

| | |
|---|------------------|
| Write your name here | |
| Surname | Other names |
| Pearson Edexcel GCE | Centre Number |
| | Candidate Number |
| A level Mathematics Practice Paper Mechanics – Statics of a particle | |
| | |
| You must have: Mathematical Formulae and Statistical Tables (Pink) | Total Marks |

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.
- Answer all the questions and ensure that your answers to parts of questions are clearly labelled.
- 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.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet ‘Mathematical Formulae and Statistical Tables’ is provided.
- There are 11 questions in this question paper. The total mark for this paper is 95.
- The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.
- Calculators must not be used for questions marked with a * sign.

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.

1.

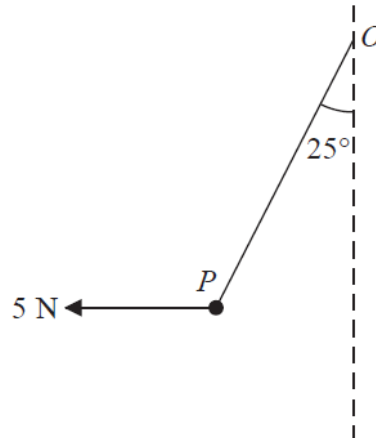


Figure 1

A particle P of weight W newtons is attached to one end of a light inextensible string. The other end of the string is attached to a fixed point O . A horizontal force of magnitude 5 N is applied to P . The particle P is in equilibrium with the string taut and with OP making an angle of 25° to the downward vertical, as shown in Figure 1.

Find

(a) the tension in the string, (3)

(b) the value of W . (3)

(Total 6 marks)

2.

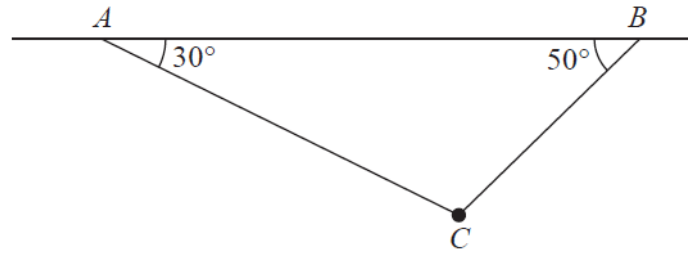


Figure 2

A particle of weight W newtons is attached at C to two light inextensible strings AC and BC . The other ends of the strings are attached to fixed points A and B on a horizontal ceiling. The particle hangs in equilibrium with AC and BC inclined to the horizontal at 30° and 50° respectively, as shown in Figure 2.

Given that the tension in BC is 6 N, find

(a) the tension in AC ,

(3)

(b) the value of W .

(3)

(Total 6 marks)

3.

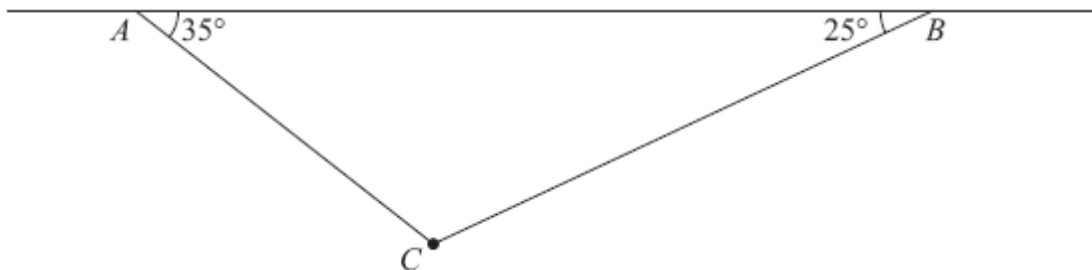


Figure 3

A particle of weight 8 N is attached at C to the ends of two light inextensible strings AC and BC . The other ends, A and B , are attached to a fixed horizontal ceiling. The particle hangs at rest in equilibrium, with the strings in a vertical plane. The string AC is inclined at 35° to the horizontal and the string BC is inclined at 25° to the horizontal, as shown in Figure 3.

Find

(i) the tension in the string AC ,

(ii) the tension in the string BC .

(Total 8 marks)

4.

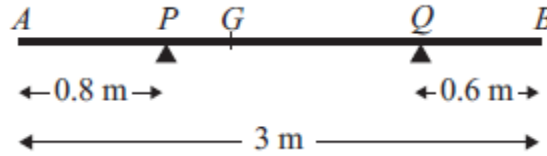


Figure 4

A non-uniform rod AB has length 3 m and mass 4.5 kg. The rod rests in equilibrium, in a horizontal position, on two smooth supports at P and at Q , where $AP = 0.8$ m and $QB = 0.6$ m, as shown in Figure 4. The centre of mass of the rod is at G . Given that the magnitude of the reaction of the support at P on the rod is twice the magnitude of the reaction of the support at Q on the rod, find

(a) the magnitude of the reaction of the support at Q on the rod,

(3)

(b) the distance AG .

(4)

(Total 7 marks)

5.

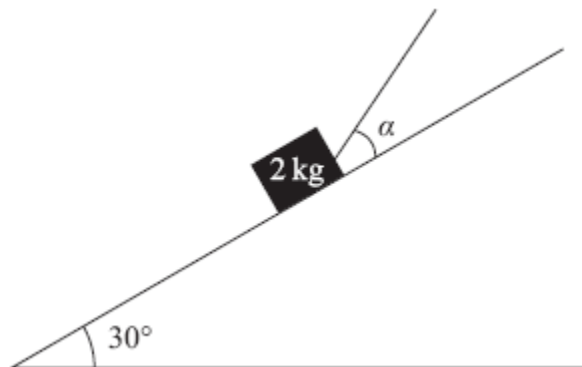


Figure 5

A box of mass 2 kg is held in equilibrium on a fixed rough inclined plane by a rope. The rope lies in a vertical plane containing a line of greatest slope of the inclined plane. The rope is inclined to the plane at an angle α , where $\tan \alpha = \frac{3}{4}$, and the plane is at an angle of 30° to the horizontal, as shown in Figure 5. The coefficient of friction between the box and the inclined plane is $\frac{1}{3}$ and the box is on the point of slipping up the plane. By modelling the box as a particle and the rope as a light inextensible string, find the tension in the rope.

(Total 8 marks)

6.

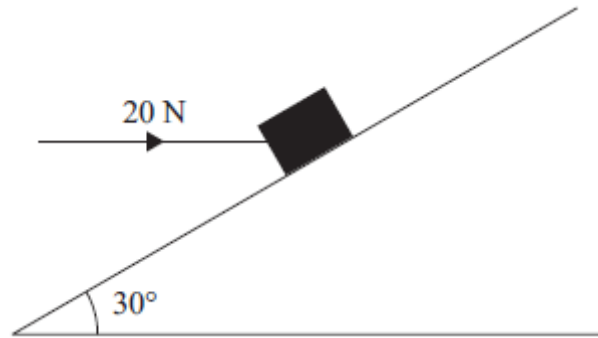


Figure 6

A box of mass 5 kg lies on a rough plane inclined at 30° to the horizontal. The box is held in equilibrium by a horizontal force of magnitude 20 N, as shown in Figure 6. The force acts in a vertical plane containing a line of greatest slope of the inclined plane.

The box is in equilibrium and on the point of moving down the plane. The box is modelled as a particle.

Find

(a) the magnitude of the normal reaction of the plane on the box,

(4)

(b) the coefficient of friction between the box and the plane.

(5)

(Total 9 marks)

7.

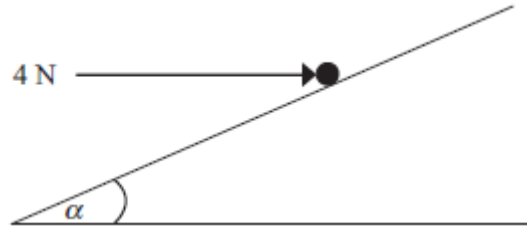


Figure 7

A particle of weight W newtons is held in equilibrium on a rough inclined plane by a horizontal force of magnitude 4 N. The force acts in a vertical plane containing a line of greatest slope of the inclined plane. The plane is inclined to the horizontal at an angle α , where $\tan \alpha = \frac{3}{4}$ as shown in Figure 7.

The coefficient of friction between the particle and the plane is $\frac{1}{2}$.

Given that the particle is on the point of sliding down the plane,

- (i) show that the magnitude of the normal reaction between the particle and the plane is 20 N,
- (ii) find the value of W .

(Total 9 marks)

8. Three forces \mathbf{F}_1 , \mathbf{F}_2 and \mathbf{F}_3 acting on a particle P are given by

$$\mathbf{F}_1 = (7\mathbf{i} - 9\mathbf{j}) \text{ N}$$

$$\mathbf{F}_2 = (5\mathbf{i} + 6\mathbf{j}) \text{ N}$$

$$\mathbf{F}_3 = (p\mathbf{i} + q\mathbf{j}) \text{ N}$$

where p and q are constants.

Given that P is in equilibrium,

- (a) find the value of p and the value of q . **(3)**

The force \mathbf{F}_3 is now removed. The resultant of \mathbf{F}_1 and \mathbf{F}_2 is \mathbf{R} . Find

- (b) the magnitude of \mathbf{R} , **(2)**
- (c) the angle, to the nearest degree, that the direction of \mathbf{R} makes with \mathbf{j} . **(3)**

(Total 8 marks)

9.

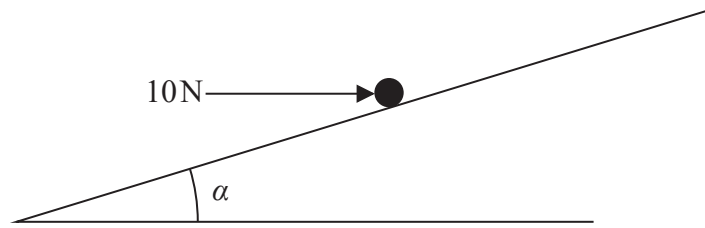


Figure 8

A particle P of mass 5 kg is held at rest in equilibrium on a rough inclined plane by a horizontal force of magnitude 10 N. The plane is inclined to the horizontal at an angle α where $\tan \alpha = \frac{3}{4}$, as shown in Figure 8. The line of action of the force lies in the vertical plane containing P and a line of greatest slope of the plane. The coefficient of friction between P and the plane is μ . Given that P is on the point of sliding down the plane, find the value of μ .

(Total 9 marks)

10.

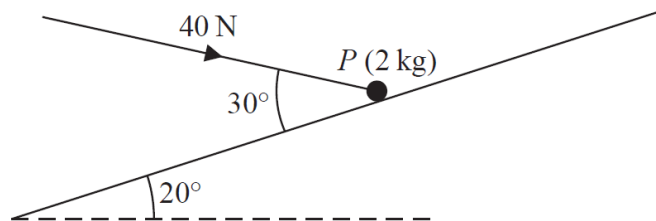


Figure 9

A particle P of mass 2 kg is held at rest in equilibrium on a rough plane by a constant force of magnitude 40 N. The direction of the force is inclined to the plane at an angle of 30° . The plane is inclined to the horizontal at an angle of 20° , as shown in Figure 9. The line of action of the force lies in the vertical plane containing P and a line of greatest slope of the plane. The coefficient of friction between P and the plane is μ .

Given that P is on the point of sliding up the plane, find the value of μ .

(Total 10 marks)

11.

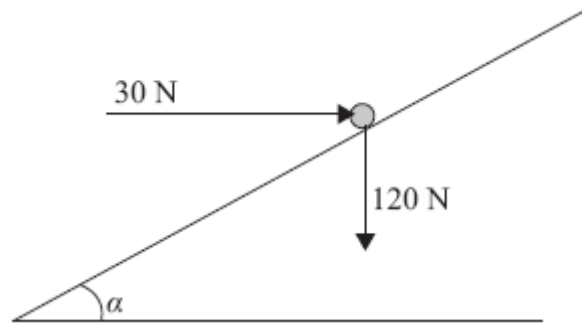


Figure 10

A particle of weight 120 N is placed on a fixed rough plane which is inclined at an angle α to the horizontal, where $\tan \alpha = \frac{3}{4}$.

The coefficient of friction between the particle and the plane is $\frac{1}{2}$.

The particle is held at rest in equilibrium by a horizontal force of magnitude 30 N, which acts in the vertical plane containing the line of greatest slope of the plane through the particle, as shown in Figure 10.

- (a) Show that the normal reaction between the particle and the plane has magnitude 114 N. (4)

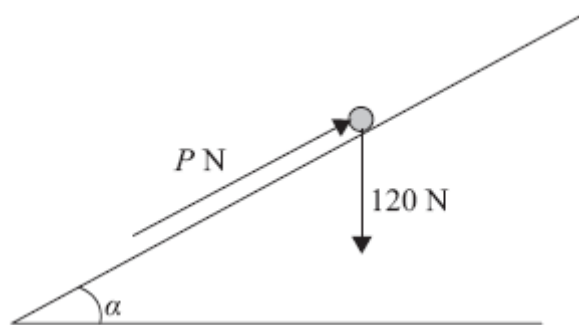


Figure 11

The horizontal force is removed and replaced by a force of magnitude P newtons acting up the slope along the line of greatest slope of the plane through the particle, as shown in Figure 11. The particle remains in equilibrium.

- (b) Find the greatest possible value of P . (8)
- (c) Find the magnitude and direction of the frictional force acting on the particle when $P = 30$. (3)

(Total 15 marks)

TOTAL FOR PAPER: 95 MARKS