

Candidate Name

Candidate Number

Centre Name

Centre Number

Paper 4: Statistics and Mechanics**Sample Paper**

(2 hours)

It is necessary to respond on this question paper. You must have a soft pencil (preferably of type B or HB), a clean eraser and a dark blue or black pen.

INSTRUCTIONS:

- You must write your name, candidate number, centre name and centre number in the designated spaces.
- Attempt all the questions using a dark blue or black pen.
- You may use a soft pencil for graphs.
- If working is needed for any question it must be shown below that question.
- Do not use correction fluid.
- Avoid writing on any bar codes.
- You are allowed to use a calculator if needed.

INFORMATION:

- This paper has a total of 100 marks.
- The number of marks assigned for every question or its parts is indicated within brackets [].
- Rough work must be completed on this question paper; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question

Section 1 Statistics

1. (a) Two events A and B are mutually exclusive.

Given that $P(A) = x \neq 0$ and

$$P(B) = 7 \times P(A)$$

Draw a Venn diagram to illustrate this information and find the possible values of $P(A)$. [3]

(b) If $P(A' \cap B') = 0.12$, find x . [3]

(c) Write down the value of $P(A/B)$.

[1]

(d) Find the value of $P(A/B')$

[2]

[1]

[illegible]

2. A discrete random variable X has the probability function shown in the table below.

x	1	2	3	4	5	6	7
$P(X = x)$	$\frac{1}{8}$	$\frac{1}{3}$	$\frac{1}{4}$	a	$\frac{1}{12}$	$\frac{1}{12}$	$\frac{1}{24}$

(a) Show that $a = \frac{1}{12}$. [1]

(b) Find $F(3)$. [2]

(c) Show that $E(X) = 3\frac{1}{12}$. [2]

[illegible]

(d) Find $Var(X)$. [4]

[illegible]

3. In a shopping survey a random sample of 100 people were asked how many hours to the nearest hour, they spent shopping online last month. The results are summarised in the table below

Number of hours	Mid-point	Frequency
0-5	2.75	10
6 - 7	6.5	25
8 - 10	9	20
11-15	13	15
16-25	20.5	10
26-50	38	20

(a) Estimate the mean and standard deviation of the number of hours spent shopping. [4]

(b) Use linear interpolation to estimate the interquartile range. [4]

4. A student is comparing the height, h (cm) of a plant and the surrounding temperature ($^{\circ}\text{C}$) and took the following measurements over 7 days.

$t/^{\circ}\text{C}$	21	20.9	21.1	21.3	21.2	21.4	21.7
h, cm	3.2	4.6	6	6.7	9.4	11	16.1

(You may use $\sum th = 1216.7, S_{tt} = 0.43429, S_{hh} = 116.72$)

(a) Show that $S_{th} = 6.67$ to 3 significant figures. [3]

(b) Find the equation of the regression line of h on t giving your answer in the form

$h = at + b$. [4]

(c) Use your regression line to estimate the height of the plant when the surrounding temperature is 24°C . [1]

(d) Comment on the reliability of this estimate, giving a reason for your answer. [1]

5. The volume X ml, of shampoo put into a bottle by machine A is normally distributed with a mean of 200ml and a standard deviation of 5ml . A bottle of shampoo is selected at random.

(a) Find the probability that this bottle contains more than 206 ml . [3]

The volume stated on the bottle is w ml.

(b) Find w such that $P(X < w) = 0.001$

[3]

The volume, Y ml, of shampoo put into a bottle by machine B is normally distributed with a mean of μ ml a standard deviation σ ml .

(c) Given that $P(Y < 200) = 0.975$ and $P(Y > 196) = 0.99$, find the value of μ and the value of σ .

[6]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.

Section 2 – Mechanics

1. A plank of wood AB has mass 8 kg and length 6 m . It rests in a horizontal position on two smooth supports. One support is at the end A . The other is at the point C , 1.2 m from B . A block of mass 4 kg is placed at B with the plank in equilibrium. By modelling the plank as a uniform rod and the block as a particle,

(a) find the reaction on the plank at A .

[4]

[illegible]

(b) Find the value of x . [4]

[illegible]

2. A particle of mass 5 kg is attached to one end of a light inextensible string of length 130 cm . The other end of the string is attached to a fixed point A . The particle moves with constant angular speed in a horizontal circle of radius 120 cm . The centre of the circle is vertically below A .

(a) Calculate the tension, T , in the string. [3]

(b) Calculate the angular speed of the particle. [4]

A diagram showing a projectile launched from point A at a height of 12 m. The launch angle is 45° and the initial speed is 5 m s^{-1} . The projectile follows a parabolic path and lands at point B on the ground. A right-angle symbol is shown at the base of the 12 m height.

(a) Find the time taken for P to move from A to B . [5]

This image shows a single sheet of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

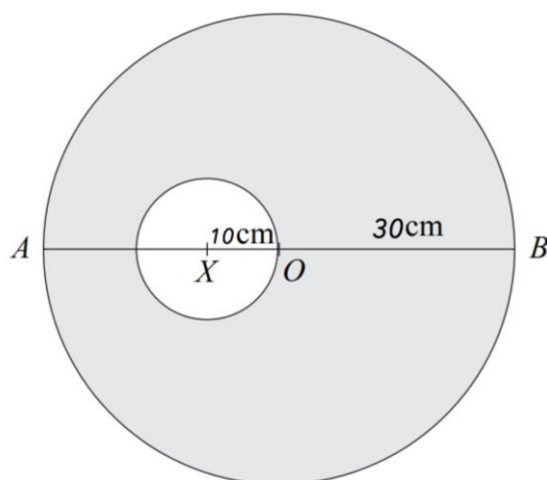
(b) Find the range of flight.

[2]

(c) Find the speed of P as it hits the ground.

[4]

4.



The figure shows a template C made by removing a circular disc, of centre X and radius 10cm, from a uniform circular lamina, of centre O and radius 30 cm. The point X lies on the diameter AOB of the lamina and $AX = 20$ cm. The centre of mass of T is at the point G .

(a) Find AG

[6]

[illegible]

(b) Find the mass of C in terms of m . [4]

[illegible]

5. A particle Q is moving in a straight line with simple harmonic motion on a smooth horizontal floor. The particle comes to instantaneous rest at points A and B where AB is 0.8 m . The midpoint of AB is O . The mid-point of OA is C . The mid-point of OB is D . The particle takes 0.4 s to travel directly from C to D . At time $t = 0$, Q is moving through O towards A .

(a) Show that the period of the motion is 2.4 s . [6]

(b) Find the distance of Q from B when $t = 4\text{ s}$. [4]

(c) Find the maximum magnitude of the acceleration of Q . [2]

(d) Find the maximum speed of Q . [2]
