

Please write clearly in block capitals.

Centre number

Candidate number

Surname \_\_\_\_\_

Forename(s) \_\_\_\_\_

Candidate signature \_\_\_\_\_

I declare this is my own work.

# INTERNATIONAL AS MATHEMATICS

(9660/MA02) Unit PSM1 Pure Mathematics, Statistics and Mechanics

Wednesday 15 January 2020 07:00 GMT Time allowed: 1 hour 30 minutes

### Materials

- For this paper you must have the Oxford International AQA booklet of formulae and statistical tables (enclosed).
- You may use a graphics calculator.

### Instructions

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

### Information

- The marks for questions are shown in brackets.
- There are three sections to this paper.
- The maximum mark for this paper is 80. There are 40 marks for **Section A**, 20 marks for **Section B** and 20 marks for **Section C**.

### Advice

- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- Show all necessary working; otherwise marks may be lost.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
<b>TOTAL</b>	



**Section A****Pure Mathematics**Answer **all** questions in the spaces provided.**1** It is given that

$$p = \log_3 5$$

and

$$q = \log_3 4$$

**1 (a)** Find in terms of  $p$  and  $q$  an expression for  $\log_3 1.25$ **[1 mark]**

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Answer \_\_\_\_\_

**1 (b)** Find in terms of  $p$  and  $q$  an expression for  $\log_3 50$ **[3 marks]**

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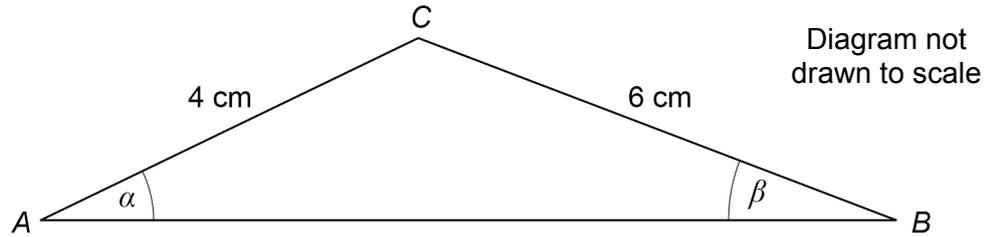
Answer \_\_\_\_\_

4
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2 The diagram shows triangle  $ABC$ , where  $AC = 4$  cm and  $BC = 6$  cm.

Angle  $BAC = \alpha$  and angle  $ABC = \beta$ , where both  $\alpha$  and  $\beta$  are acute.



2 (a) Given that  $\sin \alpha = \frac{3}{7}$ , show that  $\sin \beta = \frac{2}{7}$

[2 marks]

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2 (b) Using a trigonometrical identity, show that  $\cos \beta = \frac{k\sqrt{5}}{7}$  where  $k$  is an integer.

[3 marks]

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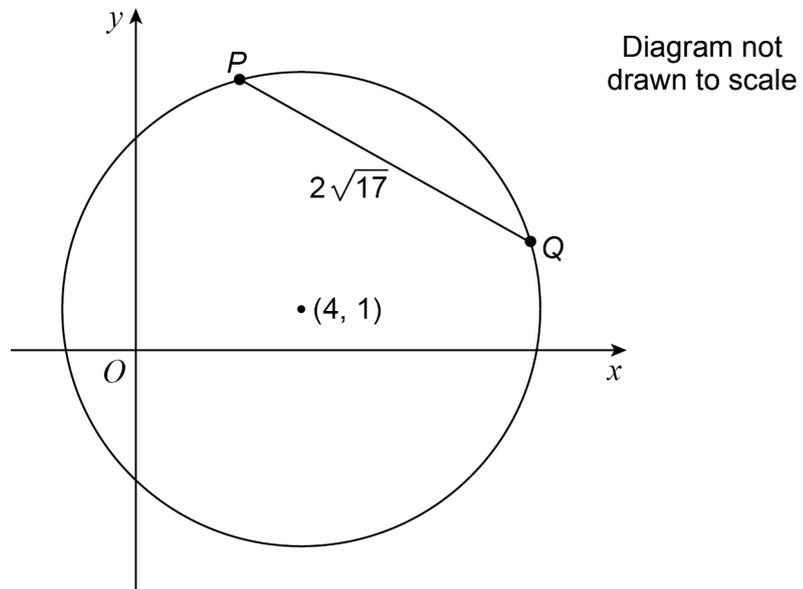
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3 The diagram below shows the circle  $C_1$

The centre of  $C_1$  has coordinates  $(4, 1)$

The chord  $PQ$  has length  $2\sqrt{17}$



3 (a) The shortest distance between the chord  $PQ$  and the centre of  $C_1$  is  $\sqrt{17}$

Find the equation of  $C_1$ , giving your answer in the form  $(x - a)^2 + (y - b)^2 = k$

**[4 marks]**

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Answer \_\_\_\_\_



**3 (b)**  $C_2$  is a different circle.

The translation  $\begin{bmatrix} 3 \\ -2 \end{bmatrix}$  maps  $C_2$  onto the original circle  $C_1$

Find the equation of  $C_2$

**[2 marks]**

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Answer \_\_\_\_\_

**3 (c)** Jane claims that she has found the equation of a circle which is a translation of  $C_1$

The equation of her circle is

$$x^2 - 12x + y^2 - 4y + 2 = 0$$

Explain whether or not Jane is correct.

**[4 marks]**

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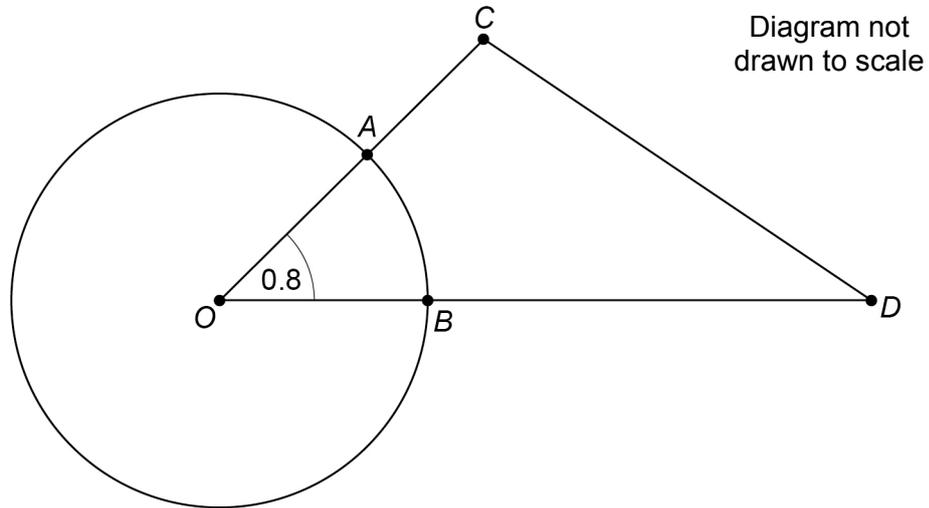
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4 The diagram below shows a triangle  $OCD$  and a circle with centre  $O$ .

The line  $OC$  intersects the circle at the point  $A$  and the line  $OD$  intersects the circle at the point  $B$ .

Angle  $AOB$  is  $0.8$  radians.



The area of the minor sector  $OAB$  is  $3.6 \text{ cm}^2$

The lengths of  $OB$  and  $OD$  are in the ratio  $1:4$

The length of  $OC$  is  $6 \text{ cm}$ .

Find the length of  $CD$ , giving your answer to three significant figures.

**[6 marks]**

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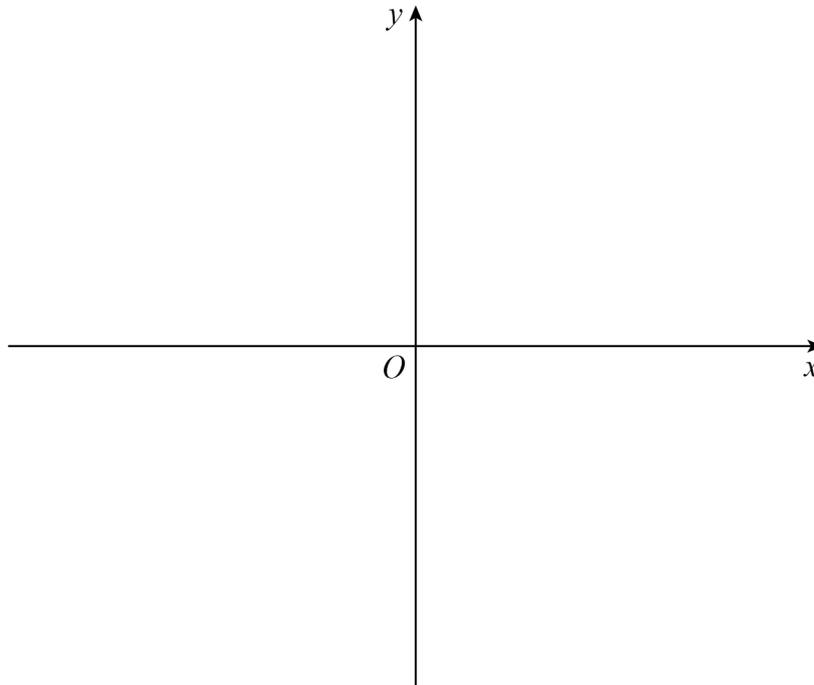


- 5 (a) Sketch the graph of

$$y = 15 \times 7^x$$

on the axes below, indicating the value of the  $y$ -intercept.

[2 marks]



- 5 (b) The curves with equations

$$y = 15 \times 7^x \quad \text{and} \quad y = 625^{2x}$$

intersect at the point  $P$ .

Show that the  $x$ -coordinate of  $P$  can be written in the form

$$\frac{a + \log_5 b}{c - \log_5 d}$$

where  $a$ ,  $b$ ,  $c$  and  $d$  are integers.

[6 marks]

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**Section B****Statistics**

Answer **all** questions in the spaces provided.

**7** Football team A plays 10 matches against different teams.

The number of matches that team A wins is modelled by the random variable  $W$  where

$$W \sim B(10, 0.4)$$

**7 (a)** Find the probability that team A wins exactly 4 matches, giving your answer to three decimal places.

**[1 mark]**

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Answer \_\_\_\_\_

**7 (b)** Find the probability that team A wins less than 3 matches, giving your answer to three decimal places.

**[2 marks]**

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Answer \_\_\_\_\_

**7 (c)** Explain whether or not  $W$  provides a suitable model for the number of matches that team A wins.

**[2 marks]**

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Turn over ►



- 8 The probability distribution of the discrete random variable  $X$  is given in the table.

$x$	1	2	3
$P(X=x)$	0.4	0.25	0.35

The random variable  $Y$  is given by  $Y = 3X^2 + X$

You are given that  $E(Y) = 15.6$

- 8 (a) Find  $\text{Var}(Y)$ .

[3 marks]

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Answer \_\_\_\_\_



8 (b) Find  $\text{Var}(0.5Y - 6)$ .

[2 marks]

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Answer \_\_\_\_\_

8 (c)  $Y_1, Y_2$  and  $Y_3$  are independent random variables such that  $Y_1 = Y_2 = Y_3 = Y$

Find  $E\left(\sum_{i=1}^3 Y_i\right)$

[2 marks]

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Answer \_\_\_\_\_

7

Turn over ►





- 9 (b)** Find the exact probability that the customer goes to the supermarket given that they do not go to the bank.

**[2 marks]**

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Answer \_\_\_\_\_

8

**Turn over for the next question**

**Turn over ►**



**Section C****Mechanics**

Answer **all** questions in the spaces provided.

- 10** A particle of mass 0.4 kg is moving in a straight line, perpendicular to a wall.  
The particle collides with the wall.  
The speed of the particle immediately before it collides with the wall is  $20 \text{ m s}^{-1}$   
During the impact the particle receives an impulse of magnitude  $10.4 \text{ N s}$ .  
Find the speed of the particle as it rebounds from the wall.

**[2 marks]**

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Answer \_\_\_\_\_  $\text{m s}^{-1}$

2
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**11** A particle moves in a straight line.

At time  $t$  seconds, where  $0 \leq t \leq 9$ , it has displacement

$$(7 + 2t + 18t^2 - 2t^3) \text{ metres}$$

relative to a fixed origin  $O$ .

**11 (a)** Find an expression for the velocity of the particle at time  $t$  seconds.

**[2 marks]**

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Answer \_\_\_\_\_

**11 (b)** The particle is initially at position  $A$ .

Its maximum velocity occurs when at position  $B$ .

Find the distance  $AB$ .

**[5 marks]**

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Answer \_\_\_\_\_

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Turn over ►

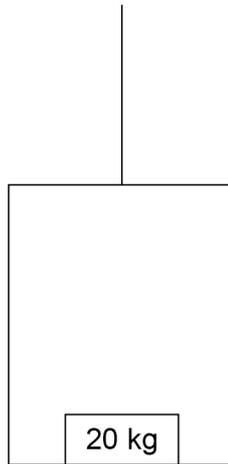


**12** The acceleration due to gravity,  $g$ , should be taken as  $9.8 \text{ m s}^{-2}$ 

A lift is being raised vertically by a vertical light inextensible cable which is attached to the top of the lift.

A box of mass 20 kg is on the floor of the lift.

The lift is moving upwards with a constant acceleration of  $0.5 \text{ m s}^{-2}$



**12 (a)** Find the magnitude of the force exerted on the box by the floor of the lift.

**[2 marks]**

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Answer \_\_\_\_\_ N









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