OXFORD

INTERNATIONAL
AQA EXAMINATIONS

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	
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TOTAL	

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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]

Answer _____

1 (b) Find in terms of p and q an expression for $\log_3 50$

[3 marks]

Answer _____

4

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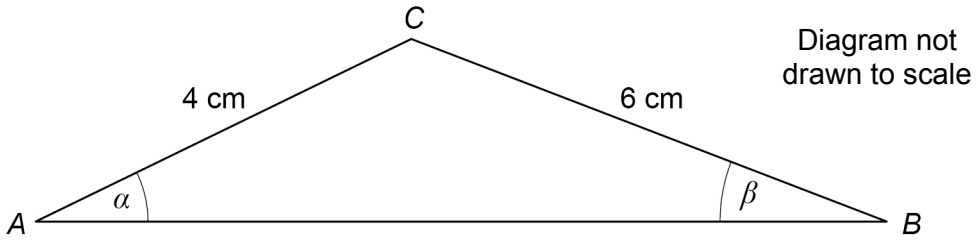
2 The diagram shows triangle *ABC*, where $AC = 4$ cm and $BC = 6$ cm.

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



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

[2 marks]

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

[3 marks]

5

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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 $2\sqrt{17}$

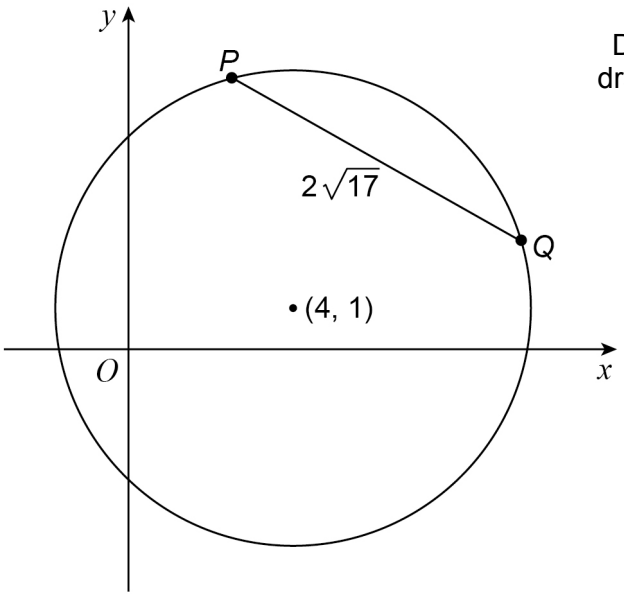

Diagram not drawn to scale

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]

Answer _____

Do not write outside the box

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]

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]

10

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.

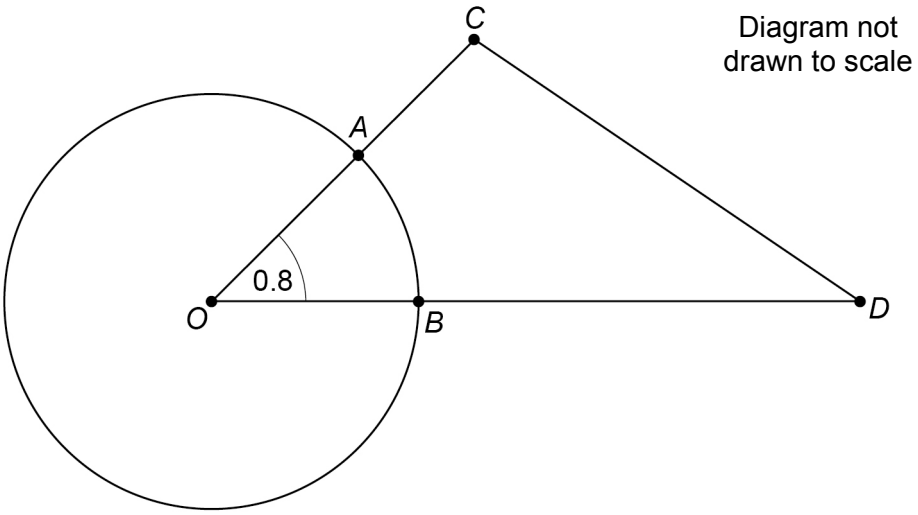

Diagram not drawn to scale

The area of the minor sector *OAB* is 3.6 cm^2

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

The length of *OC* is 6 cm.

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

[6 marks]

Do not write outside the box

Answer _____ cm

6

Turn over for the next question

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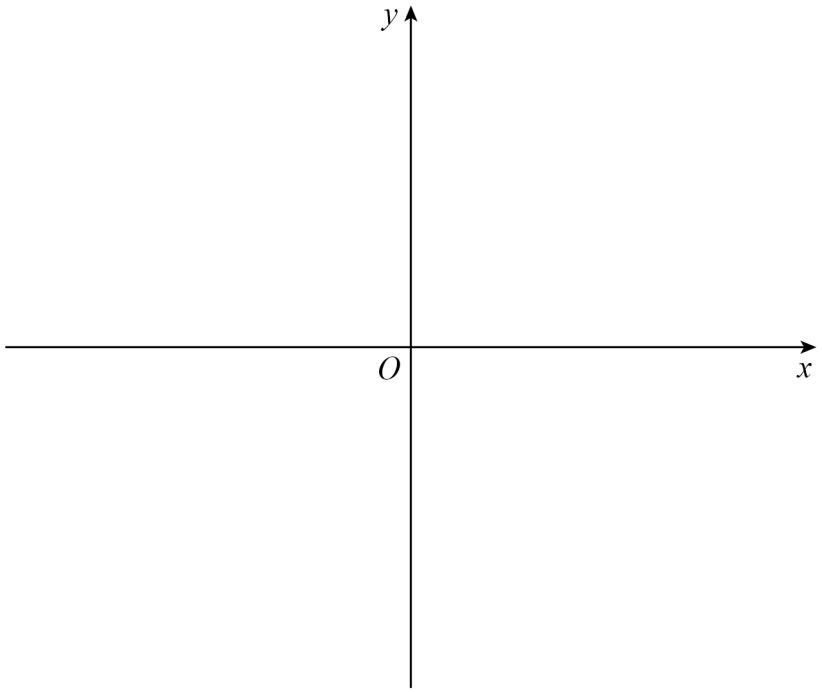
5 (a) Sketch the graph of

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

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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8

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6 By first factorising both sides of the equation, solve

$$15\cos x \sin x - 10\sin x = 8 - 12\cos x$$

in the interval $-\pi \leq x \leq \pi$, giving your answers to three decimal places.

[7 marks]

Answers _____

7

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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

$$W \sim \mathrm{B}(10, 0.4)$$

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

[1 mark]

Answer _____

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

[2 marks]

Answer _____

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

[2 marks]

5

Turn over ►

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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 $Var(Y)$.

[3 marks]

Answer _____

Do not write outside the box

8 (b) Find Var($0.5Y - 6$).

[2 marks]

Answer _____

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

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

[2 marks]

Answer _____

7

Turn over ►

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9 A sample of 50 customers is taken in a shopping centre.

2 go to both the bank and the supermarket.

20 go to the supermarket.

15 do **not** go to either the bank or the supermarket.

One customer from the sample is chosen at random.

9 (a) Event B is defined as the event that the customer goes to the bank.

Event S is defined as the event that the customer goes to the supermarket.

Explain whether or not the events B and S are independent.

[6 marks]

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

[2 marks]

Answer _____

8

Turn over for the next question

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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 m s^{-1}

During the impact the particle receives an impulse of magnitude 10.4 N s.

Find the speed of the particle as it rebounds from the wall.

[2 marks]

Answer _____ 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

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

relative to a fixed origin O.

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

[2 marks]

Answer _____

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

Its maximum velocity occurs when at position *B*.

Find the distance *AB*.

[5 marks]

Answer _____

7

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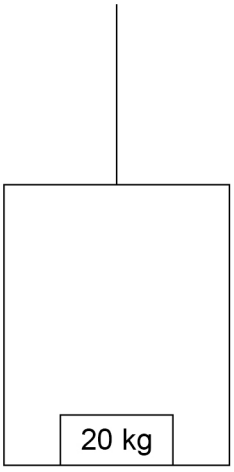
12 **The acceleration due to gravity, g, should be taken as 9.8 m s^{-2}**

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 m s^{-2}



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

[2 marks]

Answer _____ N

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12 (b) For safety reasons, the tension in the cable raising the lift must not exceed 11 000 N.

The mass of the empty lift is 900 kg.

Find the greatest number of boxes, each of mass 20 kg, that could be safely carried by the lift.

Assume that the lift moves upwards with a constant acceleration of 0.5 m s^{-2}

[5 marks]

Answer _____

7

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13 A particle is moving in a straight line with constant acceleration.

The particle has a velocity of 3 m s^{-1} when it passes through a fixed origin O.

The particle is at the point P, 10 seconds after passing through O.

P is at a distance of 75 metres from O.

Find the two possible values for the acceleration of the particle.

[4 marks]

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Answer _____ m s^{-2} or _____ m s^{-2}

4

END OF QUESTIONS

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