Please check the examination details bel	low before ente	ring your candidate	information
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Centre Number Candidate N			To To This Is a little micron, by John W. J. J.
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Time 2 hours	Paper reference	4PM	1/02R
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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 This is the state of the state of

#### 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

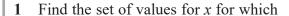
$$\log_a x = \frac{\log_b x}{\log_b a}$$



# Answer all ELEVEN questions.

# Write your answers in the spaces provided.

# You must write down all the stages in your working.



(a) 
$$5x - 10 > 4x - 7$$

(1)

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(b) 
$$2x^2 - 11x + 5 < 0$$

(3)

(c) both 
$$5x - 10 > 4x - 7$$
 and  $2x^2 - 11x + 5 < 0$ 

(1)

(Total for Question 1 is 5 marks)



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2	The point A has coordinates $(-7, -1)$ and the point B has coordinates $(3, 4)$	S. Britishs	
	(a) Find an equation of the line that passes through $A$ and $B$ Give your answer in the form $ax + by + c = 0$ where $a$ , $b$ and $c$ are integers	S.	(3) Negapo
	The point $C$ has coordinates $(-3, 7)$		dy)
	Given that $k$ is a constant such that $AB = kAC$		
	(b) find the value of k		
			(2)
	The point $D$ has coordinates $(3, p)$ where $p$ is a constant.		
	Given that $CD$ is perpendicular to $AB$		
	(c) find the value of p		(3)





3 Differentiate with respect to	x
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3	_	$\sqrt{5}x$	$e^{2x}$	(a)
	_	$\sqrt{2}x$	$e^{2x}$	(a)

(h)	$x^3$
(U)	$\cos 3x$

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4	The	quadratic	equation
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$$2x^2 + 4x + 3 = 0$$

has roots  $\alpha$  and  $\beta$ 

(a) Without solving the equation, show that  $\alpha^2 + \beta^2 = 1$ 

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(b) Without solving the equation, find the value of  $\alpha^4 + \beta^4$ 

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(c) Hence form a quadratic equation with integer coefficients that has roots  $\alpha^4$  and  $\beta^4$ 

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- 5 A geometric series G has first term 12 and common ratio  $\frac{3}{8}$ 
  - (a) Find the sum to infinity of G
  - (b) Show that the 6th term of G can be written as  $\frac{3^6}{2^{13}}$

(3)

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The *n*th term of G is  $u_n$ 

(c) By finding an expression for  $u_n$  in terms of n, show that

$$\log_2 u_n = n \log_2 3 - 3n + 5$$

(5)

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6	The	curve	C	has	equation
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$$y = 4\sqrt{x}$$

The point A on C has coordinates (9, 12)

The tangent to C at the point A meets the x-axis at the point T

(a) Find the coordinates of T

(5)

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The normal to C at the point A meets the x-axis at the point N

(b) Find the coordinates of N

(4)

(c) Calculate the area of triangle ATN

(2)



7 Given that

$$\frac{3+\sin^2\theta}{\cos\theta-2}=3\cos\theta$$

(a) show that  $\cos \theta = -\frac{1}{2}$ 

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**(4)** 

(b) Hence solve the equation

$$\frac{3 + \sin^2 3x}{\cos 3x - 2} = 3\cos 3x \quad \text{for } 0^{\circ} \leqslant x < 180^{\circ}$$

**(4)** 






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8	Liquid drips onto a large horizontal flat cloth, forming a circular stain.	British <sub>sto.</sub>
	The liquid starts to drip onto the cloth at time $t = 0$	Udentioon.
	The area of the stain increases at a constant rate of 1.5 cm <sup>2</sup> /s	Britishshakellroom bakida web abb
	(a) Find, in terms of $\pi$ , the radius of the stain at time $t = 4$ seconds.	(8).
		(3)
	(b) Find, in cm/s to 3 significant figures, the rate at which the radius of the stain is increasing at time $t = 4$ seconds.	
	increasing at time $i = 4$ seconds.	(4)





- Given that  $\alpha$  is the acute angle such that  $\tan \alpha =$ 
  - (a) find the exact value of  $\cos \alpha$

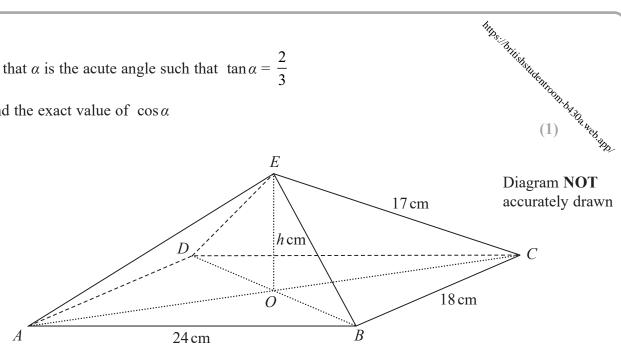


Figure 1

Figure 1 shows a right pyramid with a rectangular base ABCD and vertex E

The rectangular base of the pyramid is horizontal with  $AB = 24 \,\mathrm{cm}$  and  $BC = 18 \,\mathrm{cm}$ .

The diagonals of the base intersect at the point O

The vertex E of the pyramid is vertically above O such that

$$AE = BE = CE = DE = 17 \text{ cm}$$

The height of the pyramid is h cm.

(b) Find the value of h

(3)

The size of the angle between the plane *EBC* and the plane *ABCD* is  $\theta^{\circ}$ 

(c) Show that  $\tan \theta^{\circ} = \frac{2}{3}$ 

**(2)** 

The point P is the midpoint of EB and the point Q is the midpoint of EC

(d) Find the size, in degrees to one decimal place, of the angle between the plane *OPQ* and the plane BCQP

**(4)** 



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Figure 2

Figure 2 shows part of the curve  $C_1$  with equation  $y = \sin x + 1$  and part of the curve  $C_2$  with equation  $y = \cos x + 1$ 

As shown in Figure 2,  $C_1$  and  $C_2$  intersect at the point A and at the point B

(a) Find the exact value of the x coordinate of A and the exact value of the x coordinate of B (3)

The shaded finite region  $R_1$  shown in Figure 2 is bounded by  $C_1$  and  $C_2$ 

The shaded finite region  $R_2$  shown in Figure 2 is bounded by the x-axis,  $C_1$  and  $C_2$ 

(b) Use calculus to find the ratio

area of  $R_1$ : area of  $R_2$ 

Give your answer in the form  $a: \left(\frac{\pi\sqrt{2}}{b} - c\right)$  where a, b and c are integers.

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Diagram NOT accurately drawn

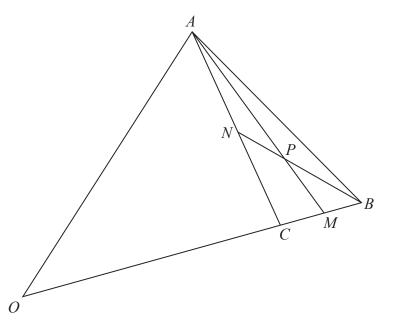


Figure 3

Figure 3 shows triangle OAB with  $\overrightarrow{OA} = \mathbf{a}$  and  $\overrightarrow{OB} = \mathbf{b}$ 

The point C lies on OB such that OC: CB = 2:1

The point M is the midpoint of CB and the point N is the midpoint of AC

The lines AM and NB intersect at the point P

(a) Using a vector method, find  $\overrightarrow{OP}$  as a simplified expression in terms of **a** and **b** 

(9)

The point Q is the midpoint of AB

(b) Using a vector method, show that C, P and Q are collinear.

**(4)** 




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	(Total for Question 11 is 13 marks)
	TOTAL FOR PAPER IS 100 MARKS