Please check the examination details bel	ow before ente	ring your candidate i	nformation
Candidate surname		Other names	Toritishelita
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<b>Time</b> 2 hours	Paper reference	4PM	1/01
Further Pure Mat PAPER 1	hema	tics	0
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 ▶





# 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.

1	Using calculus find the exact value of	$\int_{\underline{\pi}}^{\underline{\pi}} \frac{\pi}{3}$	$\cos 4\theta d\theta$
		4	

Give your answer in the form $-\frac{\sqrt{a}}{b}$ where a is a prime number and b is	an integer.
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**(4)** 

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(Total for Question 1 is 4 marks)



1	
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$$f(x) = 2x^2 - 12x + 5$$

Given that f(x) can be written in the form  $f(x) = a(x+b)^2 + c$  where a, b and c are integers,

(a) find the value of a, the value of b and the value of c

(3)

(b) Hence find the set of values of x for which f(x) - 37 > 0

(4)






3	A geometric series $G$ has first term $a$ and common ratio $r$	h <sub>ths:/Aritico</sub>
	The 2nd term of G is $\frac{5}{16}$ and the 5th term of G is $\frac{135}{1024}$	hips: Ariishshidentoon bada web ah
	(a) Find	**10 <sub>0, 146</sub> 00, 400.
	(i) the value of $r$	
	(ii) the value of $a$	(5)
	Given that $G$ is convergent with sum to infinity $S$	
	(b) find the exact value of S	(2)





- (a) On the grid opposite, draw the line with equation
  - (i) y = 2x 4
- (ii) 2x + 3y = 12
- (iii) y + 2x + 2 = 0

(b) Show, by shading on the grid, the region R defined by the inequalities

$$y \geqslant 2x - 4$$

$$2x + 3y \leq 12$$

$$y + 2x + 2 = 0$$

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$$y + 2x + 2 \ge 0$$

$$y + 2x + 2 \ge 0$$

$$(1)$$

(1)

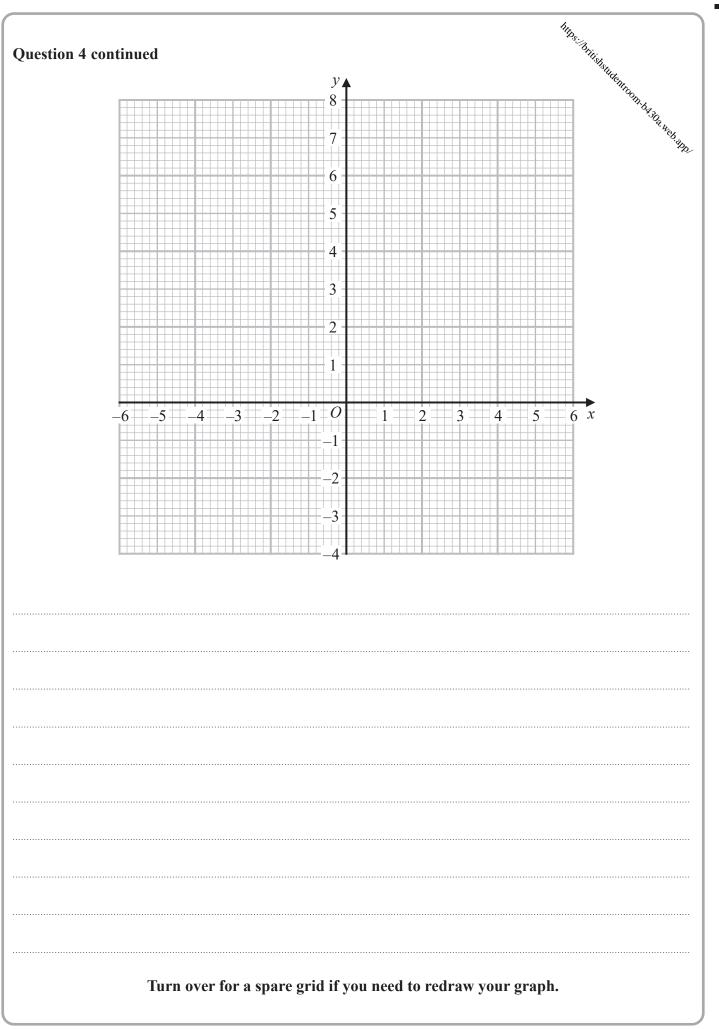
For all points in R, with coordinates (x, y)

$$P = x - 2y$$

(c) find the least value of P









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# Hips: Britists tide on to A John Med and **Question 4 continued** Only use this grid if you need to redraw your graph. 7 6 5 4 3 2 1 (Total for Question 4 is 8 marks)



5	Given that	$f(x) = ax^3 + 5bx^2 + 8ax - 4b$ $(x+2) \text{ is a factor of } f(x)$	where $a$ and $b$ are integers	hips://hitishstadentoon/b430a Nebapo
		when $f(x)$ is divided by $(x + a)$ and find the value of $a$ solve the equation $f(x) = 0$	3) the remainder is 21	(5) (4)





6 In triangle ABC, AC = x cm, AB = (x + 3) cm and  $\angle ABC = 30^{\circ}$ 

Given that  $\angle ACB = \theta^{\circ}$  where  $0 < \theta < 90$ 

(a) show that

(i) 
$$\sin \theta^{\circ} = \frac{x+3}{2x}$$

(ii) 
$$\cos \theta^{\circ} = \frac{\sqrt{3x^2 - 6x - 9}}{2x}$$

(5)

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Given that the size of  $\angle BAC$ : the size of  $\angle ABC = 7:2$ 

(b) find the exact value of x

Give your answer in the form  $a + a\sqrt{b}$  where a and b are prime numbers.

(5)









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7 (a) Write down the value of log	<sub>2</sub> 16
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Given that  $4 + 2\log_4 x = \log_2 y$ 

- (b) show that y = 16x
- (c) Hence solve the equation  $4 + 2\log_4 x = \log_2(4x + 5)$

(3)

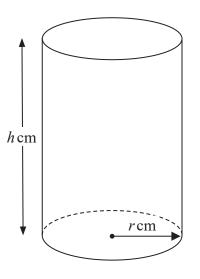
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Figure 1

A solid right circular cylinder has base radius r cm and height h cm as shown in Figure 1.

The cylinder has a volume of  $90\pi \,\mathrm{cm}^3$  and a total surface area of  $S \,\mathrm{cm}^2$ 

(a) Show that 
$$S = 2\pi r^2 + \frac{180\pi}{r}$$

(3)

Given that r can vary,

(b) use calculus to find, to 3 significant figures, the value of r for which S is a minimum, justifying that this value of r gives a minimum value of S

(5)

(c) Find, to 3 significant figures, the minimum value of S

**(2)** 



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9 (a) Expand  $\frac{1}{\sqrt{1-2x}}$  in ascending powers of x up to and including the term in  $x^3$ 

Simplify each term as far as possible.



(b) Show that  $\frac{1}{\sqrt{0.96}} = \frac{5\sqrt{6}}{12}$ 

Show all your working clearly.

**(2)** 

(c) Express  $\frac{1}{5\sqrt{6}-12}$  in the form  $\frac{a\sqrt{6}}{c}+b$  where a, b and c are integers.

Show all your working clearly.

(2)

Using the expansion you found in part (a) with a suitable value of x

(d) find an estimate, to 5 decimal places, of  $\frac{9}{5\sqrt{6}-12}$ 

(4)




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**10** The equation of the line  $L_1$  is y - 2x - 6 = 0

The point P with coordinates (2, a) lies on  $L_1$ 

(a) Find the value of a

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The line  ${\cal L}_{\scriptscriptstyle 2}$  is perpendicular to  ${\cal L}_{\scriptscriptstyle 1}$  and passes through  ${\cal P}$ 

(b) Show that an equation of  $L_2$  is x + 2y - 22 = 0

(4)

Line  $L_1$  crosses the x-axis at the point A and line  $L_2$  crosses the x-axis at the point B

The point C has coordinates (m, n) such that m > 0 and n < 0

The length of AC is  $5\sqrt{2}$  and the gradient of BC is  $\frac{1}{4}$ 

(c) Find the value of m and the value of n



(d) Find the area of quadrilateral ACBP

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11 Given that

$$y = \frac{e^{4x}}{32} \left( 8x^2 - 4x + 1 \right)$$

(a) show that  $\frac{dy}{dx} = x^2 e^{4x}$ 



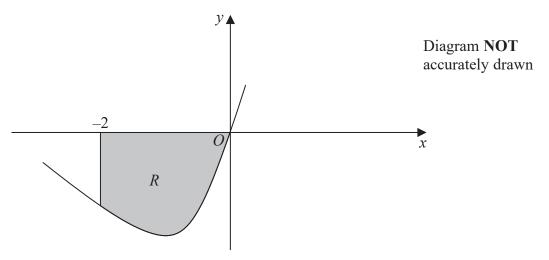


Figure 2

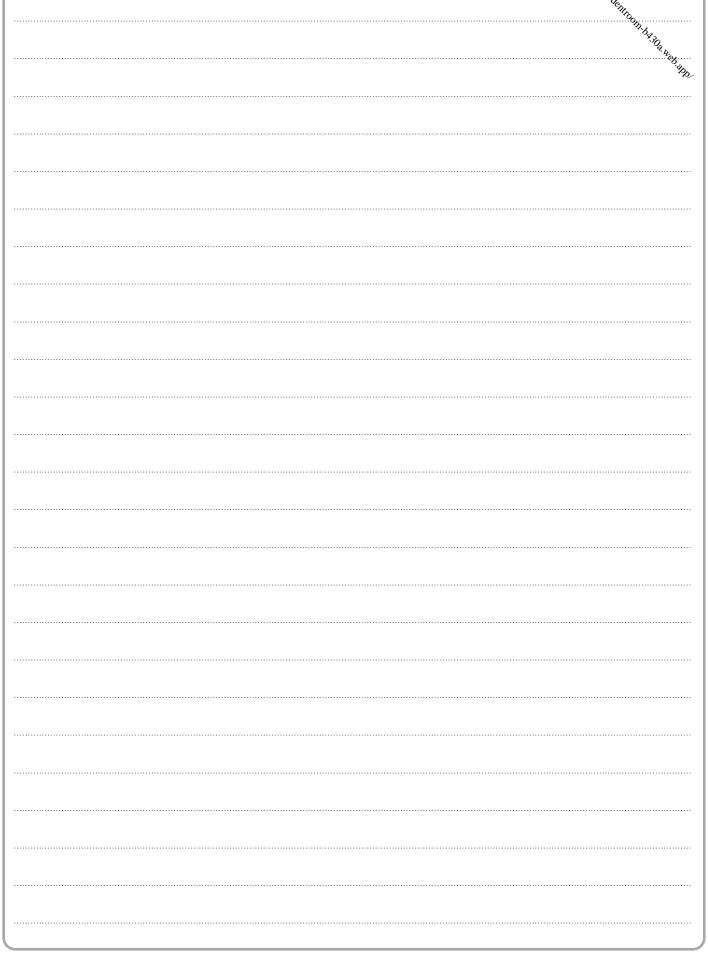
Figure 2 shows part of the curve C with equation  $y = 3xe^{2x}$ 

The finite region R bounded by C, the straight line with equation x = -2 and the x-axis, shown shaded in Figure 2, is rotated though 360° about the x-axis.

(b) Using part (a), find the volume, to 2 significant figures, of the solid formed.







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