Please check the examination details bel	ow before ente	ring your candidate i	nformation
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Time 2 hours	Paper reference	4PM	1/02
Further Pure Mat PAPER 2	hema	tics	
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 TEN questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.



1

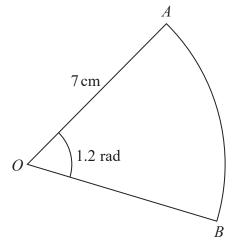


Diagram **NOT** accurately drawn

Figure 1

Figure 1 shows sector AOB of a circle with centre O and radius 7 cm.

The angle *AOB* is 1.2 radians.

Calculate

(a) the area of sector AOB

(2)

(b) the perimeter of sector AOB

(2)

(Total for Question 1 is 4 marks)



2	Solve the equation						Attos:	(Brig.
2	Solve the equation	$\sin(2\theta -$	– 20)° –	$-\sqrt{3}\cos(2\theta$	- 20)° = 0	for $0 \leqslant \theta \leqslant$	180	Britishshidentoop by Star (5) Programmed app.
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3	The curve C has equation $y = 9 - x^2$	h _{thos://thisho.}
	The curve C has equation $y = 9 - x^2$ Use algebraic integration to find the area of the finite region bounded by C and	the x -axis. t_{t_0} (5) t_0
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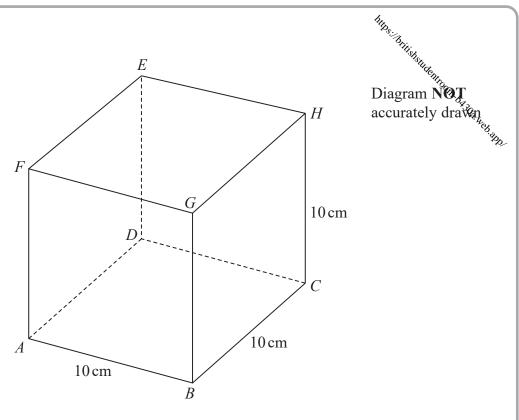


Figure 2

Figure 2 shows a solid cube ABCDEFGH with sides of length 10 cm.

(a) Find, in cm, the exact length of FC

(2)

(b) Find, in degrees to one decimal place, the size of $\angle FCA$

(2)

(c) Find, to the nearest degree, the size of the obtuse angle between the plane BFH and the plane BHC

(5)



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5	A particle P is moving along the x-axis. At time t seconds $(t \ge 0)$ the velocity, P is given by $v = 3t^2 - 23t + 30$	V m/s, tof _{sudentroom, basing} (3)
	(a) Find the values of t when P is instantaneously at rest.	(3) (3)
	At time t seconds the acceleration of P is $a \text{ m/s}^2$	20
	(b) Find the range of values of t for which $a > 0$	(2)
	When $t = 0$, P is at the point with coordinates $(d, 0)$	
	Given that, when $t = 8$, P is at the point with coordinates (26, 0)	
	(c) find the value of d	
		(4)



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- 6 The sum of the first *n* terms of an arithmetic series is S_n where $S_n = n(3 + 2n)$
 - (a) Find the value of S_{20}

Given that $S_n = \sum_{r=1}^n (Ar + B)$

(b) find the value of A and the value of B

(6)

A different arithmetic series has first term 7 and common difference 4. The sum of the first n terms of this series is T_n

(c) Use algebra to find the value of *n* for which $T_n = S_n + 252$

(5)



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

The equation g(x) = 0 has roots $\frac{\alpha}{\beta}$ and $\frac{\beta}{\alpha}$

Given that p + q = -4 where p > 0 and without solving the equation g(x) = 0

- (a) find
 - (i) the value of p
 - (ii) the value of q

(9)

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Given also that $\alpha > \beta$

(b) show that
$$\alpha^2 - \beta^2 = -\frac{3\sqrt{65}}{4}$$

(4)



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(a) Given that x is measured in radians, complete the table of values for

$$y = \sin x - 3\cos 2x - 0.5$$

Given that			$y = \sin$	$x-3\cos 2$		alues for	Airba	Onition of the Control of the Contro	bajla web app
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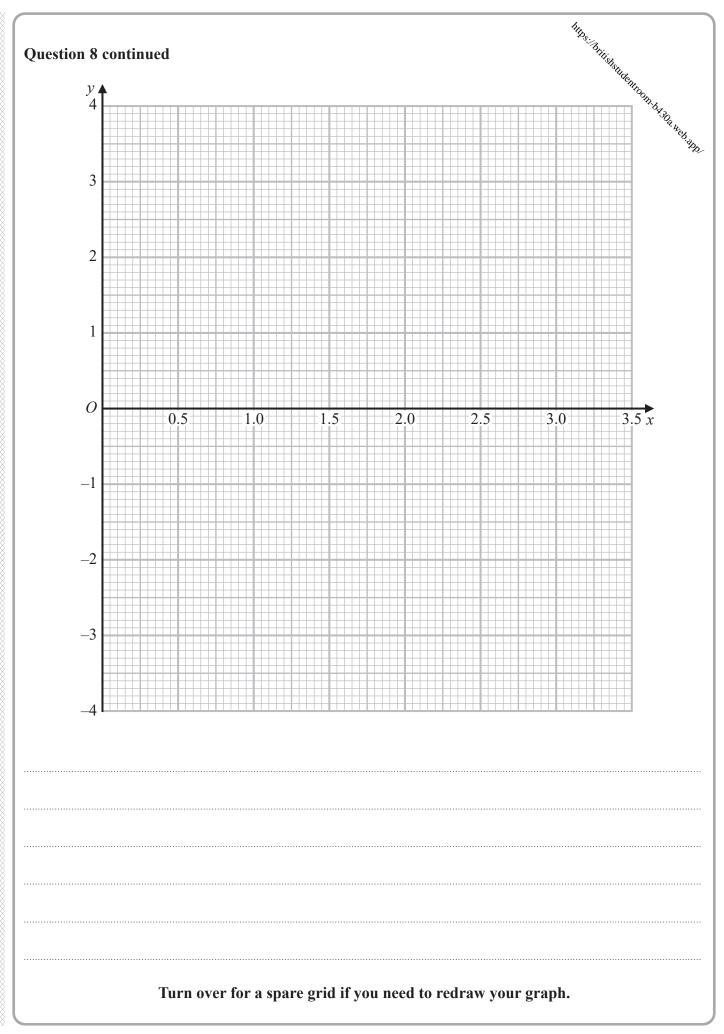
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- (b) On the grid opposite, draw the graph of $y = \sin x 3\cos 2x 0.5$ for $0 \le x \le 3$
- (c) Use a formula from page 2 to show that $\cos 2A = 1 2\sin^2 A$

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

(d) By drawing a suitable straight line on the grid, obtain estimates, to one decimal place, of the roots of the equation f(x) = 0 in the interval $0 \le x \le 3$

(5)





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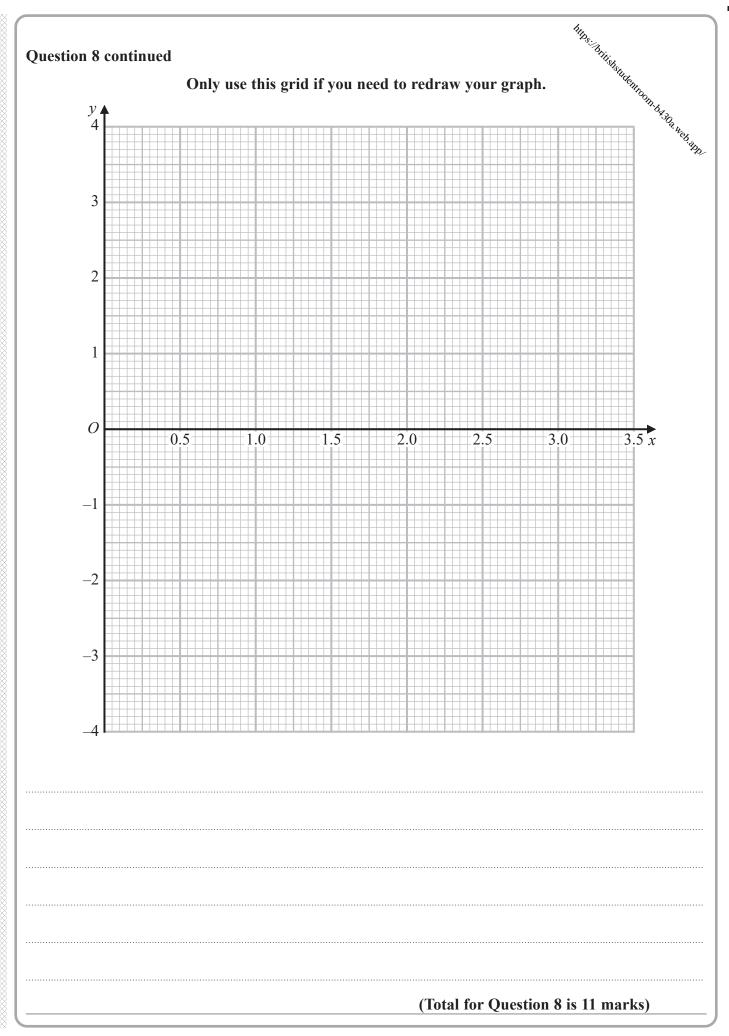
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Figure 3

4**b** 

Figure 3 shows the triangle *OAB* with

$$\overrightarrow{OA} = 2\mathbf{a}$$
 and  $\overrightarrow{OB} = 4\mathbf{b}$ 

(a) Find  $\overrightarrow{AB}$  in terms of **a** and **b** 

**(2)** 

The point P is the midpoint of AB

(b) Find  $\overrightarrow{OP}$  as a simplified expression in terms of **a** and **b** 

2a

**(2)** 

The point Q lies on OP such that OQ: QP = 3:1

(c) Find  $\overrightarrow{AQ}$  as a simplified expression in terms of **a** and **b** 

(3)

The point R lies on OB such that AQR is a straight line.

(d) Find in its simplest form the ratio OR : RB

**(6)** 





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- 10 The curve C has equation  $y = \frac{2x-1}{x+4}$   $x \neq -4$
- -4
  - (a) Write down an equation of the asymptote to C that is
    - (i) parallel to the x-axis,
    - (ii) parallel to the y-axis.

- (2)
- (b) Find the coordinates of the points of intersection of C with the coordinate axes.
- (2)
- (c) Using the axes on the opposite page, sketch C, showing clearly the asymptotes and the coordinates of the points of intersection of C with the coordinate axes.
- (3)

The line with equation  $y = x + k_1$  is the tangent to C at the point P

The line with equation  $y = x + k_2$  is the tangent to C at the point Q

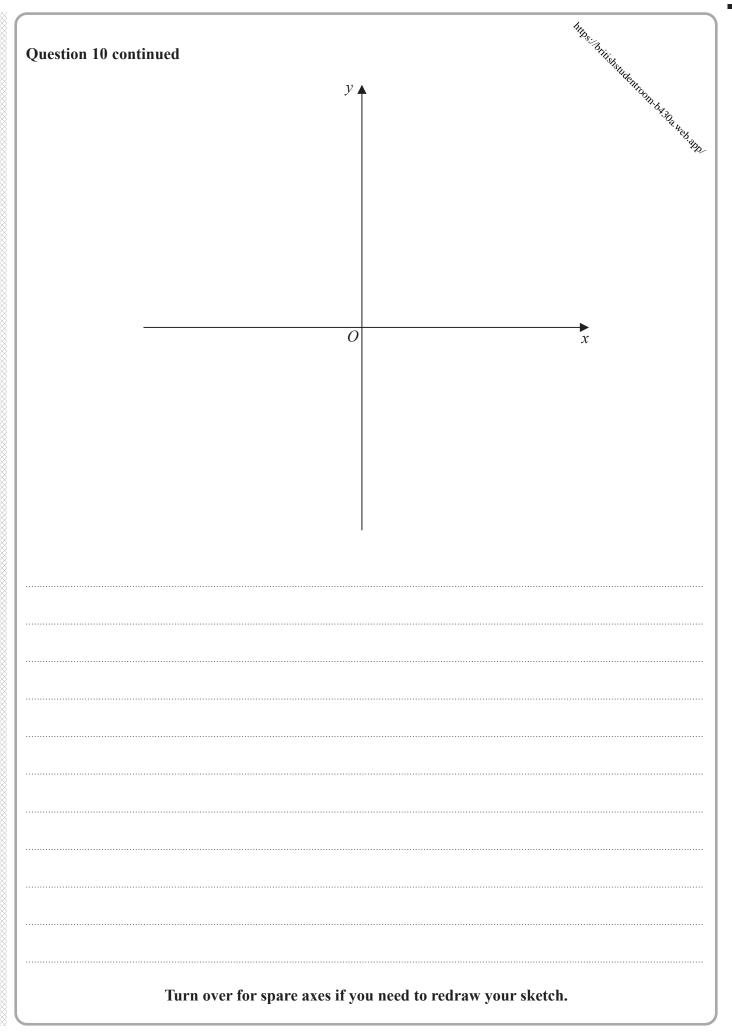
Given that the x coordinate of P is greater than the x coordinate of Q

- (d) using calculus, find the coordinates of
  - (i) *P*
  - (ii) Q

**(8)** 

- (e) Hence find the value of
  - (i)  $k_1$
  - (ii)  $k_2$

(3)



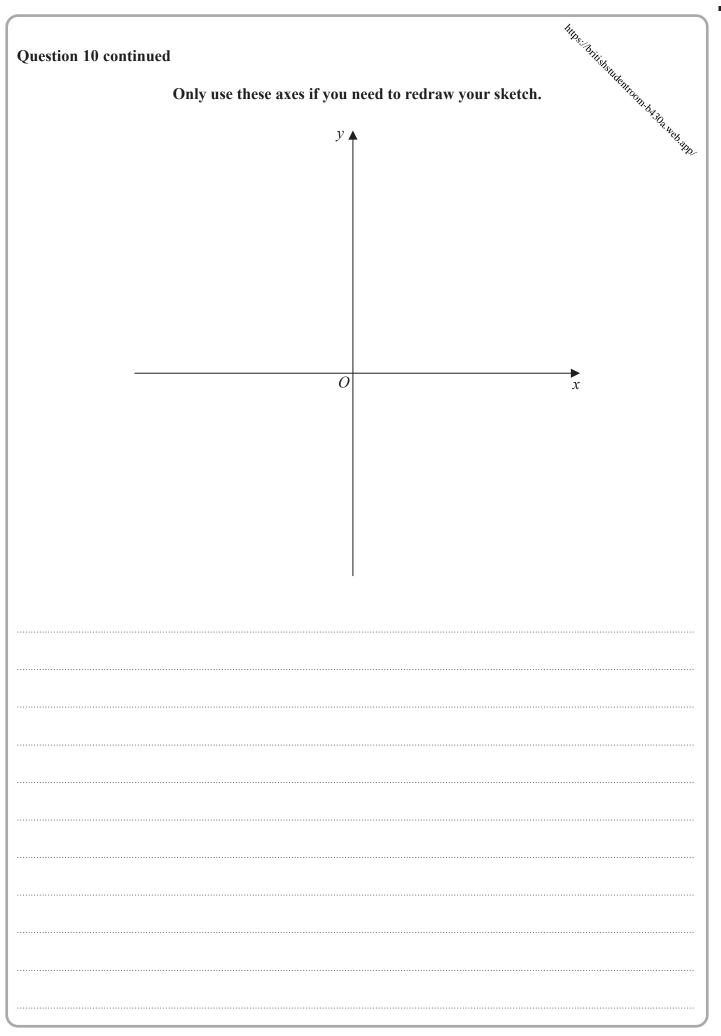


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Question 10 continued	Antists Antion to A Star Mess and
	Total Andrews
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	(Total for Question 10 is 18 marks)
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