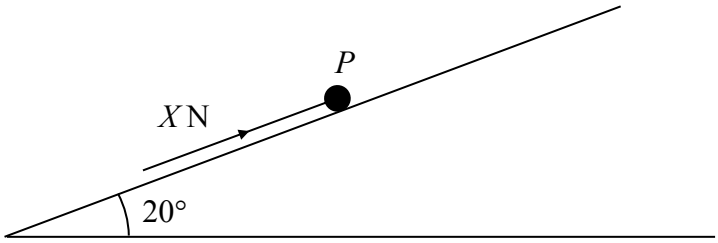
Friction & Static Particles - Edexcel Past Exam Questions

1.



A particle P of mass 2.5 kg rests in equilibrium on a rough plane under the action of a force of magnitude X newtons acting up a line of greatest slope of the plane, as shown in Figure 3. The plane is inclined at 20° to the horizontal. The coefficient of friction between P and the plane is 0.4. The particle is in limiting equilibrium and is on the point of moving up the plane. Calculate

(a) the normal reaction of the plane on P, **(2)**

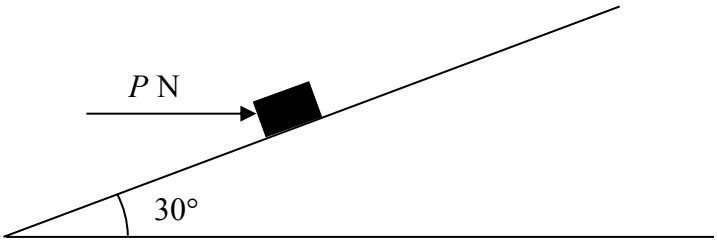
(b) the value of X. **(4)**

The force of magnitude X newtons is now removed.

(c) Show that P remains in equilibrium on the plane. **(4)**

Jan 05 Q4

2.



A parcel of weight 10 N lies on a rough plane inclined at an angle of 30° to the horizontal. A horizontal force of magnitude P newtons acts on the parcel, as shown in Figure 2. The parcel is in equilibrium and on the point of slipping up the plane. The normal reaction of the plane on the parcel is 18 N. The coefficient of friction between the parcel and the plane is μ. Find

(a) the value of P, **(4)**

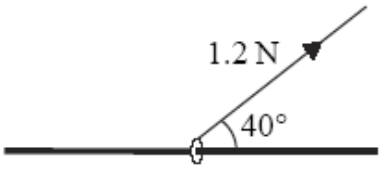
(b) the value of μ. **(5)**

The horizontal force is removed.

(c) Determine whether or not the parcel moves. **(5)**

Jan 06 Q5

3. **Figure 3**



A small ring of mass 0.25 kg is threaded on a fixed rough horizontal rod. The ring is pulled upwards by a light string which makes an angle 40° with the horizontal, as shown in Figure 3. The string and the rod are in the same vertical plane. The tension in the string is 1.2 N and the coefficient of friction between the ring and the rod is μ. Given that the ring is in limiting equilibrium, find

(*a*) the normal reaction between the ring and the rod, **(4)**

(*b*) the value of μ. **(6)**

June 07 Q5

4.

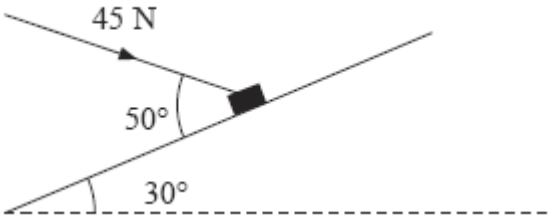


Figure 3

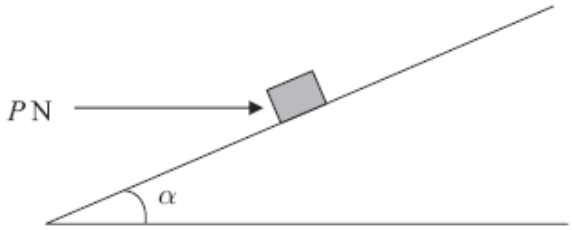
A package of mass 4 kg lies on a rough plane inclined at 30° to the horizontal. The package is held in equilibrium by a force of magnitude 45 N acting at an angle of 50° to the plane, as shown in Figure 3. The force is acting in a vertical plane through a line of greatest slope of the plane. The package is in equilibrium on the point of moving up the plane. The package is modelled as a particle. Find

(*a*) the magnitude of the normal reaction of the plane on the package, **(5)**

(*b*) the coefficient of friction between the plane and the package. **(6)**

June 08 Q7

5.



A small package of mass 1.1 kg is held in equilibrium on a rough plane by a horizontal force. The plane is inclined at an angle α to the horizontal, where $\tan \alpha = \frac{3}{4}$. The force acts in a vertical plane containing a line of greatest slope of the plane and has magnitude P newtons, as shown in Figure 2.

The coefficient of friction between the package and the plane is 0.5 and the package is modelled as a particle. The package is in equilibrium and on the point of slipping down the plane.

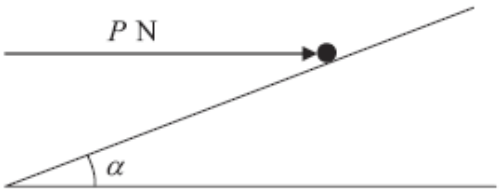
(a) Draw, on Figure 2, all the forces acting on the package, showing their directions clearly. **(2)**

(b) (i) Find the magnitude of the normal reaction between the package and the plane.

(ii) Find the value of P. **(11)**

Jan 09 Q5

6.



A particle of mass 0.4 kg is held at rest on a fixed rough plane by a horizontal force of magnitude P newtons. The force acts in the vertical plane containing the line of greatest slope of the inclined plane which passes through the particle. The plane is inclined to the horizontal at an angle α, where $\tan \alpha = \frac{3}{4}$, as shown in Figure 2.

The coefficient of friction between the particle and the plane is $\frac{1}{3}$.

Given that the particle is on the point of sliding up the plane, find

(a) the magnitude of the normal reaction between the particle and the plane, **(5)**

(b) the value of P. **(5)**

June 10 Q7

7.

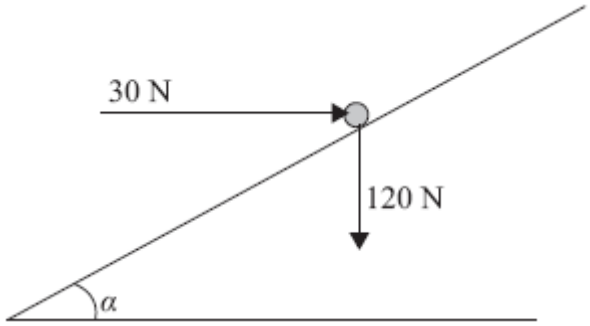


Figure 4

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 2.

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

(4)

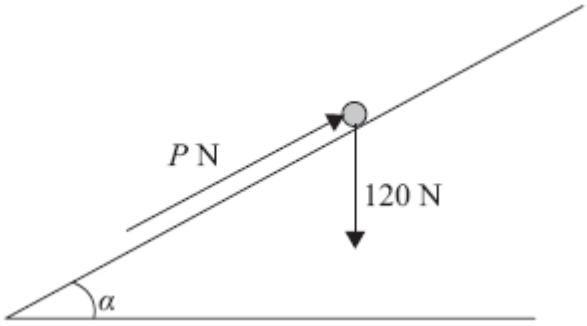


Figure 3

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 3. 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)

Jan 11 Q6

8.

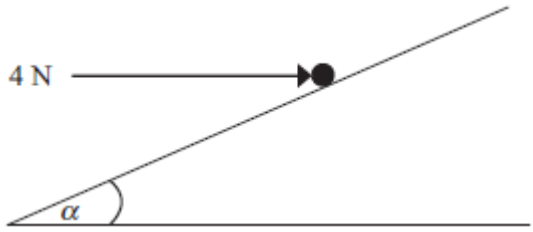


Figure 1

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 α, where $\tan \alpha = \frac{3}{4}$ 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)**

June 11 Q3