

Please write clearly in block capitals.

Centre number

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Candidate number

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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 5 January 2022 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	
2	
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11	
12	
TOTAL	



J A N 2 2 M A 0 2 0 1

IB/G/Jan22/E7

MA02

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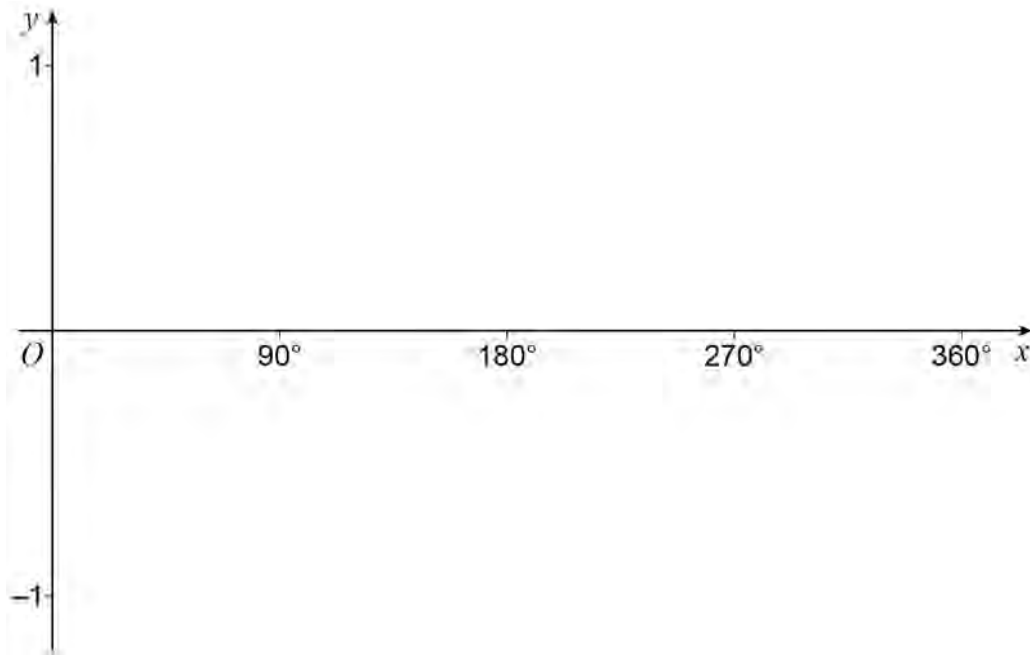
Section A**Pure Mathematics**

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

- 1 (a)** On the axes, sketch the graph of $y = \cos(x + 60^\circ)$ for $0^\circ \leq x \leq 360^\circ$

Show on your graph the coordinates of any intercepts with the axes.

[3 marks]



- 1 (b)** The period of $f(x) = \cos(x + 60^\circ)$ is 4 times the period of $g(x) = \tan(kx)$ where k is a constant.

Find the value of k

[2 marks]

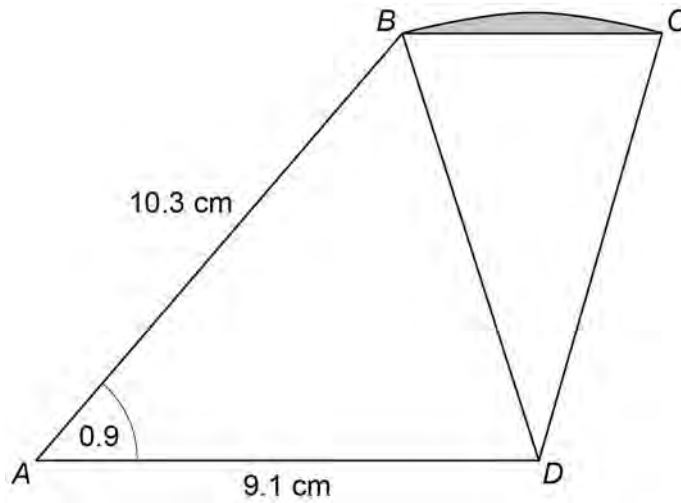
$k =$ _____

Turn over ►



- 2** The diagram shows the wing of a model aircraft.

The wing consists of a triangle ABD and the sector BCD of a circle with centre D



The length $AB = 10.3$ cm

The length $AD = 9.1$ cm

The angle $BAD = 0.9$ radians

- 2 (a)** Show that $BD = 8.5$ cm correct to one decimal place.

[2 marks]

- 2 (b)** The arc $BC = 5.1$ cm

Show that angle $BDC = 0.6$ radians correct to one decimal place.

[1 mark]



Give your answer to one decimal place.

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Answer _____

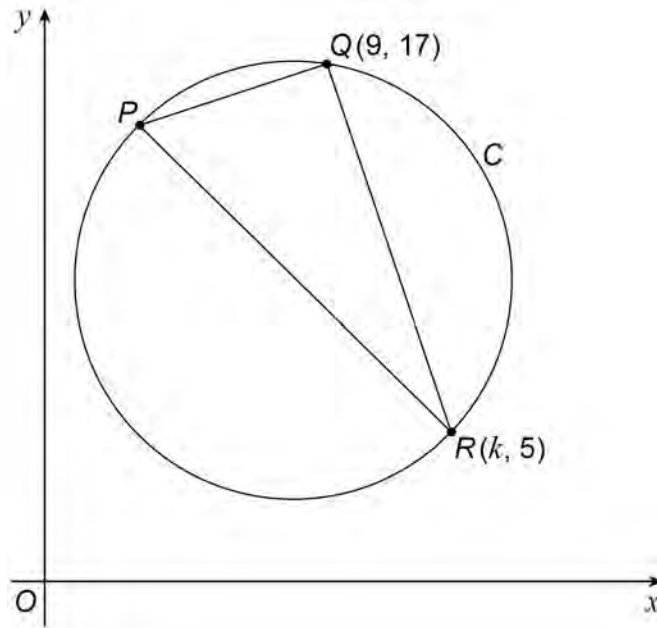
8

Turn over ►



- 3** The diagram shows the circle C and the triangle PQR

The points P , $Q(9, 17)$ and $R(k, 5)$, where k is a constant, lie on C



- 3 (a)** PR is a diameter of C and the gradient of PQ is $\frac{1}{3}$
Show that $k = 13$

[3 marks]

- 3 (b)** The centre of C has coordinates $(8, 10)$

- 3 (b) (i)** Find the length of the radius of C giving your answer in exact form.

[2 marks]



Answer _____

- 3 (b) (ii)** Hence state the equation of C giving your answer in the form

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

where a , b and c are integers

[1 mark]

Answer _____

- 3 (c)** The circle D has equation

$$x^2 - 8x + y^2 + 6y - d = 0$$

where d is a constant.

The radius of D is equal in length to the radius of C

- 3 (c) (i)** Find the coordinates of the centre of D

[2 marks]

Answer _____

- 3 (c) (ii)** Describe the transformation which maps D onto C

[2 marks]



4 (a) Solve the equation

$$\sin 2\alpha = 0.7$$

in the interval $0^\circ < \alpha < 90^\circ$, giving your answers to the nearest degree.

[2 marks]

Answer _____

4 (b) (i) Given that

$$\frac{10}{\sin x} - 3 \tan x = \frac{11 \cos x}{\sin x}$$

where $0^\circ < x < 90^\circ$, show that

$$8 \cos^2 x - 10 \cos x + 3 = 0$$

[3 marks]



$$\frac{10}{\sin(\theta - 15^\circ)} - 3 \tan(\theta - 15^\circ) = \frac{11 \cos(\theta - 15^\circ)}{\sin(\theta - 15^\circ)}$$

Give any non-exact answer to the nearest 0.1°

[illegible]

Answer _____

- 5 (a) The point with coordinates $(p, 9)$ lies on the curve with equation $y = 7^{x-5}$

Find the value of p

Give your answer in the form $a + b \log_7 c$ where a , b and c are prime numbers.

[3 marks]

Answer _____

- 5 (b) It is given that

$$8 + \log_n k + 4 \log_n (2y) = 6 \log_n (n^2 y)$$

where n , k and y are positive constants.

Express y in terms of k and n in a form **not** involving logarithms.

Simplify your answer.

[5 marks]



[illegible]

Answer

8

Turn over ►



Section B**Statistics**

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

- 6** The discrete random variable X has probability distribution function

$$P(X = x) = \begin{cases} kx^2 & \text{for } x = 1, 2, 3, 4 \\ 0 & \text{otherwise} \end{cases}$$

where k is a constant.

- 6 (a)** Show that $k = \frac{1}{30}$

[2 marks]

- 6 (b)** Find $P(X \geq 3)$

[1 mark]

Answer _____



[2 marks]

[illegible]

Answer _____

Find $E(X - Y)$

[2 marks]

Answer

7

Turn over ►



7 Art and Business are optional subjects that students can study in a particular school.

The headteacher of the school selects a student at random.

The event that the student studies Art is represented by A

The event that the student studies Business is represented by B

It is given that $P(A) = 0.2$, $P(B) = 0.35$ and $P(A \cup B) = 0.48$

7 (a) Find $P(A \cap B)$

[2 marks]

Answer _____

7 (b) State with a reason whether A and B are mutually exclusive.

[1 mark]



- 7 (c)** Find the probability that the student studies Business, given that the student studies Art. **[2 marks]**

Answer _____

- 7 (d)** State with a reason whether A and B are independent. **[1 mark]**

6

Turn over for the next question

Turn over ►



8 The discrete random variable X has a Bernoulli distribution with parameter p

8 (a) (i) State $E(X)$ in terms of p

[1 mark]

Answer _____

8 (a) (ii) State $\text{Var}(X)$ in terms of p

[1 mark]

Answer _____

8 (b) The discrete random variables X_1, X_2, \dots, X_n are independent and identically distributed Bernoulli distributions with parameter p

It is given that $E\left(\sum_{i=1}^n X_i\right) = 6.25$ and $\text{Var}\left(\sum_{i=1}^n X_i\right) = 4.6875$

Find the value of n and the value of p

[5 marks]



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$$n = \qquad p =$$

7

Turn over for the next question

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Section C**Mechanics**

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

- 9** A sphere of mass 2 kg moves with speed 5 m s^{-1} in a straight line on a smooth horizontal surface towards a fixed vertical wall.



The wall is perpendicular to the path of the sphere.

The sphere collides with the wall and rebounds with speed 1.5 m s^{-1}

- 9 (a)** Find the magnitude of the momentum of the sphere before the collision.

[1 mark]

Answer _____

- 9 (b)** Find the magnitude of the impulse exerted on the wall by the sphere during the collision.

[2 marks]

Answer _____



The acceleration due to gravity, g , should be taken as 9.8 ms^{-2}

A diagram showing a pulley system. A large black circle at the top represents the pulley. Two vertical lines extend downwards from the pulley, representing the rope. At the end of the left rope is a small black circle labeled 'P'. At the end of the right rope is a small black circle labeled 'Q'.

P and Q are released from rest with the string taut.

Immediately after release Q accelerates vertically downwards at 1.25 m s^{-2}

Find the value of m

[4 marks]

[illegible]
$$m =$$

4

Turn over ►



11

The velocity $v \text{ ms}^{-1}$ of the particle at time t seconds after it starts its motion is given by

$$v = \frac{t^3}{2} - 3t^2 + 5t$$

11 (a)

[3 marks]

[illegible]

Answer

11 (b)

[3 marks]



11 (c) Find the change in displacement for the particle between $t = 0$ and $t = 4$

[3 marks]

Answer _____

9

Turn over ►



- 12** A firework is launched from rest vertically upwards from ground level and travels vertically with constant acceleration for 3.4 seconds and then explodes.

When it explodes the firework is at a height of 150 metres above the ground.

- 12 (a)** Find the acceleration of the firework.

[3 marks]

Answer _____

- 12 (b)** After the explosion parts from the firework fall to the ground.

A method to find the speed $v \text{ m s}^{-1}$ at which one of the parts collides with the ground is shown below.

$$v^2 = u^2 + 2as$$

$$v^2 = 0^2 + 2 \times 9.8 \times 150$$

$$v = 54 \quad (\text{to two significant figures})$$

Other than air resistance not being considered, give a reason why it may **not** be appropriate to use this method to calculate the value of v

[1 mark]

END OF QUESTIONS



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