


Please check the examination details below before entering your candidate information

Candidate surname					Other names						
<b>Pearson Edexcel International GCSE</b>		Centre Number					Candidate Number				
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Time 2 hours		Paper reference		<b>4PM1/02</b>							
<b>Further Pure Mathematics</b>											
<b>PAPER 2</b>											
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.
- Good luck with your examination.

Turn over ►



## International GCSE in Further Pure Mathematics Formulae sheet

### Mensuration

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

Curved surface area of cone =  $\pi r \times$  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

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

### Calculus

#### Quotient rule (differentiation)

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

### Trigonometry

#### Cosine rule

In triangle  $ABC$ :  $a^2 = b^2 + c^2 - 2bc \cos A$

$$\tan \theta = \frac{\sin \theta}{\cos \theta}$$

$$\sin(A+B) = \sin A \cos B + \cos A \sin B$$

$$\cos(A+B) = \cos A \cos B - \sin A \sin B$$

$$\tan(A+B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$$

$$\sin(A-B) = \sin A \cos B - \cos A \sin B$$

$$\cos(A-B) = \cos A \cos B + \sin A \sin B$$

$$\tan(A-B) = \frac{\tan A - \tan B}{1 + \tan A \tan B}$$

### Logarithms

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

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**Answer all ELEVEN questions.**

**Write your answers in the spaces provided.**

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

**1** Find the set of values for  $x$  for which

(a)  $8x - 7 < 5x + 5$  (2)

(b)  $2x^2 - 5x - 3 > 0$  (3)

(c) **both**  $8x - 7 < 5x + 5$  **and**  $2x^2 - 5x - 3 > 0$  (1)

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(Total for Question 1 is 6 marks)



2

$$f(x) = 2 + \frac{4}{5}x - \frac{1}{25}x^2$$

Given that  $f(x)$  can be expressed in the form  $A - B(x + C)^2$  where  $A$ ,  $B$  and  $C$  are constants,

(a) find the value of  $A$ , the value of  $B$  and the value of  $C$ . (4)

(b) Hence write down

(i) the maximum value of  $f(x)$ ,

(ii) the value of  $x$  for which this maximum occurs. (2)

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**Question 2 continued**

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



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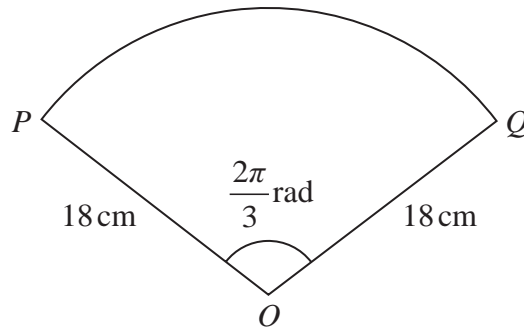


Diagram NOT accurately drawn

Figure 1

Figure 1 shows a sector  $OPQ$  of a circle with centre  $O$ .

The radius of the circle is 18 cm and the angle  $POQ$  is  $\frac{2\pi}{3}$  radians.

- (a) Find the length of the arc  $PQ$ , giving your answer as a multiple of  $\pi$  (2)

Figure 2 below shows the sector  $OPQ$  and the kite  $OPTQ$ .

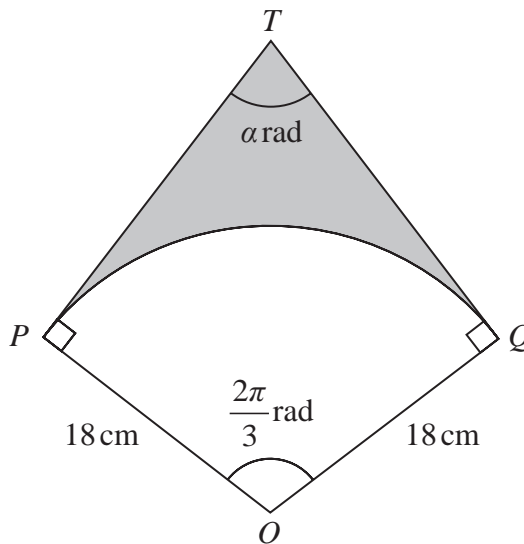


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Figure 2

$PT$  is the tangent to the circle at  $P$  and  $QT$  is the tangent at  $Q$ , such that angle  $PTQ = \alpha$  radians.

- (b) (i) Find  $\alpha$  in terms of  $\pi$  (1)
- (ii) Calculate, to 3 significant figures, the area of the region, shown shaded in Figure 2, which is bounded by the arc  $PQ$  and the tangents  $PT$  and  $QT$ . (6)

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**Question 3 continued**

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**Question 3 continued**

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**Question 3 continued**

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**(Total for Question 3 is 9 marks)**



4 The point  $A$  has coordinates  $(-4, -10)$  and the point  $B$  has coordinates  $(3, 11)$   
The line  $l$  passes through  $A$  and  $B$ .

- (a) Find an equation of  $l$ . (2)

The point  $P$  lies on  $l$  such that  $AP : PB = 3 : 4$

- (b) Find the coordinates of  $P$ . (2)

The point  $Q$  with coordinates  $(m, n)$ , where  $m < 0$ , lies on the line through  $P$  that is perpendicular to  $l$ .

Given that the length of  $PQ$  is  $\sqrt{10}$

- (c) find the coordinates of  $Q$ . (6)

The point  $R$  has coordinates  $(-11, -21)$

- (d) Show that
- (i)  $AB$  and  $RQ$  are equal in length,
  - (ii)  $AB$  and  $RQ$  are parallel. (4)

- (e) Find the area of the quadrilateral  $ABQR$ . (2)

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**Question 4 continued**

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**Question 4 continued**

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**Question 4 continued**

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**(Total for Question 4 is 16 marks)**



5 The  $n$ th term of a geometric series with common ratio  $r$  is  $u_n$

Given that  $u_2 + u_4 = 212.5$  and that  $u_3 + u_4 = 62.5$

(a) find the two possible values of  $r$ .

(5)

Given that the series is convergent with sum to infinity  $S$ ,

(b) find the exact value of  $S$ .

(2)

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**Question 5 continued**

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**(Total for Question 5 is 7 marks)**



6

$$f(x) = x^3 + (p + 1)x^2 - 10x + q$$

where  $p$  and  $q$  are integers.

Given that  $(x - 3)$  is a factor of  $f(x)$

(a) show that  $9p + q + 6 = 0$  (3)

Given that  $(x + p)$ , where  $p > 0$ , is also a factor of  $f(x)$

(b) show that  $p^2 + 10p + q = 0$  (3)

(c) Hence find the value of  $p$  and the value of  $q$ . (5)

(d) Using your values of  $p$  and  $q$ , factorise  $f(x)$  completely. (2)

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**Question 6 continued**

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**Question 6 continued**

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**(Total for Question 6 is 13 marks)**



7 (a) Complete the table of values for  $y = 3^{\frac{x}{4}} + 2$

Give your answers to 2 decimal places where appropriate.

(2)

<b>x</b>	0	1	2	3	4	5
<b>y</b>	3	3.32				5.95

(b) On the grid opposite, draw the graph of

$$y = 3^{\frac{x}{4}} + 2 \quad \text{for } 0 \leq x \leq 5$$

(2)

(c) By drawing a suitable straight line on the grid, obtain an estimate, to one decimal place, of the root of the equation

$$\log_3(6 - 2x)^4 - x = 0$$

in the interval  $0 \leq x \leq 5$

(5)

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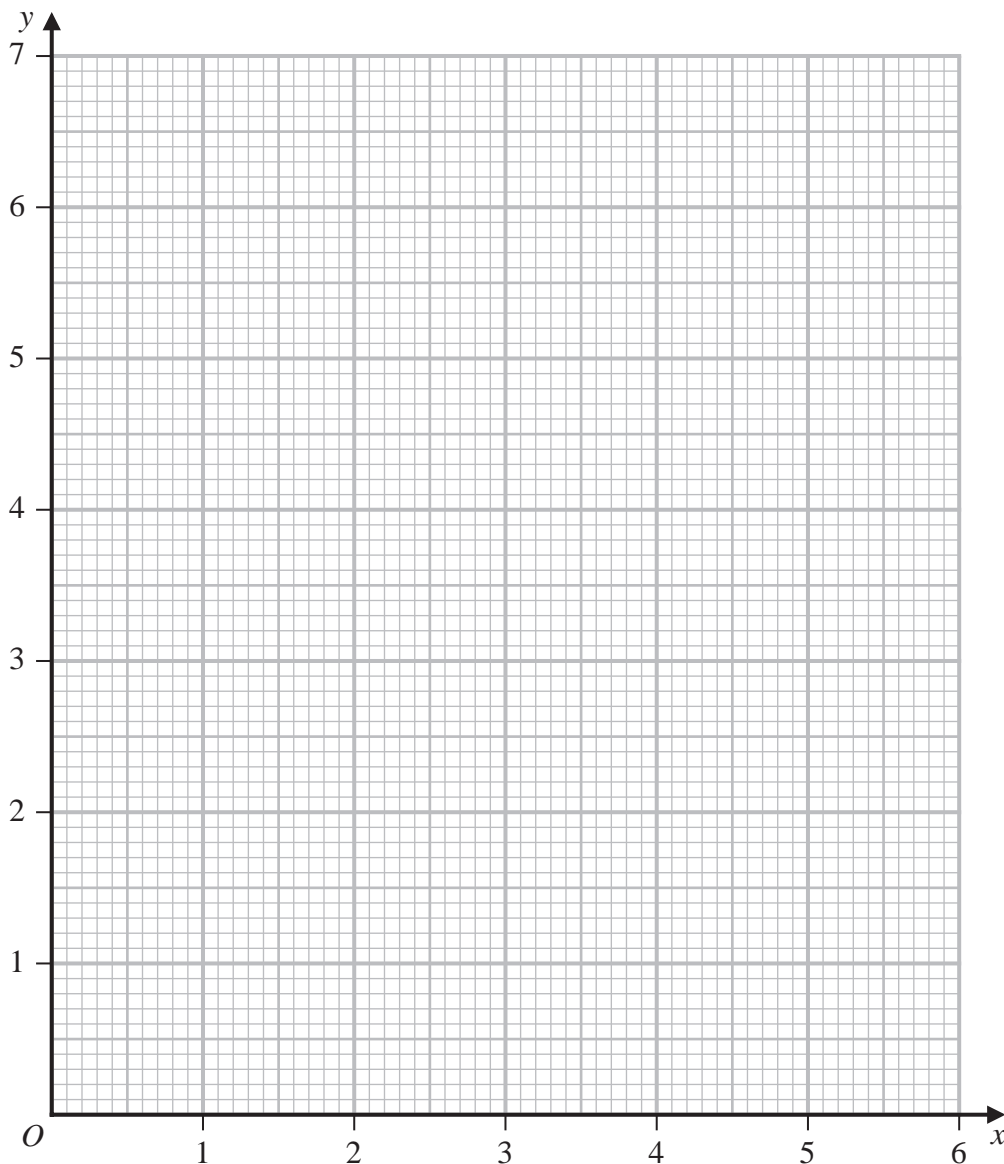
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Question 7 continued



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Turn over for a spare grid if you need to redraw your graph.



**Question 7 continued**

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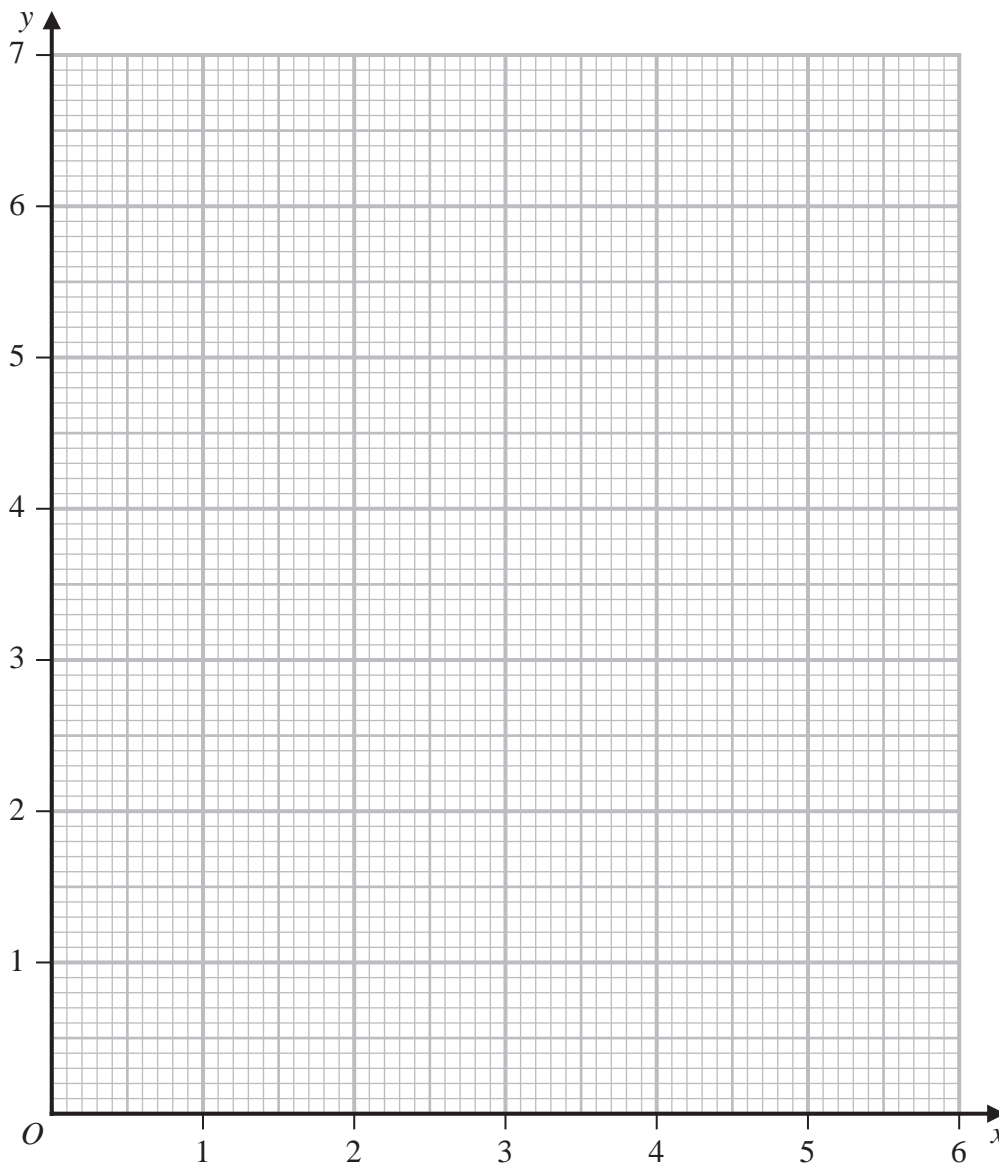
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Question 7 continued

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(Total for Question 7 is 9 marks)



8 Use an algebraic method to solve the simultaneous equations

$$\log_4 a + 3 \log_8 b = \frac{5}{2}$$

$$2^a = \frac{16^4}{4^{b^2}}$$

(8)

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**Question 8 continued**

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**(Total for Question 8 is 8 marks)**



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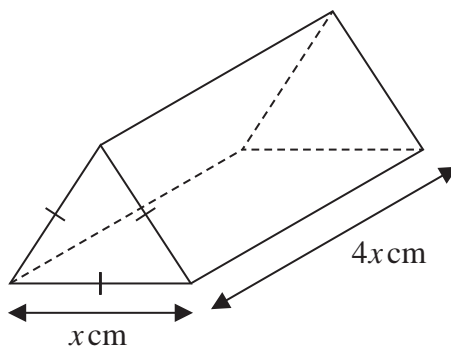


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accurately drawn

Figure 3

Figure 3 shows a metal solid  $S$ .

The solid is a right triangular prism.

The cross section of  $S$  is an equilateral triangle with sides of length  $x$  cm.

The length of  $S$  is  $4x$  cm.

The prism is being heated so that the cross sectional area is increasing at a constant rate of  $0.03 \text{ cm}^2/\text{s}$ .

(a) Find, giving your answer to 3 significant figures,  $\frac{dx}{dt}$  when  $x = 2$  (5)

(b) Find the rate of increase, in  $\text{cm}^3/\text{s}$ , of the volume of  $S$  when  $x = 2$  (3)

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**Question 9 continued**

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Question 9 continued

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**Question 9 continued**

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**(Total for Question 9 is 8 marks)**



10 (a) Solve the equation

$$\tan x^\circ = -3 \quad \text{for } 0 \leq x < 360$$

Give your solutions to the nearest whole number.

(3)

Given that

$$7 \sin^2 \theta + \sin \theta \cos \theta = 6$$

(b) show that

$$\tan^2 \theta + \tan \theta - 6 = 0$$

(3)

(c) Hence solve the equation

$$7 \sin^2 y^\circ + \sin y^\circ \cos y^\circ = 6 \quad \text{for } 0 \leq y < 360$$

Give your solutions to the nearest whole number.

(4)

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**Question 10 continued**

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**Question 10 continued**

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**Question 10 continued**

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**(Total for Question 10 is 10 marks)**



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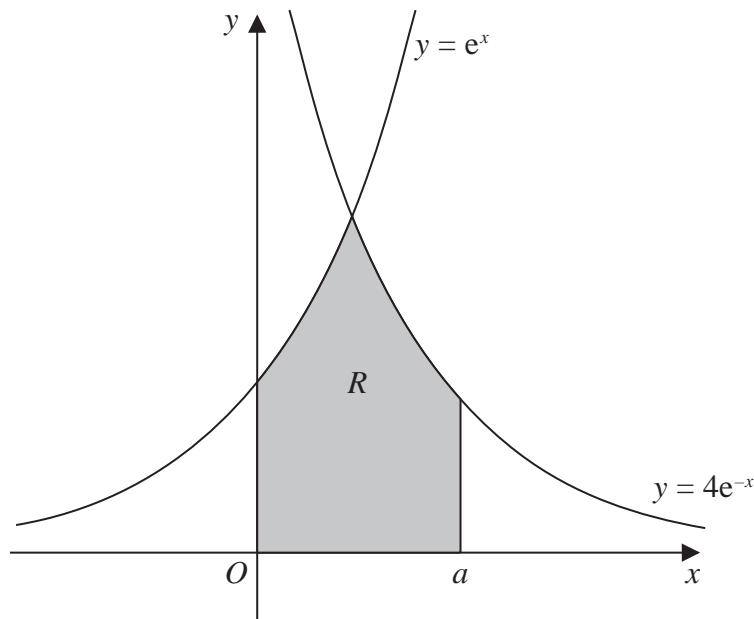


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Figure 4

The region  $R$ , shown shaded in Figure 4, is bounded by the curve with equation  $y = e^x$ , the curve with equation  $y = 4e^{-x}$ , the straight line with equation  $x = a$ , the  $x$ -axis and the  $y$ -axis.

When the region  $R$  is rotated through  $360^\circ$  about the  $x$ -axis, the volume of the solid generated is

$$k - 8\pi e^{-4}$$

where  $k$  is a constant.

Using algebraic integration, find a possible value of  $a$  and the exact corresponding value of  $k$ .

(8)

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(Total for Question 11 is 8 marks)

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**TOTAL FOR PAPER IS 100 MARKS**

