



Forces and Friction

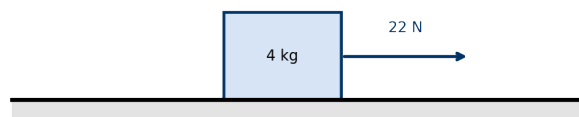
Questions

Suitable for:
Pearson Edexcel International A-Level (iAL) — Mechanics 1



Question 1

A particle of mass 4 kg is pulled along a rough horizontal surface by a horizontal force of 22 N. The coefficient of friction between the particle and the surface is 0.3. Take $g = 9.8 \text{ m s}^{-2}$.



Find the acceleration of the particle.

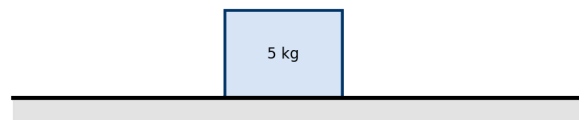
(4 marks)

Total for question = 4 marks



Question 2

A particle of mass 5 kg slides along a rough horizontal surface. No horizontal force other than friction acts on the particle. The particle decelerates at 2.1 m s^{-2} . Take $g = 9.8 \text{ m s}^{-2}$.



Find the coefficient of friction between the particle and the surface.

(3 marks)

Total for question = 3 marks



Question 3

A particle of mass 6 kg rests in equilibrium on a rough horizontal surface. A horizontal force P is applied to the particle. The particle is on the point of sliding when $P = 21$ N. Take $g = 9.8 \text{ m s}^{-2}$.

Find the coefficient of friction between the particle and the surface.

(3 marks)

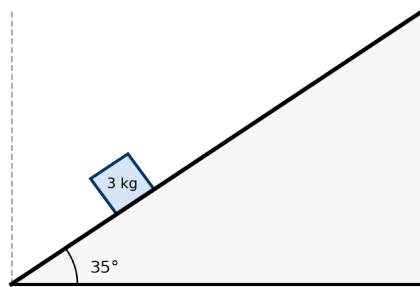
Total for question = 3 marks



Question 4

A particle of mass 3 kg rests on a rough plane inclined at 35° to the horizontal. The coefficient of friction between the particle and the plane is 0.4. Take $g = 9.8 \text{ m s}^{-2}$.

Figure 1



Determine whether the particle slides down the plane. Show your working clearly.

(4 marks)

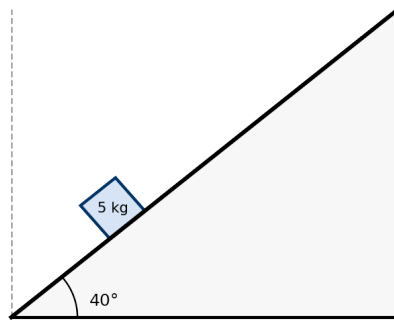
Total for question = 4 marks



Question 5

A particle of mass 5 kg slides down a rough plane inclined at 40° to the horizontal. The coefficient of friction between the particle and the plane is 0.25. Take $g = 9.8 \text{ m s}^{-2}$.

Figure 2



Find the acceleration of the particle.

(4 marks)

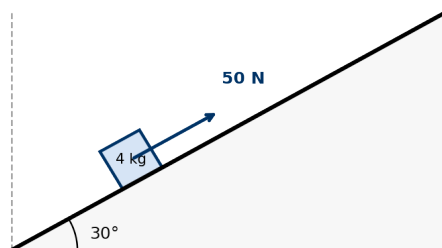
Total for question = 4 marks



Question 6

A particle of mass 4 kg is pushed up a rough plane inclined at 30° to the horizontal by a force of 50 N acting parallel to and up the plane. The coefficient of friction between the particle and the plane is 0.3. Take $g = 9.8 \text{ m s}^{-2}$.

Figure 3



Find the acceleration of the particle.

(5 marks)

Total for question = 5 marks



Question 7

A particle of mass 8 kg rests on a rough plane inclined at 25° to the horizontal. The particle is on the point of sliding down the plane. Take $g = 9.8 \text{ m s}^{-2}$.

Find the coefficient of friction between the particle and the plane.

(3 marks)

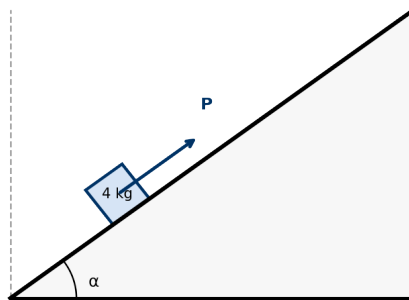
Total for question = 3 marks



Question 8

A particle of mass 4 kg rests on a rough plane inclined at an angle α to the horizontal, where $\tan \alpha = 3/4$. The coefficient of friction between the particle and the plane is 0.4. A force P acts on the particle parallel to and up the plane. The particle is on the point of sliding down the plane. Take $g = 9.8 \text{ m s}^{-2}$.

Figure 4



Find the value of P .

(5 marks)

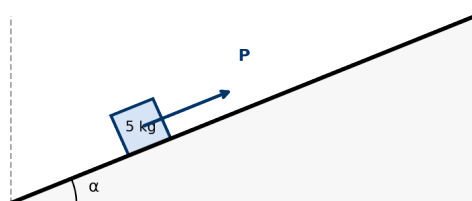
Total for question = 5 marks



Question 9

A particle of mass 5 kg rests on a rough plane inclined at an angle α to the horizontal, where $\tan \alpha = 5/12$. The coefficient of friction between the particle and the plane is 0.3. A force P acts on the particle parallel to the plane. Take $g = 9.8 \text{ m s}^{-2}$.

Figure 5



Find the value of P when

(a) the particle is on the point of sliding up the plane,

(4 marks)

(b) the particle is on the point of sliding down the plane.

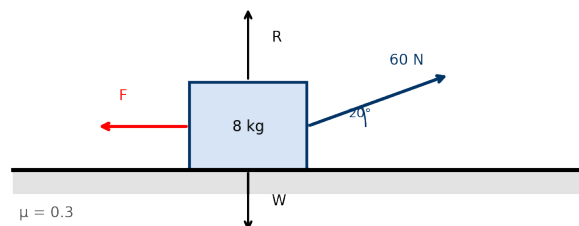
(3 marks)

Total for question = 7 marks



Question 10

A force of 60 N acts on a particle of mass 8 kg at an angle of 20° above the horizontal. The particle moves along a rough horizontal surface. The coefficient of friction is 0.3. Take $g = 9.8 \text{ m s}^{-2}$.



Find the acceleration of the particle.

(5 marks)

Total for question = 5 marks



Question 11

A force of 30 N acts on a particle of mass 5 kg at an angle of 20° above the horizontal on a rough horizontal surface. The particle is in limiting equilibrium. Take $g = 9.8 \text{ m s}^{-2}$.

Find the coefficient of friction between the particle and the surface.

(4 marks)

Total for question = 4 marks

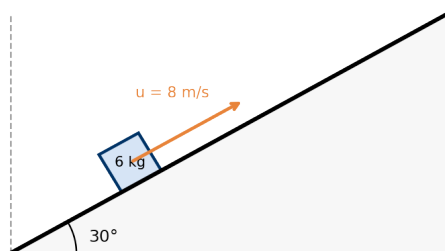




Question 12

A particle of mass 6 kg is projected up a rough plane inclined at 30° to the horizontal with initial speed 8 m s^{-1} . The coefficient of friction between the particle and the plane is 0.2 . Take $g = 9.8\text{ m s}^{-2}$.

Figure 6



(a) Find the deceleration of the particle as it moves up the plane.

(3 marks)

(b) Find the time taken for the particle to reach its highest point.

(2 marks)

(c) Find the acceleration of the particle as it slides back down the plane.

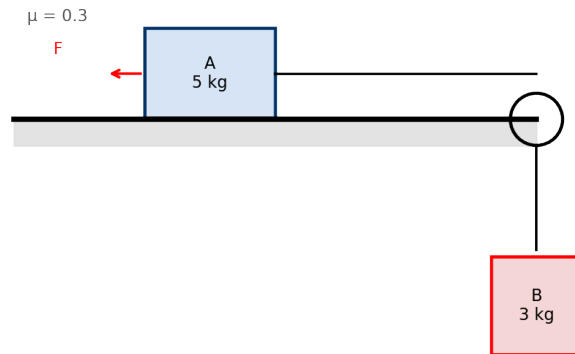
(3 marks)

Total for question = 8 marks



Question 13

Particle A of mass 5 kg rests on a rough horizontal table with coefficient of friction 0.3. It is connected by a light inextensible string passing over a smooth pulley at the edge of the table to particle B of mass 3 kg, which hangs freely. The system is released from rest. Take $g = 9.8 \text{ m s}^{-2}$.



(a) Show that the system moves.

(2 marks)

(b) Find the acceleration of the system.

(3 marks)

(c) Find the tension in the string.

(2 marks)

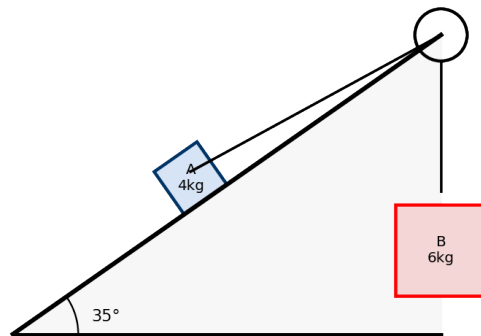
Total for question = 7 marks



Question 14

Particle A of mass 4 kg rests on a rough plane inclined at 35° to the horizontal. The coefficient of friction between A and the plane is 0.25. Particle A is connected by a light inextensible string passing over a smooth pulley at the top of the plane to particle B of mass 6 kg, which hangs freely. The system is released from rest. Take $g = 9.8 \text{ m s}^{-2}$.

$$\mu = 0.25$$



(a) Find the acceleration of the system.

(5 marks)

(b) Find the tension in the string.

(2 marks)

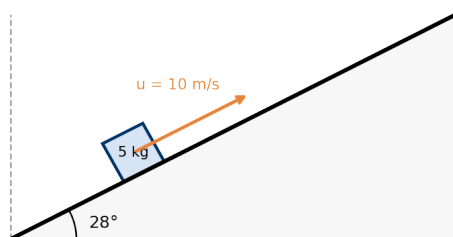
Total for question = 7 marks



Question 15

A particle of mass 5 kg is projected with speed 10 m s^{-1} up a rough plane inclined at 28° to the horizontal. The coefficient of friction between the particle and the plane is 0.35. Take $g = 9.8 \text{ m s}^{-2}$.

Figure 7



(a) Find the deceleration of the particle as it moves up the plane.

(3 marks)

(b) Find the distance the particle travels before coming to rest.

(2 marks)

(c) Determine whether the particle remains at rest or slides back down the plane, justifying your answer carefully.

(3 marks)

Total for question = 8 marks



Question 16

A particle of mass 3 kg is held in equilibrium on a rough horizontal surface by a force of magnitude P newtons acting at 25° above the horizontal. The coefficient of friction between the particle and the surface is 0.4. The friction is limiting. Take $g = 9.8 \text{ m s}^{-2}$.

(a) Find the value of P .

(4 marks)

The force of magnitude P is now removed.

(b) Find the deceleration of the particle.

(3 marks)

Total for question = 7 marks

