OXFORD

INTERNATIONAL AQA EXAMINATIONS

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INTERNATIONAL AS
MATHEMATICS

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

Thursday 17 January 2019 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.
- 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	
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9	
10	
11	
12	
TOTAL	

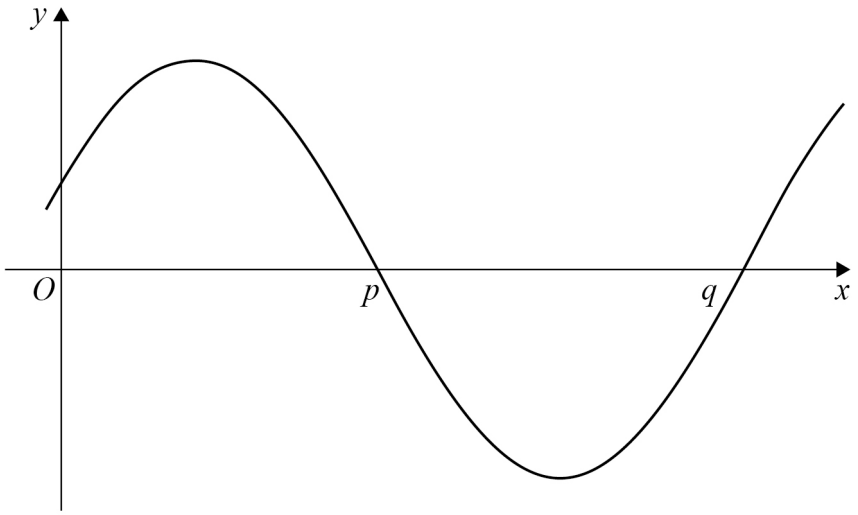
Section A

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

1 The diagram below shows a sketch of part of the curve with equation $y = \mathrm{f}(x)$, such that

$$\mathrm{f}(x) = k\sin(x + b)°$$

where k is a positive integer and b is a constant such that $0 < b < 90$



1 (a) The curve passes through the points $(p, 0)$ and $(q, 0)$.

1 (a) (i) Find, in terms of b, an expression for the value of p.

[1 mark]

$p =$ _____

1 (a) (ii) Find, in terms of b, an expression for the value of q.

[1 mark]

$q =$ _____

Do not write outside the box

1 (b) (i) State the minimum value of $f(x)$.

[1 mark]

Answer _____

1 (b) (ii) State the period of $f(x)$.

[1 mark]

Answer _____

4

Turn over for the next question

Do not write outside the box

2 (a) Given that $n > 1$, state the value of:

2 (a) (i) $\log_n(n^4)$;

[1 mark]

Answer _____

2 (a) (ii) $\log_n 1$

[1 mark]

Answer _____

Do not write outside the box

2 (b) Given that

$$2 \log_m x = \log_m 5 - \log_m (x + 1), \text{ where } x > 0$$

show that

$$x^3 + x^2 - 5 = 0$$

[3 marks]

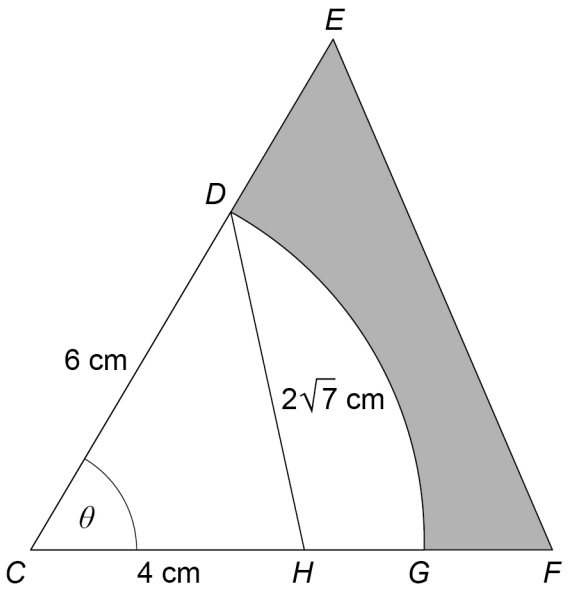
5

Turn over for the next question

Do not write outside the box

3 The diagram shows:

- two triangles *CEF* and *CDH*, where $CD = 6$ cm, $CH = 4$ cm and $DH = 2\sqrt{7}$ cm
- the sector of a circle with centre *C* and arc *DG*
- the angle $DCH = \theta$ radians.



3 (a) Show that $\theta = \frac{\pi}{3}$

[3 marks]

Do not write outside the box

3 (b) The lengths $CE = 9$ cm and $CF = 8$ cm

Find the area of the shaded region $DEFG$.

Give your answer to 3 significant figures.

[6 marks]

Answer _____ cm^2

9

Turn over for the next question

Do not write outside the box

4 (a) Given that

$$\frac{\sqrt{1-\sin^2\theta}}{\tan\theta} = \sin\theta$$

show that

$$\tan^2\theta = 1$$

[4 marks]

4 (b) Hence solve the equation

$$\frac{\sqrt{1-\sin^2\theta}}{\tan\theta} = \sin\theta$$

for $-90° \leq \theta \leq 90°$

[2 marks]

$\theta =$ _____

6

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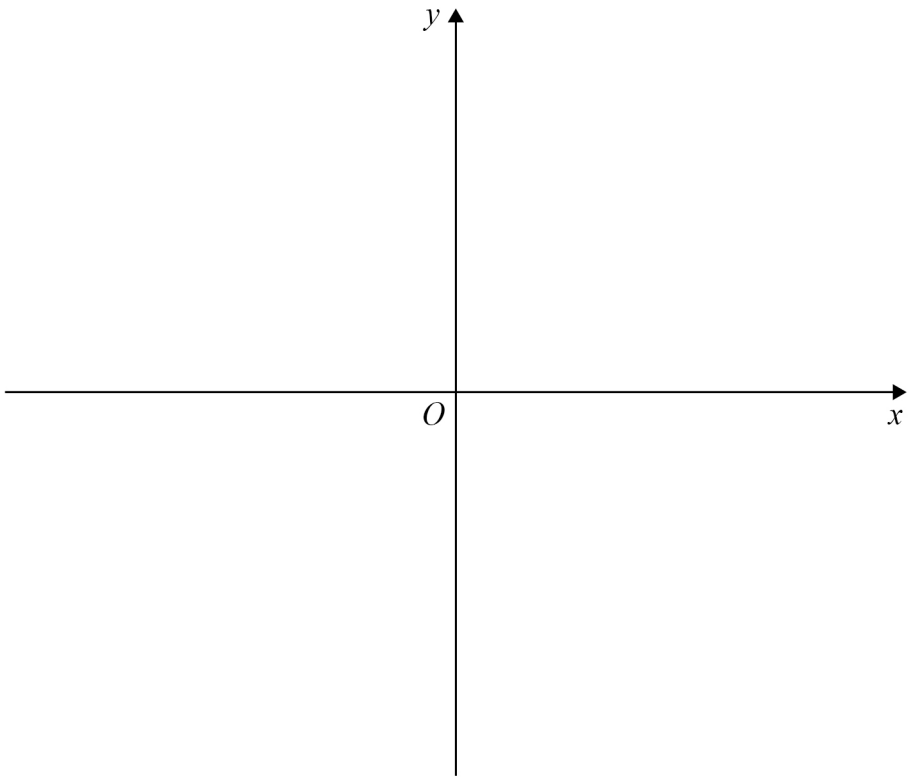
5 A curve C has equation $y = 3^{x-2}$

5 (a) On the axes below, sketch the curve C, showing the exact value of any y-intercepts.

[2 marks]



5 (b) The point with coordinates $(p, 7)$ lies on C.

Find the exact value of p, giving your answer in the form $a + \log_3 b$, where a and b are integers.

[3 marks]

$p =$ _____

5

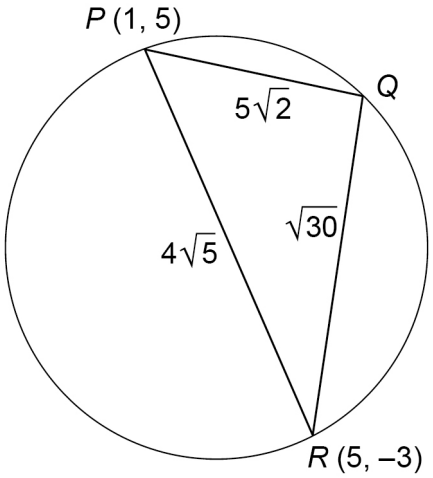
Turn over ►

Do not write outside the box

6 The diagram shows the circle C_1 and triangle PQR.

The points P, Q and R lie on C_1, where P has coordinates (1, 5) and R has coordinates (5, −3).

The lengths $PQ = 5\sqrt{2}$, $PR = 4\sqrt{5}$, and $QR = \sqrt{30}$



6 (a) Show that PR is a diameter of C_1

[3 marks]

Do not write outside the box

6 (b) Find an equation of the tangent to C_1 at P.

[3 marks]

Answer _____

6 (c) A second circle, C_2 has equation $(x - 9)^2 + (y - 9)^2 = 5$

The circles C_1 and C_2 do **not** intersect.

The point S lies on C_1 and the point T lies on C_2

Find the shortest possible length of the line segment ST, giving your answer in the form $a + b\sqrt{c}$, where a, b and c are integers.

[5 marks]

Answer _____

11

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Section B

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

7 The discrete random variable X has the probability distribution given in the following table.

x	2	4	6
$P(X = x)$	0.6	0.3	0.1

7 (a) Find $E(X^2)$.

[2 marks]

Answer _____

7 (b) Aminah plays a game.

Aminah's score for this game is X.

Find the probability that Aminah's score is higher than 3

[1 mark]

Answer _____

Do not write outside the box

7 (c) Aminah plays a different game.

Aminah's score for this game is Y, where Y is a discrete random variable with $\text{Var}(Y) = 3$

Given that X and Y are independent, find the variance of Aminah's total score $X + Y$.

[4 marks]

Answer _____

7

Turn over for the next question

Do not write outside the box

8 Poyntz Ltd is a company with 1000 employees.

The company has three departments: Manufacturing, Delivery and Services.

Each employee works in at least one of the departments:

650 work in Manufacturing

300 work in Delivery

100 work in Services

None of the employees working in Services also work in Manufacturing or Delivery.

8 (a) Describe the relationship between the event M, that an employee works in Manufacturing, and the event S, that an employee works in Services.

[1 mark]

Do not write outside the box

8 (b) An employee is selected at random.

Find the probability that the employee:

8 (b) (i) works in both Manufacturing **and** Delivery;

[3 marks]

Answer _____

8 (b) (ii) works in Manufacturing given that the employee works in Delivery.

[2 marks]

Answer _____

6

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9 Ben is an athlete who regularly takes part in races.

Let X be the random variable that takes the value 1 if Ben wins a race and takes the value 0 if he loses a race.

The variance of X is 0.16

9 (a) Find the possible values of p, the probability that Ben wins a race.

[3 marks]

Answer _____

Do not write outside the box

9 (b) Ben takes part in 10 races. The random variable Y represents the number of races he wins.

Given that p < 0.5, find, giving your answers to three significant figures:

9 (b) (i) the standard deviation of Y;

[2 marks]

Answer _____

9 (b) (ii) the probability that Ben wins more than one race.

[2 marks]

Answer _____

7

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Section C

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

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

A basketball has mass 0.6 kg

The ball is released above a horizontal floor and reaches a maximum height of 1.2 metres after its first bounce.

At this instant a player strikes the ball vertically downwards with his hand. Assume that the time the player's hand is in contact with the ball is negligible.

The ball leaves the player's hand with a speed u m s^{-1}, and hits the floor with a speed of 6 m s^{-1}

Model the ball as a particle and assume there is no air resistance.

10 (a) Find the value of u, giving your answer to 2 significant figures.

[3 marks]

$u =$ _____

Do not write outside the box

10 (b) Find the magnitude of the impulse exerted on the ball by the player's hand, giving your answer to 2 significant figures.

[2 marks]

Answer _____ N s

5

Turn over for the next question

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11 A particle is moving in a straight line. The velocity, v m s^{-1}, of the particle at time t seconds is given by

$$v = 0.5t^2 - 4t + 11$$

11 (a) Find the change in the displacement of the particle between $t = 3$ and $t = 6$

[4 marks]

Answer _____ metres

Do not write outside the box

11 (b) The velocity of the particle is always positive.

Explain whether or not the value for the displacement you found in part **(a)** is the same as the distance travelled between $t = 3$ and $t = 6$

[2 marks]

6

Turn over for the next question

Do not write outside the box

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

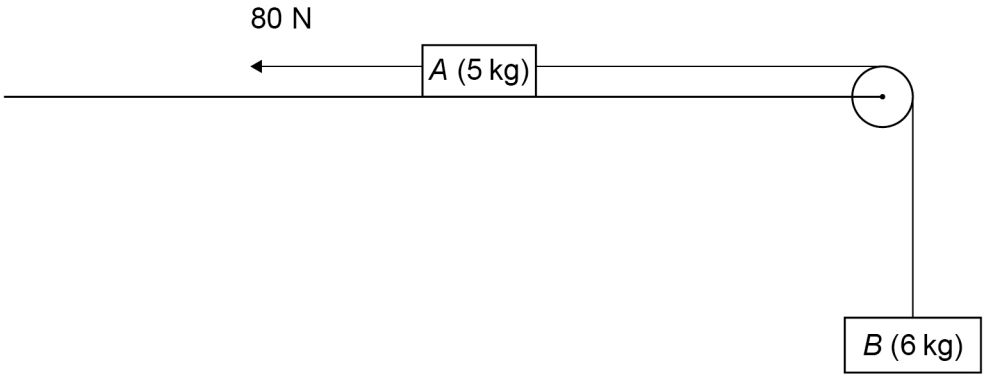
Two blocks of wood, *A* of mass 5 kg and *B* of mass 6 kg, are attached to the ends of a taut light inextensible string.

The string passes over a smooth, light pulley.

Block *A* is on the surface of a rough horizontal table and a horizontal force of 80 newtons is acting on *A*, as shown in the diagram.

Block *A* is accelerating at 0.4 m s^{-2} away from the pulley.

The string between the pulley and block *B* is vertical.



12 (a) Find the tension in the string.

[3 marks]

Answer _____ N

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12 (b) Find the coefficient of friction between block *A* and the table, giving your answer to 3 significant figures.

[6 marks]

Answer _____

9

END OF QUESTIONS

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