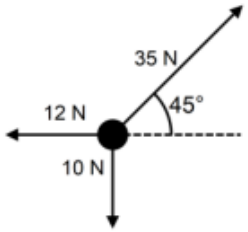
RESOLVING FORCES

Calculate the resultant force acting on the particle giving you answer in the form ai + bj



Working in i (horizontal)
Ri = 35cos45° - 12
= 12.7 N

Working in j (vertical)
Rj = 35sin45° - 10
= 14.7 N

R = 12.7 i + 14.7 j

The forces shown in the diagram act on particle A of mass 0.8 kg. Calculate the magnitude of the acceleration of the particle
Resultant force = 12.7**i** + 14.7**j**
Force = mass × acceleration
0.8**a** = 12.7**i** + 14.7**j**
a = 15.875**i** + 18.375**j**

$|\mathbf{a}| = \sqrt{15.875^2 + 18.375^2}$

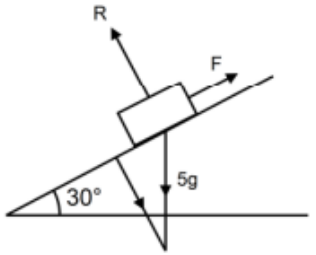
$|\mathbf{a}| = 24.3\ ms^{-2}$ (3 s.f.)

If the system is in **Equilibrium**, then resultant force = 0
Take care with objects on slope – always draw a diagram showing all the forces

A box of mass 5 kg rests on a slope inclined at an angle of 30° to the horizontal
Calculate the normal reaction and the friction

Resolving perpendicular to the slope R = 5g cos 30°
= 42.4 N (3 s.f)

Resolving parallel to the slope F = 5g sin 30°
= 24.5 N(3 s.f)



- Area under a velocity time graph = displacement
- Gradient at a point on position/time graph = velocity
- Gradient at a point on velocity/time graph = acceleration

Kinematics

For motion in a straight line with constant acceleration:

$v = u + at$

$s = ut + \frac{1}{2}at^2$

$s = vt - \frac{1}{2}at^2$

$v^2 = u^2 + 2as$

$s = \frac{1}{2}(u + v)t$

COEFFICIENT OF FRICTION

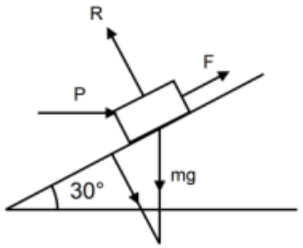
The maximum or limiting value of friction F_{max} is given by

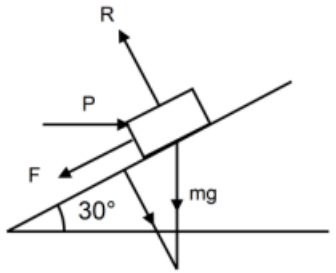
$\mathbf{F_{max} = \mu R}$ R is the normal reaction and μ is the **coefficient of friction**

If a force is acting on the object but the object remains at rest then $F < \mu R$
When the object is moving the frictional force is constant (F_{max})

For questions looking at the minimum and maximum force needed to move a block on a rough slope look at the magnitude of force P

When the block is on the verge of sliding down the slope
Friction is 'acting up the slope'





When the block is on the verge of sliding up the slope
Friction is 'acting down the slope'

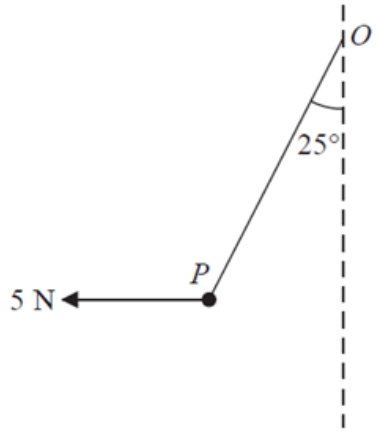


Figure 1

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)

A lifeboat slides down a straight ramp inclined at an angle of 15° to the horizontal. The lifeboat has mass 800 kg and the length of the ramp is 50 m. The lifeboat is released from rest at the top of the ramp and is moving with a speed of 12.6 m s^{-1} when it reaches the end of the ramp. By modelling the lifeboat as a particle and the ramp as a rough inclined plane, find the coefficient of friction between the lifeboat and the ramp.

(Total 9 marks)

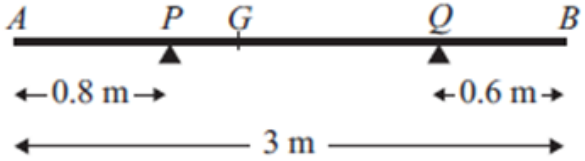


Figure 4

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)

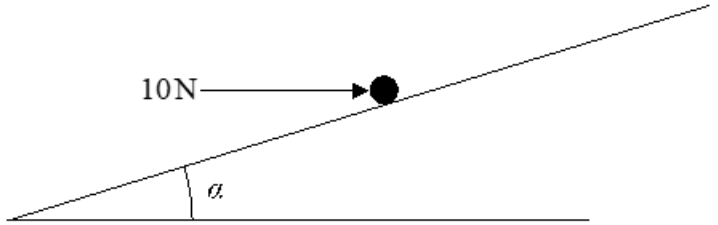


Figure 8

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)