

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Centre Number

Candidate Number

**Pearson Edexcel International GCSE**

**Thursday 8 June 2023**

Morning (Time: 2 hours)

Paper  
reference

**4PM1/02R**

**Further Pure Mathematics**  
**PAPER 2R**



**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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## International GCSE in Further Pure Mathematics Formulae sheet

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### 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

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

### 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

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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**Question 2 continued**

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**(Total for Question 2 is 6 marks)**





**Question 3 continued**

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**(Total for Question 3 is 10 marks)**







**Question 4 continued**

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**(Total for Question 4 is 6 marks)**





**Question 5 continued**

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**(Total for Question 5 is 7 marks)**



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**Question 6 continued**

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Question 6 continued

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**Question 6 continued**

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**(Total for Question 6 is 10 marks)**



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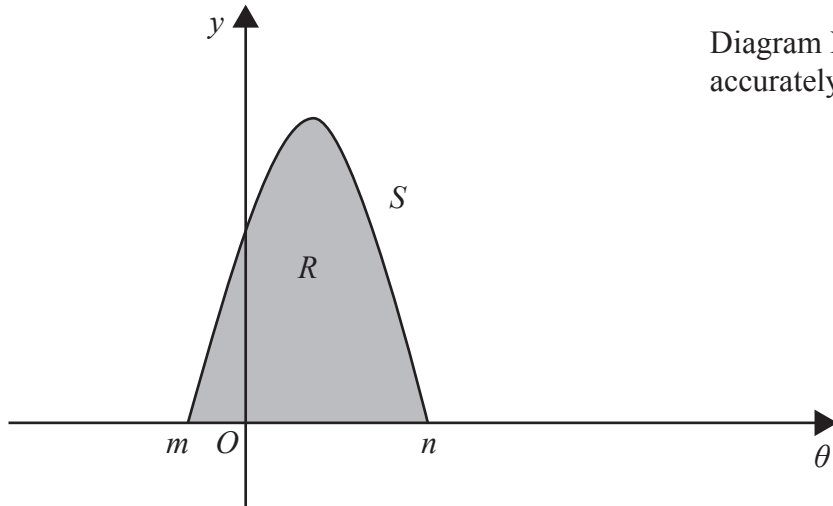


Diagram **NOT** accurately drawn

Figure 2

Figure 2 shows part of the curve  $S$  with equation  $y = (\cos 3\theta + \sqrt{3} \sin 3\theta)^{\frac{1}{2}}$  where  $m \leq \theta \leq n$

The curve  $S$  meets the  $x$ -axis at the point with coordinates  $(m, 0)$  and at the point with coordinates  $(n, 0)$

- (a) Find the exact value of  $m$  and the exact value of  $n$  (3)

The finite region  $R$ , shown shaded in Figure 2, is bounded by the curve  $S$ , and the  $x$ -axis in the region  $m \leq \theta \leq n$

The region  $R$  is rotated through  $2\pi$  radians about the  $x$ -axis.

- (b) Use calculus to find the exact volume of the solid generated. (4)

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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 7 marks)**



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8 The points  $A$  and  $B$  have coordinates  $(1, 5)$  and  $(9, 9)$  respectively.

(a) Find an equation of line  $AB$ , giving your answer in the form  $ax + by + c = 0$ , where  $a, b$  and  $c$  are integers to be found.

(3)

The line  $l$  is perpendicular to  $AB$  and passes through the point  $X$  which lies on  $AB$  such that  $AX : XB = 3:1$

(b) Show that an equation of  $l$  is  $y = -2x + 22$

(5)

The point  $C$  has coordinates  $(6, p)$

Given that  $C$  lies on  $l$

(c) find the value of  $p$

(1)

$ABCD$  is a parallelogram where the  $x$  coordinate of  $D$  is negative.

(d) Find the coordinates of the point  $D$

(3)

(e) Find the area of the parallelogram  $ABCD$

(4)

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**Question 8 continued**

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Question 8 continued

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**Question 8 continued**

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**(Total for Question 8 is 16 marks)**



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9 A curve  $C$  has equation  $y = \frac{3 - 2x}{x + 6}$  where  $x \neq -6$

(a) Write down an equation of the asymptote to  $C$  that is parallel to the

- (i)  $x$ -axis      (ii)  $y$ -axis

(2)

(b) Find the coordinates of the point where  $C$  crosses the

- (i)  $x$ -axis      (ii)  $y$ -axis

(2)

(c) Using the axes opposite, sketch the graph of  $C$ , showing clearly its asymptotes and the coordinates of the points where  $C$  crosses the coordinate axes.

(3)

(d) Show that the gradient of the tangent to  $C$  is always negative.

(3)

A tangent to  $C$  has equation  $y = -\frac{3}{5}x + k$  where  $k > 0$

(e) Find the value of  $k$

(5)

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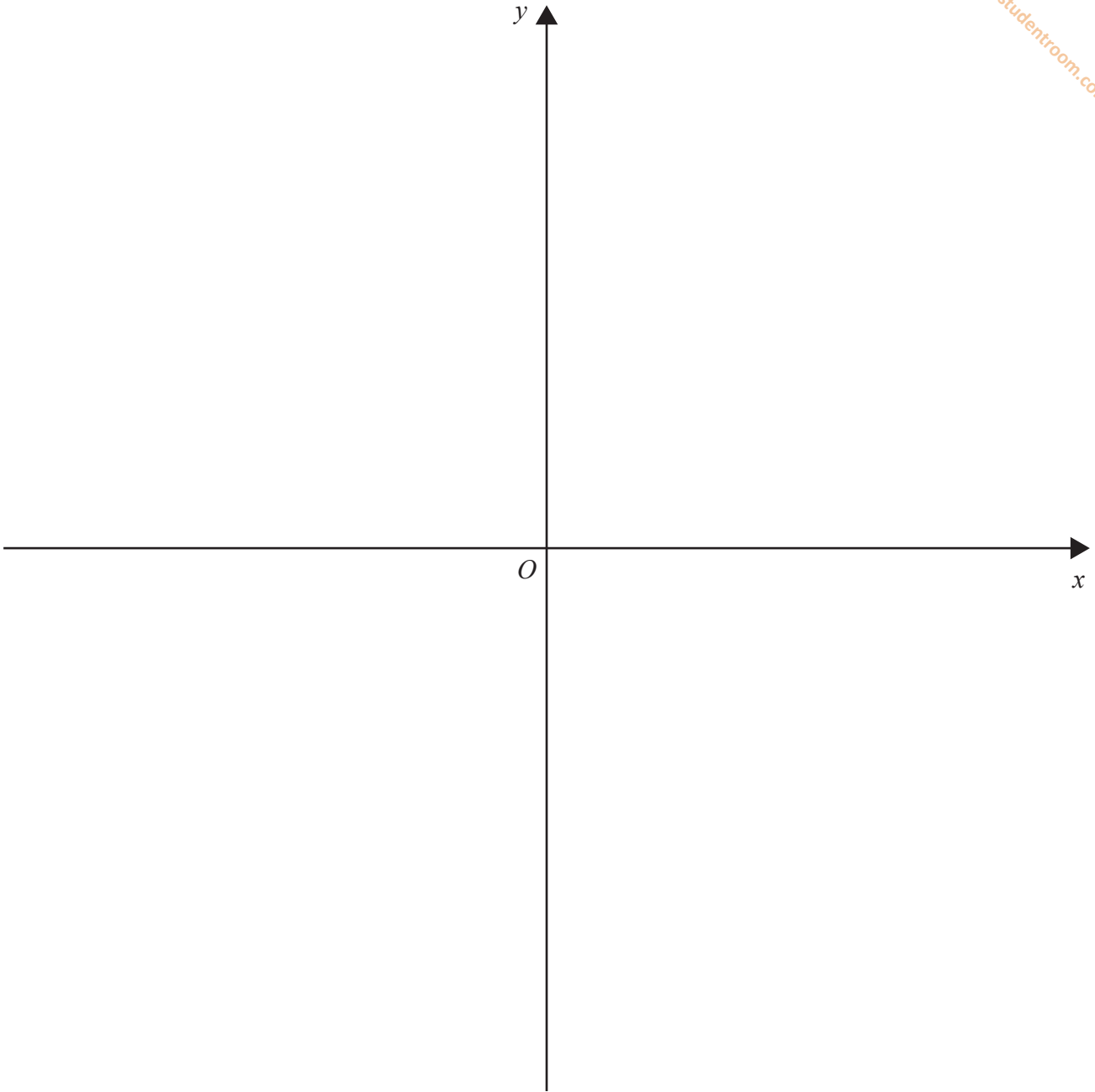
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Question 9 continued



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**Question 9 continued**

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**(Total for Question 9 is 15 marks)**



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10 Solve the equation

$$\log_4 x^3 + 8\log_x 64 = 22$$

(7)

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**Question 10 continued**

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**(Total for Question 10 is 7 marks)**



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**Question 11 continued**

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**Question 11 continued**

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**(Total for Question 11 is 12 marks)**

**TOTAL FOR PAPER IS 100 MARKS**

