Pure 2 Applied Chapter 7: Statics on a Slope – Exam Questions (Total Marks 68)

Q1.

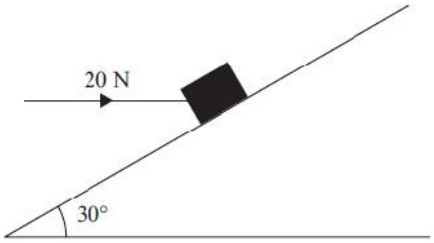


Figure 2

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)

Q2.

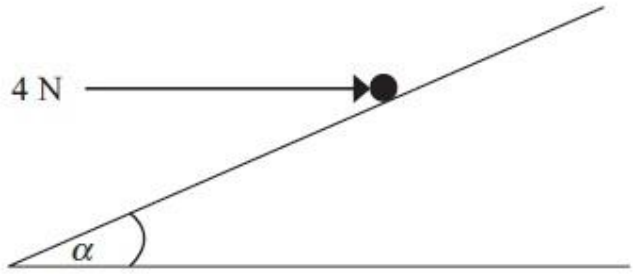


Figure 1

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)

Q3.

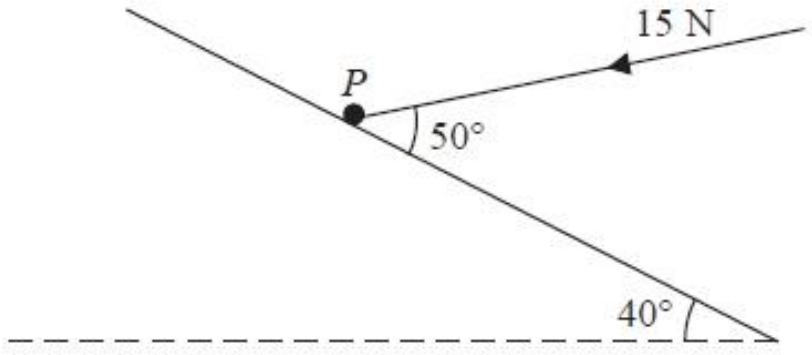


Figure 4

A particle P of mass 2.7 kg lies on a rough plane inclined at 40° to the horizontal. The particle is held in equilibrium by a force of magnitude 15 N acting at an angle of 50° to the plane, as shown in Figure 4. The force acts in a vertical plane containing a line of greatest slope of the plane. The particle is in equilibrium and is on the point of sliding down the plane.

Find

(a) the magnitude of the normal reaction of the plane on *P*,

(4)

(b) the coefficient of friction between *P* and the plane.

(5)

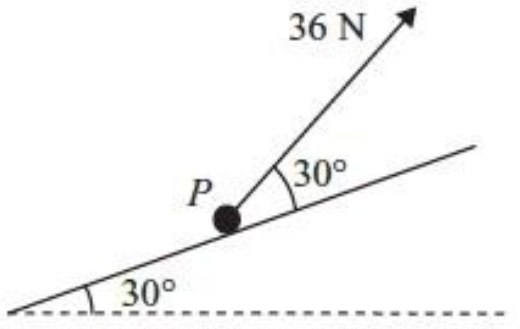
The force of magnitude 15 N is removed.

(c) Determine whether *P* moves, justifying your answer.

(4)

(Total 13 marks)

Q4.



A particle *P* of mass 4 kg is moving up a fixed rough plane at a constant speed of 16 m s^{-1} under the action of a force of magnitude 36 N. The plane is inclined at 30° to the horizontal. The force acts in the vertical plane containing the line of greatest slope of the plane through P, and acts at 30° to the inclined plane, as shown above. The coefficient of friction between *P* and the plane is μ. Find

(a) the magnitude of the normal reaction between *P* and the plane,

(4)

(b) the value of μ

(5)

The force of magnitude 36 N is removed.

(c) Find the distance that *P* travels between the instant when the force is removed and the instant when it comes to rest.

(5)

(Total 14 marks)

Q5.

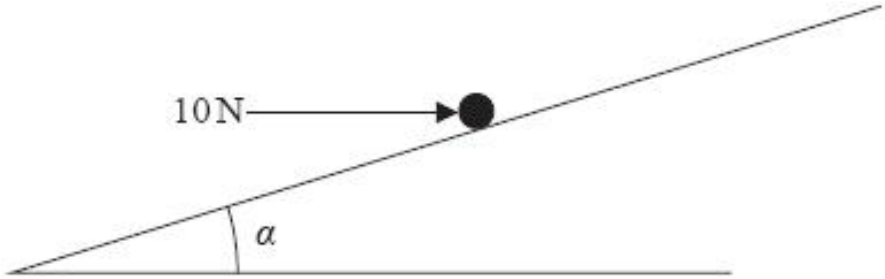


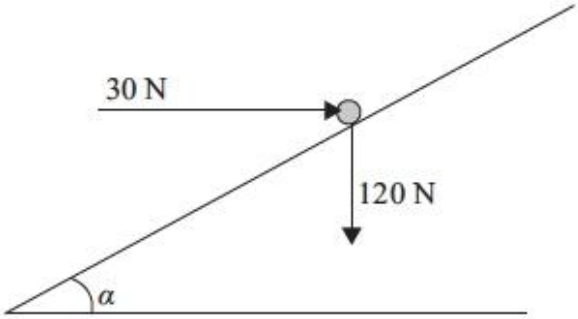
Figure 1

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)

Q6.



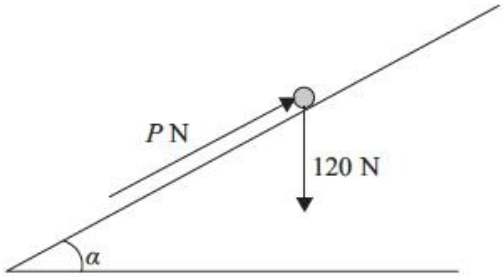
A particle of weight 120 N is placed on a fixed rough plane which is inclined at an angle α to the horizontal, where $\tan \alpha = \frac{3}{4}$

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 1.

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

(4)



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 above. 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)