More Forces and Frictions – Exam Questions

Q1.

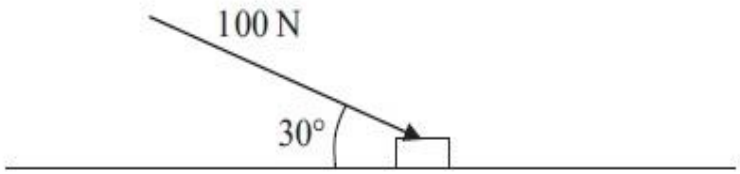

Figure 1

A small box is pushed along a floor. The floor is modelled as a rough horizontal plane and the box is modelled as a particle. The coefficient of friction between the box and the floor is ½. The box is pushed by a force of magnitude 100 N which acts at an angle of 30º with the floor, as shown in Figure 1.

Given that the box moves with constant speed, find the mass of the box.

(7)

(Total 7 marks)

Q2.

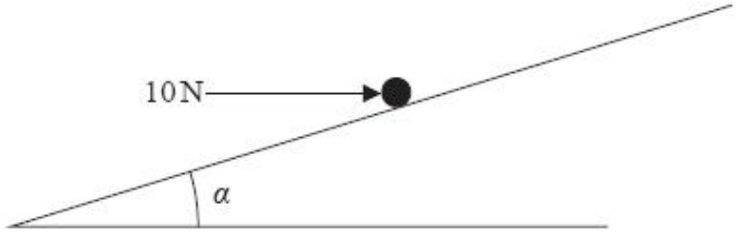

Figure 1

A particle *P* of mass 5kg is held at rest in equilibrium on a rough inclined plane by a horizontal force of magnitude 10N. The plane is inclined to the horizontal at an angle α where $\tan\alpha = \frac{3}{4}$, as shown in Figure 1. 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.

(9)

(Total for question = 9 marks)

Q3.

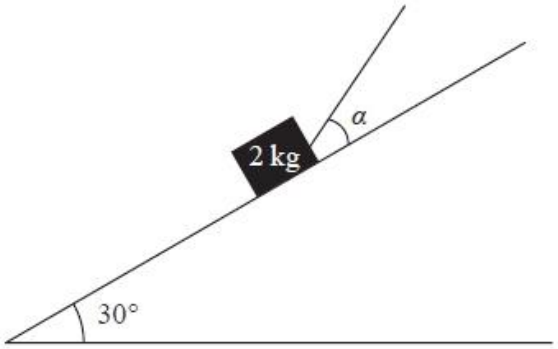

Figure 1

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 1. 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.

(8)

(Total 8 marks)

Q4.

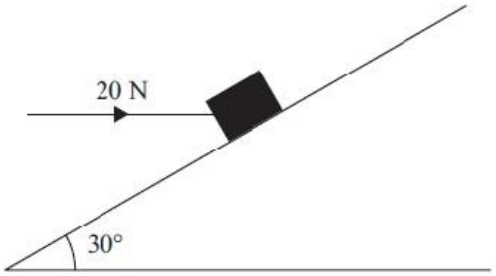

Figure 2

A box of mass 5 kg lies on a rough plane inclined at 30º to the horizontal. The box is held in equilibrium by a horizontal force of magnitude 20 N, as shown in Figure 2. 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)

Q5.

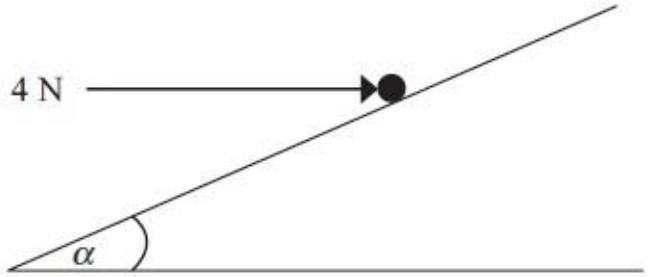

Figure 1

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 *a*, where tan *a* = $\frac{3}{4}$, as shown in Figure 1.

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*.

(9)

(Total 9 marks)