Please check the examination details bel	ow before ente	ring your candidate information
Candidate surname		Other names
Centre Number Candidate Nu		
Pearson Edexcel Inter Thursday 8 June 202		al GCSE
Morning (Time: 2 hours)	Paper reference	4PM1/02R
Further Pure Mat 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 ▶



P74284A ©2023 Pearson Education Ltd. N:1/1/1/1/1/1/1/1/



International GCSE in Further Pure Mathematics Formulae sheet

Mensuration

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

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

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, $S_{\infty} = \frac{a}{1-r} |r| < 1$

Binomial series

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

Calculus

Quotient rule (differentiation)

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

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

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

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Answer all ELEVEN questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1	$f(x) = 2x^2 + (k+8)x + k$	
	Show that for all values of k , the equation $f(x) = 0$ has distinct real roots.	(4)



(Total for Question 1 is 4 marks)

2	Find	the	set	of	values	of	x for	which

(a)
$$2(x+1) < 5x - 2$$

(2)

(b)
$$3x^2 - x \le 10$$

(3)

(c) **both**
$$2(x+1) < 5x - 2$$
 and $3x^2 - x \le 10$

(1)

 •••••	 										

|
 |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
|
 |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
|
 |





DO NOT WRITE IN THIS AREA

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



(5)

(2)

3

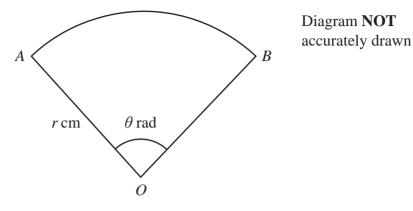


Figure 1

Figure 1 shows the sector OAB of a circle with centre O.

The radius of the circle is r cm and the angle AOB is θ radians.

The area of the sector is 675 cm²

(a) Show that the perimeter of the sector, P cm, is given by

$$P = 2r + \frac{1350}{r} \tag{3}$$

Given that r can vary,

- (b) find, using calculus, the minimum value of P Give your answer in the form $a\sqrt{b}$ where a is an integer and b is a prime number.
- (c) Justify that the value of P you found in (b) is a minimum.

 		 	 	 	 	 	 	 •••••	 •••••	
 •	• • • • • • • • • • • • • • • • • • • •	 	 	 	 	 •	 	 •	 	
 •••••		 	 	 	 	 •	 	 •	 	

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 3 continued	,
(Total for Question 3 is 10 marks)	-



4 O, A and B are fixed points such that

$$\overrightarrow{OA} = 5\mathbf{i} + 7\mathbf{j}$$
 $\overrightarrow{AB} = a\mathbf{i} + 16\mathbf{j}$ and $\left| \overrightarrow{OB} \right| = 5\sqrt{29}$

(a) Find the possible values of *a*

(4)

Given that a > 0

(b) find a unit vector that is parallel to \overrightarrow{AB}

1	7
	1.
٧.	=

|
 |
|------|------|------|------|------|------|------|------|------|------|------|
| | | | | | | | | | | |
|
 |
| | | | | | | | | | | |
|
 |
| | | | | | | | | | | |
|
 |



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

5	A particle <i>P</i> is moving along the <i>x</i> -axis.	
	At time t seconds, $t \ge 0$, the velocity, v m/s, of P is given by	
	$v = 2t^2 - 19t + 35$	
	(a) Find the acceleration of P when $t = 5$	(0)
	The particle comes to instantaneous rest at the points A and B at times t_1 seconds and t_2 seconds respectively, where $t_1 < t_2$	(2)
	(b) Find the value of t_1 and the value of t_2	(2)
	(c) Use calculus to find the distance AB	(2)
		(3)

		•

DO NOT WRITE IN THIS AREA

Question 5 continued	
(Total for Question 5 is 7 marks)	
(Total for Question 3 is 7 marks)	



 $\mathbf{6} \qquad \qquad \mathbf{f}(x) = 2x^2 + 5x - p$

The equation f(x) = 0 has roots α and β

Given that $\alpha^3 + \beta^3 = -\frac{215}{8}$

(a) find the value of p

(5)

Without solving the equation f(x) = 0

(b) form a quadratic equation, with integer coefficients, that has roots

$$\frac{\alpha+\beta}{\alpha^2}$$
 and $\frac{\alpha+\beta}{\beta^2}$

(5)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 6 continued	



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 6 continued	

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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



7

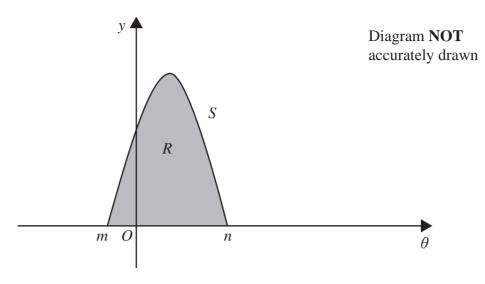


Figure 2

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

where $m \leqslant \leq n$

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 $m \leqslant s \leqslant n$

The region *R* is rotated through 2π radians about the theta-axis.

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

1 .	/III 1
1 6	•
1	- /

$\times\!\!\times\!\!\times\!\!\times$
$\times\!\!\times\!\!\times\!\!\times$
$\times\!\!\times\!\!\times\!\!\times$
$\times\!\!\!\times\!\!\!\times$
\times
\times
$\Diamond \Diamond \Diamond \Diamond \Diamond$
$\langle \rangle \rangle \rangle \rangle$
$\sim\sim$
$\otimes \otimes \otimes$
∞
$\times\!\!\times\!\!\times$
$\times\times\times$
$\times\!\!\times\!\!\times\!\!\times$
$\times\!\!\times\!\!\times\!\!\times$
$\times\!\!\times\!\!\times\!\!\times$
$\times\!\!\times\!\!\times$
4
899
XXMM
<u>C</u>
M W
$\times\!\!\times\!\!\times$
₩
\times
\otimes
\times
$\times \times \times \times$
2
X
\times
XX Indian
800
0000
$\times 5$
\times
XXIXX
$\times \circ$
<u> </u>
\times
\times
\times
8
Ö
\sim
\sim
ă
$\sim\sim$
$\times\!\!\times\!\!\times$
$\times\!\!\times\!\!\times$
$\times \times \times \times$
$\times \times \times \times$
>>>>
>>>>
$\times\!\!\times\!\!\times$
¥
¥
EA
EA
¥
REA
EA
REA
AREA
SAREA
SAREA
15 AREA
HIS AREA
HIS AREA
THIS AREA
THIS AREA
THIS AREA
THIS AREA
THIS AREA
IN THIS AREA
IN THIS AREA
E IN THIS AREA
CE IN THIS AREA
CE IN THIS AREA
ITE IN THIS AREA
RITE IN THIS AREA
RITE IN THIS AREA
RITE IN THIS AREA
RITE IN THIS AREA
RITE IN THIS AREA
WRITE IN THIS AREA
WRITE IN THIS AREA
WRITE IN THIS AREA
WRITE IN THIS AREA
OT WRITE IN THIS AREA
WRITE IN THIS AREA
NOT WRITE IN THIS AREA
NOT WRITE IN THIS AREA
NOT WRITE IN THIS AREA
NOT WRITE IN THIS AREA
O NOT WRITE IN THIS AREA
O NOT WRITE IN THIS AREA
O NOT WRITE IN THIS AREA
O NOT WRITE IN THIS AREA
O NOT WRITE IN THIS AREA
O NOT WRITE IN THIS AREA
O NOT WRITE IN THIS AREA
O NOT WRITE IN THIS AREA
O NOT WRITE IN THIS AREA
O NOT WRITE IN THIS AREA
O NOT WRITE IN THIS AREA
O NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
O NOT WRITE IN THIS AREA

Question 7 continued		



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 7 continued

DO NOT WRITE IN THIS AREA

Question 7 continued
(Total for Question 7 is 7 marks)



- 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)



DO NOT WRITE IN THIS AREA

Question 8 continued



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 8 continued

DO NOT WRITE IN THIS AREA

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



- 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.

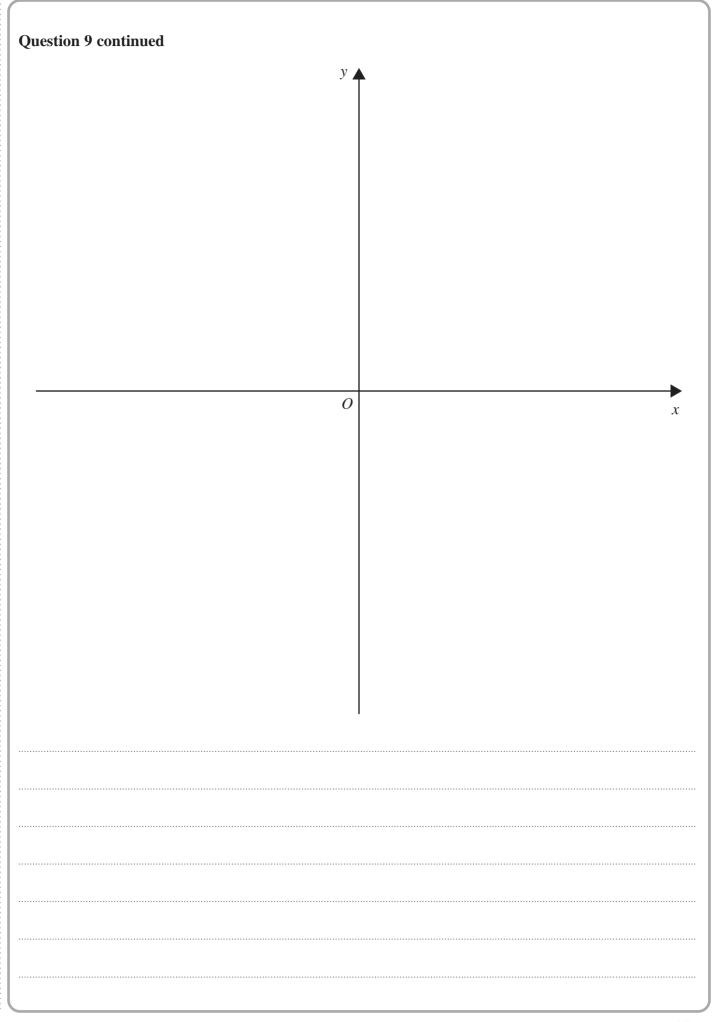
(3)

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

(e) Find the value of k

(5)

DO NOT WRITE IN THIS AREA





DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 9 continued

DO NOT WRITE IN THIS AREA

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



DO NOT WRITE IN THIS AREA

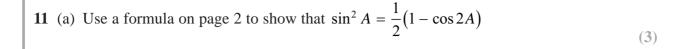
DO NOT WRITE IN THIS AREA

10 Solve the equation	
$\log_4 x^3 + 8\log_x 64 = 22$	(7)
	(7)

DO NOT WRITE IN THIS AREA

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





(b) Show that
$$\sin^4 x + \cos^4 x = \frac{3 + \cos 4x}{4}$$
 (5)

(c) Hence solve, in degrees to one decimal place, the equation

$$8\sin^4\left(\frac{\theta}{2}\right) + 8\cos^4\left(\frac{\theta}{2}\right) = 5\sin\left(2\theta\right) + 6 \quad \text{for} \quad 0^\circ \leqslant \theta < 180^\circ$$
(4)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 11 continued



٦.					
ĸ.					
	Ğ	į	6	è	
×.	1	г	7	₹	
	S		2	ä	
		-3	7	۰	
	٥	ä	ø	۹	
	q	r		Ĵ	
Ν	2		ú	ú	
<		Z	7	7	
Κ)	٠	,		
2		d		,	
	Δ	8	×	8	
K		Ç	è	6	
.>	ű	ρ	₹	7	۰
^	Α	ь.	2	à	
/	Ŋ	74	۹	Р	
>		è			
K	J	×	ņ	۹	
			ξ	١	
<	ì	ú	à	ρ	
	e	9	4		
Κ	à	Ž	۶	ą	
/	S	7	۹	×	
	8		_	_	
ĸ.	3	e		е	
>	G		я	Ы	
×	2		2	S	
	Ч	P	9	۲	
>					
ĸ)	ø	ĸ	ø	
\	d	ŕ	ú	è	
	٦	г	1	Р	
	Q	₽)	e	ŋ	
×.					
/	Ч	è			
			Z		
×	ij	۰	9		
. >	C	à	ρ	7	
	Α	9	۳	8	
<	1				
>		3			
×	a	=	۰	4	
2					
1	4	ś	ø	į	
K					
	Ğ	è			
1	1	2	2		
/	Ч	P	9	F	۰
	ű	ø	į	à	
Κ	A	ĸ	A	К	
2		7	т		
	٦	86	ù	۷	
		٦	г		
K.	À	ø	ø	۴	
/		Z	\leq	2	
	d			×	
×	à	й		6	
	S	2	ζ.	2	
1	A	ø	į	ø	
/	Ч	ľ	1	r	
	G	3	0		
Κ	2	٩	P	ģ	
2	5	d	ь	ġ	
	A	ч	7		
>	К				
ĸ.					
2					
>	C			S	

uestion 11 continued	
	(Total for Question 11 is 12 marks)
	TOTAL FOR PAPER IS 100 MARKS