Please check the examination details be	ow before entering your candidate information
Candidate surname	Other names
Centre Number Candidate N	umber
Pearson Edexcel Inter	national GCSE
Time 2 hours	Paper reference 4PM1/02R
Further Pure Mat	hematics
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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.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶





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

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



Answer all ELEVEN questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 (a) Expand $\left(1 + \frac{x}{4}\right)^8$ in ascending powers of x up to and including the term in x^3 Give each coefficient in its simplest terms.

(3)

(b) Use your expansion with a suitable value of x to obtain an approximation, to 4 decimal places, of $(1.035)^8$

(3)

(Total for Question 1 is 6 marks)



2 Find the set of values of x for which

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(1)

(b)
$$4x^2 - 7x + 1 > 6 - 2x^2$$

(4)

(c) **both**
$$3x - 8 < 5x + 3$$
 and $4x^2 - 7x + 1 > 6 - 2x^2$

(1)





3	Given that $y = e^{3x} \sin 2x$	
	show that $13y + \frac{d^2y}{dx^2} = 6\frac{dy}{dx}$	
		(8)



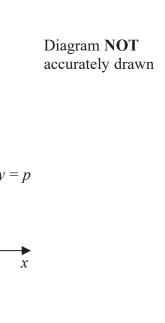


Figure 1

(s,0)

 $\left(0,\frac{3}{2}\right)$

Figure 1 shows part of the curve C with equation

$$y = \frac{2x + q}{x + r} \qquad x \neq -r$$

where q and r are integers.

The asymptote to C that is parallel to the y-axis has equation x = -4The asymptote to C that is parallel to the x-axis has equation y = p

- (a) Write down
 - (i) the value of p
 - (ii) the value of r

(2)

Given that C crosses the y-axis at the point with coordinates $\left(0,\frac{3}{2}\right)$

(b) find the value of q

(2)

Given that C crosses the x-axis at the point with coordinates (s, 0)

(c) find the value of s

(2)

DO NOT WRITE IN THIS AREA



5	The line l with gradient $-\frac{1}{12}$ passes through the points A and B with coordinates
	(p, 10) and $(123, 0)$ respectively.
	(a) Show that $p = 3$

(2)

(b) Find an equation for l in the form rx + sy + t = 0 where r, s and t are integers.

(2)

The line k is perpendicular to l and passes through the point A.

(c) Find an equation for k in the form y = mx + c

(3)

Line k intersects the x-axis at the point C.

(d) Find the exact area of triangle ABC.

(4)



Question 5 continued



Figure 2

Figure 2 shows the sector OAB of a circle with centre O and radius r cm.

$$\angle AOB = \frac{\pi}{6}$$
 radians $OA = OB = r$ cm

The area of the sector is increasing in such a way that the size of $\angle AOB$ remains constant, and the lengths OA and OB are both increasing at a constant rate of $0.2 \,\mathrm{cm/s}$

Find the exact rate of change, in cm²/s, of the area of the sector when the length of

arc
$$AB$$
 is $\frac{5\pi}{2}$

(6)

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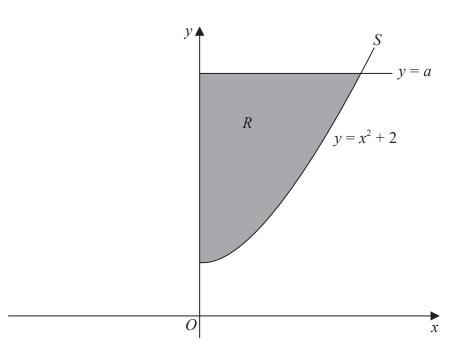


Diagram **NOT** accurately drawn

(8)

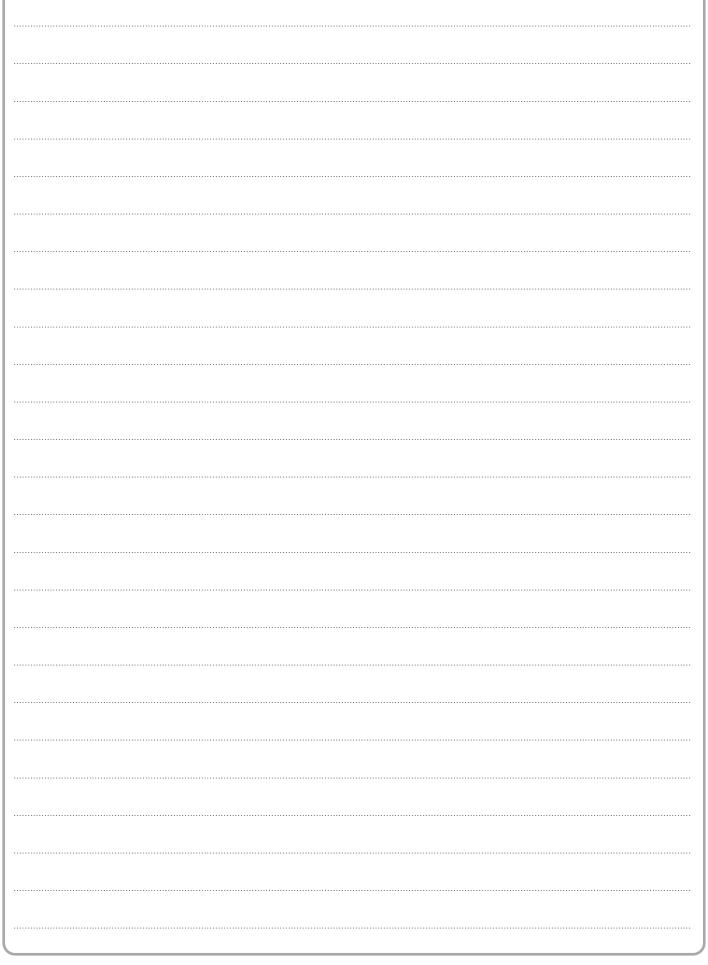
Figure 3

Figure 3 shows part of the curve S with equation $y = x^2 + 2$

The finite region R, shown shaded in Figure 3, is bounded by S, the y-axis and the line with equation y = a where a > 2

The region R is rotated through 360° about the y-axis to generate a solid with volume 18π

Use algebraic integration to find the value of a



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Question 7 continued





- 8 The quadratic equation $3x^2 kx 1 = 0$, where k is a positive integer, has roots α and β
 - (a) Show that $\alpha^2 + \beta^2 = \frac{k^2 + 6}{9}$

(3)

Given that $\alpha^4 + \beta^4 = \frac{466}{81}$

(b) find the value of k

(5)

(c) Hence form an equation, with integer coefficients, which has roots

$$\frac{\alpha^3 + \beta}{\beta}$$
 and $\frac{\beta^3 + \alpha}{\alpha}$

(6)





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Question 8 continued	





9 A geometric series G has common ratio r where r > 0

The third term of G is $\frac{27}{2}$ and the sum of the first three terms of G is $\frac{57}{2}$

Given that the sum to n terms of G is S_n

(a) show that $S_n = \sum_{j=1}^n 4\left(\frac{3}{2}\right)^j$

(8)

Given that $S_k > 50000$

(b) show that the least value of k is given by

$$k > \frac{\lg\left(\frac{12503}{3}\right)}{\lg\left(\frac{3}{2}\right)}$$

(3)

(c) Hence find the least value of k

(1)



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Question 9 continued



10 (a) Show that	$\frac{9^{3y}}{243} = 3^{(6y-5)}$
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(4)

(b) Solve the simultaneous equations

$$\frac{9^{3y}}{243} = 27^{(x-2)}$$

$$\log_{10}\sqrt{6xy} = \log_4 2$$

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Question 10 continued



h cm

Diagram **NOT** accurately drawn

Figure 4

Figure 4 shows an open container in the shape of a cylinder with radius r cm and height h cm.

Given that the total surface area of the container is 625π cm²

(a) show that

$$h = \frac{625 - r^2}{2r}$$

(3)

The volume of the container is $V \text{cm}^3$

Given that r can vary,

(b) use calculus to find the value, to 3 significant figures, of r for which V is a maximum.

Justify that this value of r gives a maximum value of V

(6)

(c) For the value of r found in part (b), find the corresponding value, to 3 significant figures, of h

(1)





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Question 11 continued	





Question 11 continued		
	(Total for Question 11 is 10 marks)	
	TOTAL FOR PAPER IS 100 MARKS	

