Write your name here

| Surname | Other names |
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**Pearson Edexcel Level 3 GCE**

| Centre Number | Candidate Number |
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# Mathematics

## Advanced Subsidiary
## Paper 3: Statistics and Mechanics

| Specimen Paper<br>**Time: 2 hours** | Paper Reference<br>**9MA0/03** |
|---|---|

**You must have:**
Mathematical Formulae and Statistical Tables, calculator

Total Marks

**Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for algebraic manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.**

## Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- There are **two** sections in this question paper. Answer **all** the questions in Section A and **all** the questions in Section B.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Answers should be given to three significant figures unless otherwise stated.

## Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 10 questions in this question paper. The total mark for this paper is 100.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

## Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

*Turn over* ▶

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## SECTION B: MECHANICS

**Answer ALL questions. Write your answers in the spaces provided.**

Unless otherwise indicated, whenever a numerical value of $g$ is required, take $g = 9.8\ \text{m s}^{-2}$ and give your answer to either 2 significant figures or 3 significant figures.

*[In this question position vectors are given relative to a fixed origin O.]*

**6.** A particle, $P$, moves with constant acceleration $(\mathbf{i} - 2\mathbf{j})\ \text{m s}^{-2}$.

At time t = 0 seconds, the particle is at the point $A$ with position vector $(2\mathbf{i} + 5\mathbf{j})$ m and is moving with velocity $\mathbf{u}\ \text{m s}^{-1}$.

At time t = 3 seconds, $P$ is at the point $B$ with position vector $(-2.5\mathbf{i} + 8\mathbf{j})$ m.

Find $\mathbf{u}$.

**(4)**

**Question 6 continued**

**(Total for Question 6 is 4 marks)**

**7.** A particle, $P$, moves under the action of a single force in such a way that at time $t$ seconds, where $t \geq 0$, its velocity $\mathbf{v}$ m s$^{-1}$ is given by

$$\mathbf{v} = (t^2 - 3t)\,\mathbf{i} - 12t\,\mathbf{j}$$

The mass of P is 0.5 kg.

Find the time at which the magnitude of the force acting on $P$ is 6.5 N.

**(7)**

**Question 7 continued**

**(Total for Question 7 is 7 marks)**

**8.**

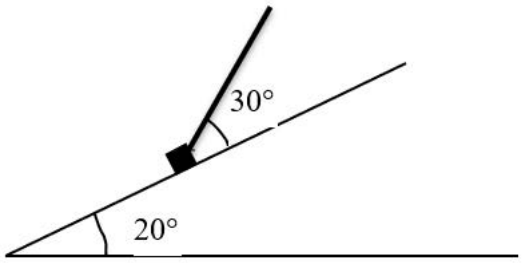


**Figure 1**

A small box of mass 3 kg moves on a rough plane which is inclined at an angle of 20° to the horizontal.

The box is pulled up a line of greatest slope of the plane using a rope which is attached to the box.

The rope makes an angle of 30° with the plane, as shown in Figure 1.

The rope lies in the vertical plane which contains a line of greatest slope of the plane.
The coefficient of friction between the box and the plane is 0.3.
The tension in the rope is 25 N.

The box is modelled as a particle, the rope is modelled as a light inextensible string and air resistance is ignored.

(a) Using the model, find the acceleration of the box.

**(7)**

(b) Suggest one improvement to the model that would make it more realistic.

**(1)**

The rope now breaks and the box slows down and comes to rest.

(c) Show that, after the box comes to rest, it immediately starts to move down the plane.

**(3)**

**Question 8 continued**

**(Total for Question 8 is 11 marks)**

**9.**

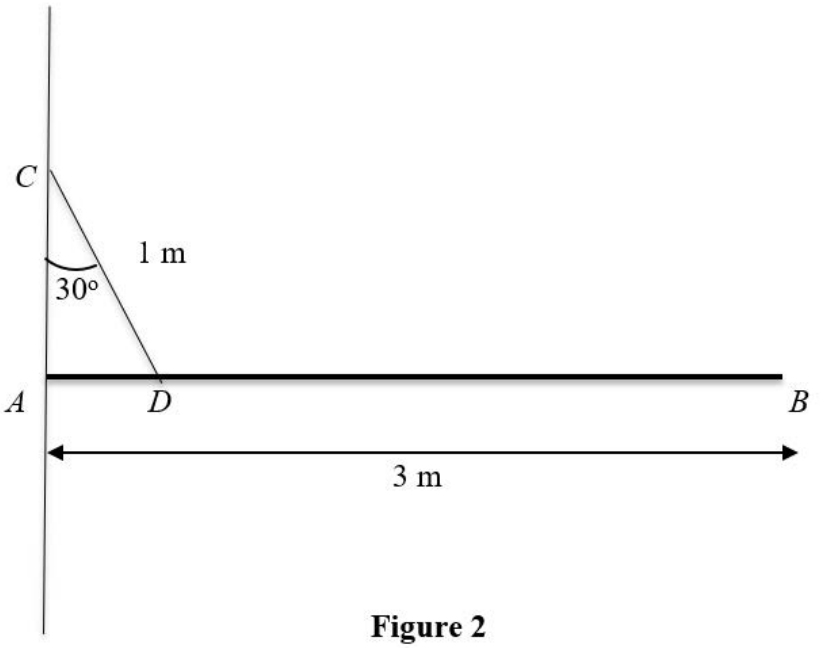


**Figure 2**

A beam *AB*, of mass 20 kg and length 3 m, is smoothly hinged to a vertical wall at one end *A*.

The beam is held in equilibrium in a horizontal position by a rope of length 1 m.
One end of the rope is fixed to a point, *C*, on the wall which is vertically above *A*.
The other end of the rope is fixed to the point *D* on the beam so that angle *ACD* is 30° , as shown in Figure 2.

The beam is modelled as a uniform rod and the rope is modelled as a light inextensible string.

Using the model, find

(a) the tension in the rope,

**(4)**

(b) the direction of the force exerted by the wall on the beam at *A*.

**(6)**

(c) If the rope were not modelled as being light, state how this would affect the tension in the rope, explaining your answer carefully.

**(2)**

The rope is now removed and replaced by a longer rope which is still attached to the wall at C but is now attached to the beam at G, where G is the midpoint of AB. The beam AB remains in equilibrium in a horizontal position.

(d) Show that the force exerted by the wall on the beam at A now acts horizontally

**(2)**

**Question 9 continued**

**(Total for Question 9 is 14 marks)**

**10.**

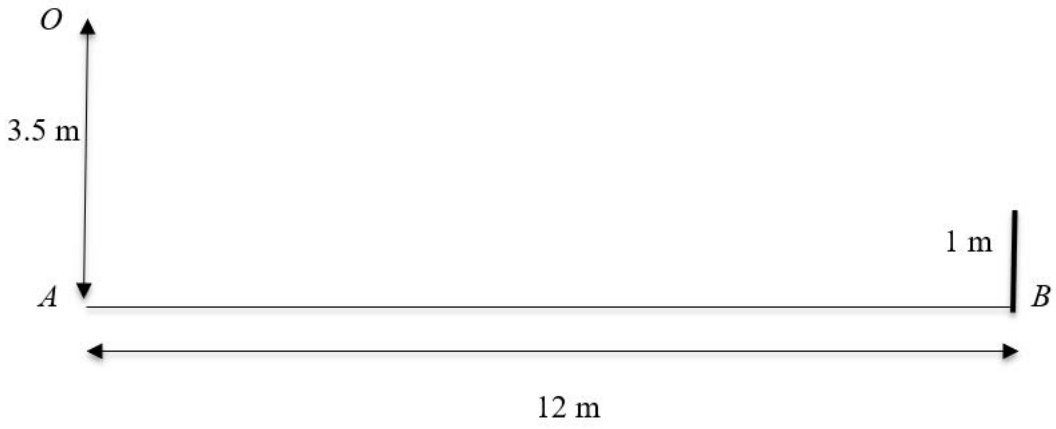


**Figure 3**

A tennis player serves a ball so as to pass over the net.
The ball is given an initial velocity of 45 m $s^{-1}$ in a direction $10^o$ below the horizontal.

The ball is struck at a point *O* which is 3.5 m vertically above the point *A* which is on horizontal ground.
The bottom of the net is the point *B* which is on the ground and *AB* = 12 m.
The height of the net is 1 m, as shown in Figure 3.

The ball is modelled as a particle moving freely under gravity.
The ball passes over the net at a point which is vertically above B.

Using the model,

(a) find, in centimetres to 2 significant figures, the distance between the ball and the top of the net, as the ball passes over the net,

**(8)**

(b) find, to 2 significant figures, the speed of the ball as it passes over the net.

**(4)**

(c) State two limitations of the model that could affect the reliability of your answers.

**(2)**

**Question 10 continued**

**Question 10 continued**

**(Total for Question 10 is 14 marks)**

**TOTAL FOR SECTION B IS 50 MARKS**
**TOTAL FOR PAPER IS 100 MARKS**