OXFORD

INTERNATIONAL
AQA EXAMINATIONS

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

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I declare this is my own work.

INTERNATIONAL AS
MATHEMATICS

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

Monday 22 May 2023 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 graphical 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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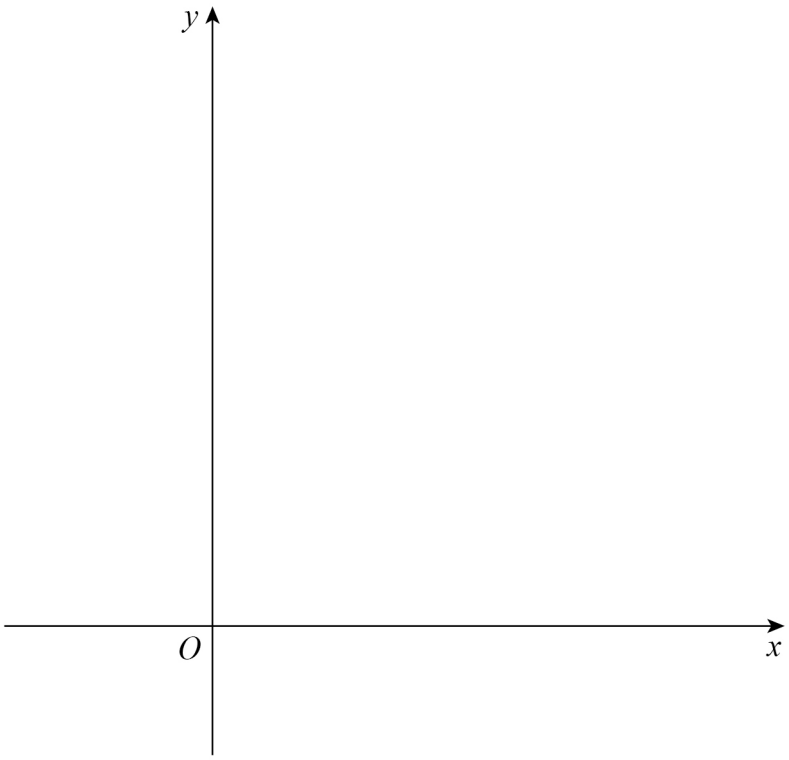
Section A

Pure Mathematics

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

1 A curve has the equation $y = \frac{1}{9^{(x-0.5)}}$

1 (a) Sketch the graph of the curve on the axes below, showing the value of the y-intercept. **[2 marks]**



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1 (b) The point P lies on the curve.

The x-coordinate of P is $2\log_9 a$ where $a > 0$

Find the y-coordinate of P

Give your answer in the form $\frac{m}{a^n}$ where m and n are integers.

[2 marks]

Answer _____

4

Turn over for the next question

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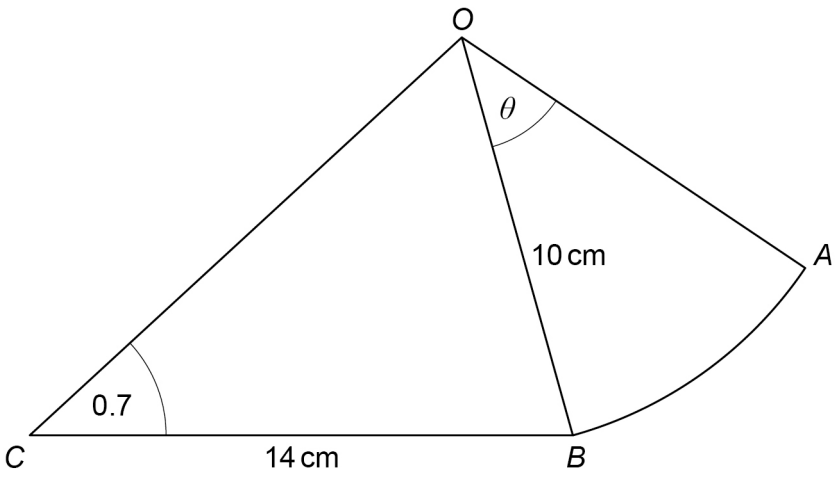
2 The diagram shows the shape *OABC*

The shape consists of the triangle *OBC* and the sector *OAB* of a circle with centre *O*



The angle $AOB = \theta$ radians

The angle $OCB = 0.7$ radians

The length $OB = 10$ cm

The length $BC = 14$ cm

2 (a) The perimeter of the sector *OAB* is 26 cm

Show that $\theta = 0.6$

[2 marks]

2 (b) The angle *BOC* is acute.

Find the angle *OBC* giving your answer in radians to two decimal places.

[4 marks]

Do not write outside the box

Answer _____

2 (c) Find the area of the shape *OABC* giving your answer in cm^2 to one decimal place.

[4 marks]

Answer _____

10

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3 The points $P(8, 5)$ and $Q(11, -10)$ lie on a circle C

3 (a) PQ is a chord of C

Show that the perpendicular bisector of PQ has the equation $x - 5y = 22$

[3 marks]

3 (b) (i) The **normal** to C at the point P has the equation $y = 8x - 59$

Find the coordinates of the centre of C

[2 marks]

Answer _____

Do not write outside the box

3 (b) (ii) Find the equation of C giving your answer in the form

$$(x-a)^2+(y+b)^2=k$$

where a, b and k are positive integers.

[3 marks]

Answer _____

3 (c) Determine whether the point $R(2,-9)$ lies inside C

[2 marks]

10

Turn over ►

Do not write outside the box

4 (a) (i) Use the substitution $Y = 5^p$ to show that the equation

$$25^p - 5^{p+2} = 54$$

can be expressed as

$$(Y + 2)(Y - 27) = 0$$

[2 marks]

4 (a) (ii) Hence explain why the equation $25^p - 5^{p+2} = 54$ has only one real solution.

Find this solution, giving your answer in the form $\log_5 n$ where n is an integer.

[3 marks]

$p =$ _____

Do not write outside the box

4 (b) It is given that

$$3\log_6\left(\frac{x}{y}\right) - 2 = \log_6\left(6x^3y^2\right)$$

where $x > 0$ and $y > 0$

Find the exact value of y giving your answer in a form not involving logarithms.

[4 marks]

$y =$ _____

9

Turn over for the next question

Do not write outside the box

5 (a) Show that

$$\frac{\sin\theta}{1+\cos\theta} + \frac{1}{\tan\theta}$$

can be written as

$$\frac{1}{\sin\theta}$$

where $0^\circ < \theta < 90^\circ$

[3 marks]

Do not write outside the box

5 (b) Hence solve the equation

$$\frac{\sin 2x}{1+\cos 2x} + \frac{1}{\tan 2x} + \frac{1}{\sin 2x} = 4\sin 2x$$

in the interval $0^\circ < x < 90^\circ$

[4 marks]

Answer _____

7

Turn over for the next section

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Section B

Statistics

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

6 Customers of a restaurant are asked whether they liked their meal.

One evening, the restaurant had 40 customers.

The number of customers who said that they liked their meal can be modelled by the random variable L ~ B(40, 0.4)

6 (a) Find the variance of L

[1 mark]

Answer _____

6 (b) Find the probability that exactly 19 customers said that they liked their meal, giving your answer to three decimal places.

[2 marks]

Answer _____

Do not write outside the box

6 (c) Find the probability that more than 13 customers said that they liked their meal, giving your answer to three decimal places.

[2 marks]

Answer _____

5

Turn over for the next question

Do not write outside the box

7 The discrete random variable X has the probability distribution given in the following table where a, b and c are constants and $a < b < c$

x	a	b	c
$P(X = x)$	0.4	0.3	0.3

The mode of X is 1

The median of X is 4

The mean of X is 3.4

7 (a) (i) State the value of a and the value of b

[2 marks]

$a =$ _____ $b =$ _____

7 (a) (ii) Find the value of c

[2 marks]

$c =$ _____

Do not write outside the box

7 (b) The discrete random variable Y is independent of X

Find $\text{Var}(X+Y)$ given that $\text{Var}(Y)=13$

[3 marks]

Answer _____

7

Turn over for the next question

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8 Claire takes part in a fitness programme.

On any one day:

- the probability that Claire runs is 0.24
- the probability that Claire swims is 0.61
- the probability that Claire swims given that she runs is 0.74

8 (a) Find the probability that Claire runs **and** swims on any one day.

[2 marks]

Answer _____

8 (b) Find the probability that Claire runs **or** swims on any one day.

[2 marks]

Answer _____

Do not write outside the box

8 (c) Find the probability that Claire runs and does **not** swim on any one day.

[2 marks]

Answer _____

8 (d) Find the probability that Claire runs given that she does **not** swim on any one day.

[2 marks]

Answer _____

8

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Section C

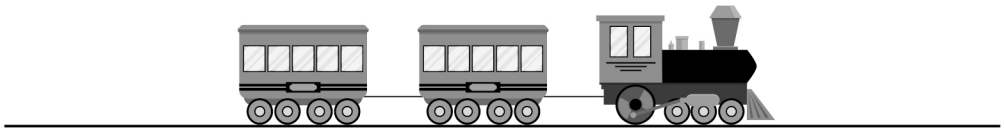
Mechanics

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

9 A toy train consists of an engine and two carriages.

The train travels along a straight horizontal track.

The engine and carriages are connected by light inextensible strings as shown below.



The train travels at a constant speed.

The engine produces a driving force of 2 newtons.

Each carriage experiences a resistive force of 0.6 newtons.

9 (a) The engine experiences a resistive force of k newtons.

Find the value of k

[2 marks]

$k =$ _____

9 (b) State the magnitude of the tension in the string connecting the two carriages.

[1 mark]

Answer _____

3

Turn over ►

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

A fairground ride rises and falls vertically.

The base of the ride is initially at rest on the ground.

10 (a) The ride takes 8 seconds to rise to its highest position.

The acceleration a m s^{-2} at time t seconds after the ride begins to rise is given by the equation

$$a = 0.72 - 0.18t$$

where $0 \leq t \leq 8$

Find the maximum speed of the ride as it rises to its highest position.

[5 marks]

Answer _____

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10 (b) The ride is held with its base 7.68 metres above the ground.

The ride is then released and falls freely under gravity until its base is 2 metres above the ground.

At this point brakes are applied causing constant deceleration of the ride.

10 (b) (i) Find the maximum speed of the ride as it falls.

[3 marks]

Answer _____

10 (b) (ii) The ride comes to rest 0.3 seconds after the brakes are applied.

Find the final height of its base above the ground.

[3 marks]

Answer _____

11

Turn over ►

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11 Two particles *A* and *B* are on a smooth horizontal surface.

Particle *A* has mass 4 kg and moves with speed 4.8 m s^{-1} directly towards particle *B*

Particle *B* has mass m kg, where m is a constant, and is at rest.

The particles collide.

After the collision:

- particle *A* moves in its original direction with speed v m s^{-1}
- particle *B* moves with speed 3 m s^{-1}

11 (a) Show that $v = 4.8 - 0.75m$

[2 marks]

11 (b) By considering the possible values for v find the range of possible values for m

[4 marks]

Answer _____

6

END OF QUESTIONS

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