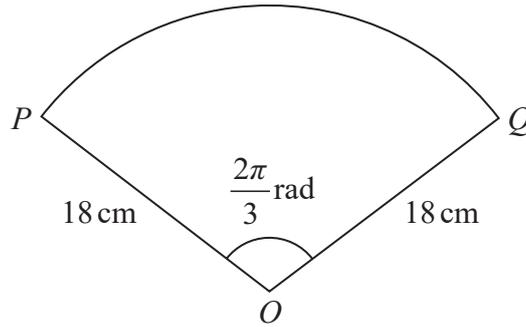
Figure 1

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 $\dfrac{2\pi}{3}$ radians.

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

(2)

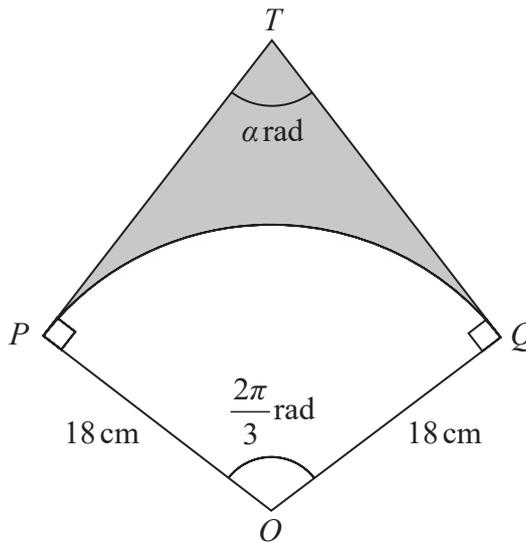Figure 2 below shows the sector OPQ and the kite $OPTQ$.

T

α rad

Diagram **NOT** accurately drawn

P Q

$\dfrac{2\pi}{3}$ rad

18 cm 18 cm

O

Figure 2

PT is the tangent to the circle at P and QT is the tangent at Q, such that angle $PTQ = \alpha$ 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)

....

....

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)

P 6 6 0 2 5 A 0 1 1 3 6

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)

(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

(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)

Question 7 continued

....

....

....

....

....

....

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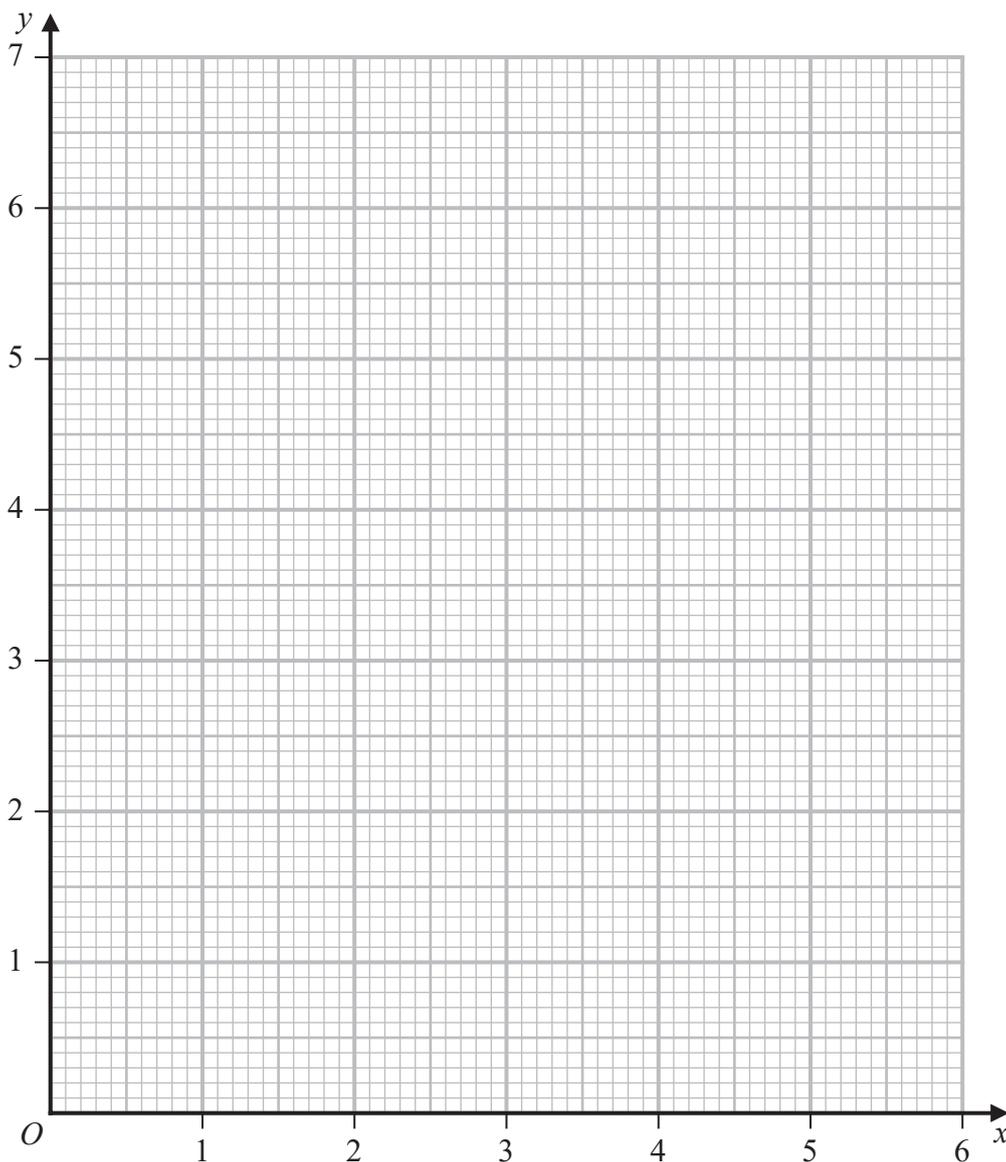
Turn over for a spare grid if you need to redraw your graph.

Question 7 continued

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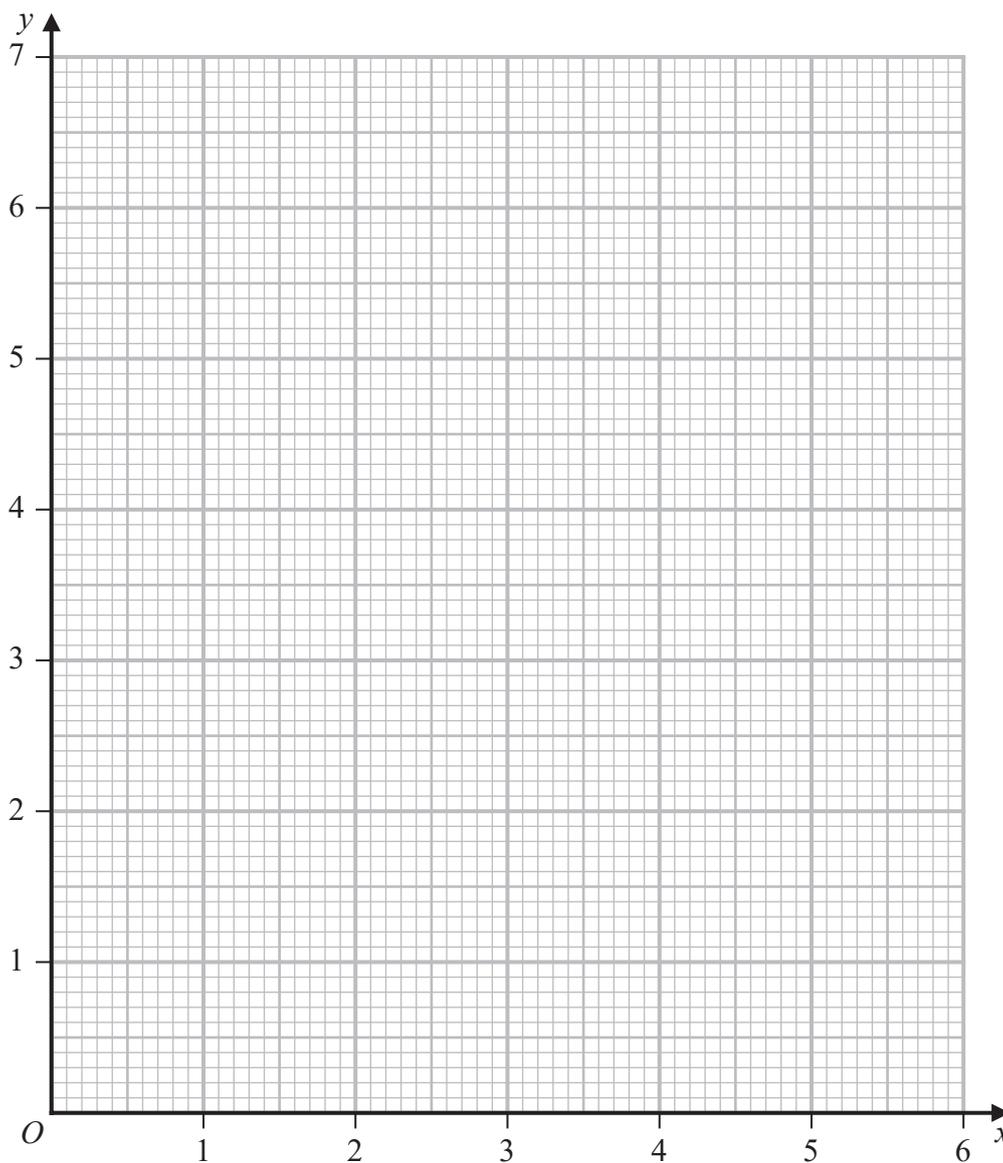
....

....

....

....

....

....

(Total for Question 7 is 9 marks)

Turn over ▶

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)

(Total for Question 8 is 8 marks)

9

Diagram **NOT**
accurately drawn

$4x$ cm

x cm

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 $0.03\,\text{cm}^2$/s.

(a) Find, giving your answer to 3 significant figures, $\dfrac{\text{d}x}{\text{d}t}$ when $x = 2$

(5)

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

(3)

....

....

....

....

....

....

....

....

....

....

....

....

P66025A02736

(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)

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

Question 10 continued
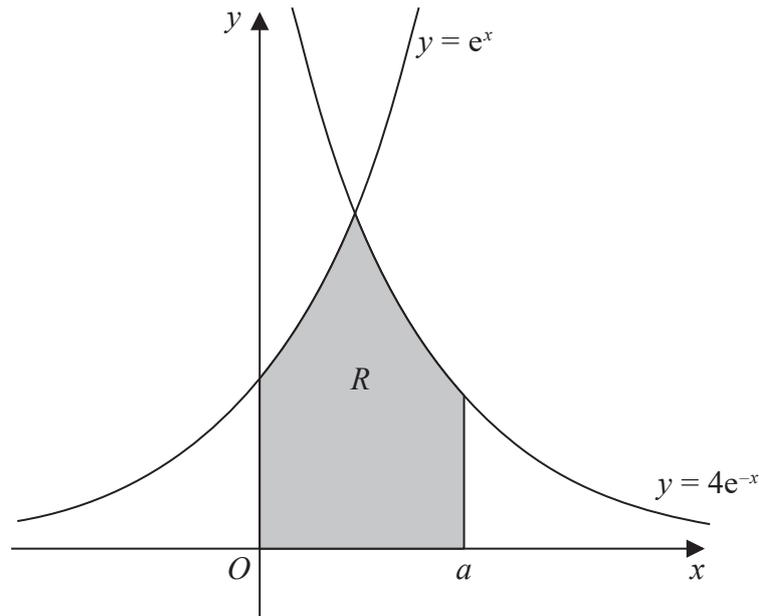
(Total for Question 10 is 10 marks)

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)

....

....

....

....

....

....

....

....

....

P 6 6 0 2 5 A 0 3 5 3 6

(Total for Question 11 is 8 marks)

TOTAL FOR PAPER IS 100 MARKS

P66025A03636