

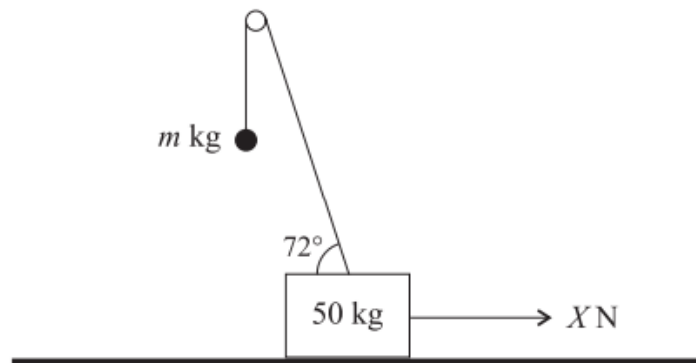
Statics and Dynamics in 2d Without Friction (From OCR 4728)

Q1, (Jun 2005, Q4)

A particle moves downwards on a smooth plane inclined at an angle α to the horizontal. The particle passes through the point P with speed $u \text{ m s}^{-1}$. The particle travels 2 m during the first 0.8 s after passing through P , then a further 6 m in the next 1.2 s. Find

- (i) the value of u and the acceleration of the particle, [7]
- (ii) the value of α in degrees. [2]

Q2, (Jun 2007, Q3)



A block of mass 50 kg is in equilibrium on smooth horizontal ground with one end of a light wire attached to its upper surface. The other end of the wire is attached to an object of mass m kg. The wire passes over a small smooth pulley, and the object hangs vertically below the pulley. The part of the wire between the block and the pulley makes an angle of 72° with the horizontal. A horizontal force of magnitude X N acts on the block in the vertical plane containing the wire (see diagram).

The tension in the wire is T N and the contact force exerted by the ground on the block is R N.

- (i) By resolving forces on the block vertically, find a relationship between T and R . [2]

It is given that the block is on the point of lifting off the ground.

- (ii) Show that $T = 515$, correct to 3 significant figures, and hence find the value of m . [4]
- (iii) By resolving forces on the block horizontally, write down a relationship between T and X , and hence find the value of X . [2]

Q3, (Jun 2010, Q6)

A block B of mass 0.85 kg lies on a smooth slope inclined at 30° to the horizontal. B is attached to one end of a light inextensible string which is parallel to the slope. At the top of the slope, the string passes over a smooth pulley. The other end of the string hangs vertically and is attached to a particle P of mass 0.55 kg. The string is taut at the instant when P is projected vertically downwards.

- (i) Calculate
 - (a) the acceleration of B and the tension in the string, [5]
 - (b) the magnitude of the force exerted by the string on the pulley. [2]

The initial speed of P is 1.3 m s^{-1} and after moving 1.5 m P reaches the ground, where it remains at rest. B continues to move up the slope and does not reach the pulley.

- (ii) Calculate the total distance B moves up the slope before coming instantaneously to rest. [6]

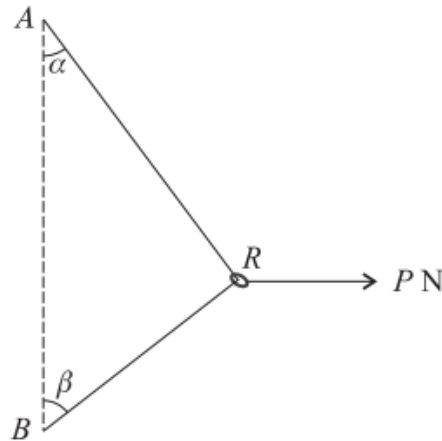


Fig. 1

A smooth ring R of weight W N is threaded on a light inextensible string. The ends of the string are attached to fixed points A and B , where A is vertically above B . A horizontal force of magnitude PN acts on R . The system is in equilibrium with the string taut; AR makes an angle α with the downward vertical and BR makes an angle β with the upward vertical (see Fig. 1).

(i) By considering the vertical components of the forces acting on R , show that $\alpha < \beta$. [3]

(ii)

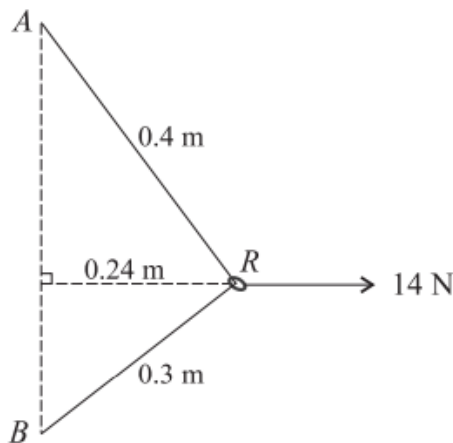


Fig. 2

It is given that when $P = 14$, $AR = 0.4$ m, $BR = 0.3$ m and the distance of R from the vertical line AB is 0.24 m (see Fig. 2). Find

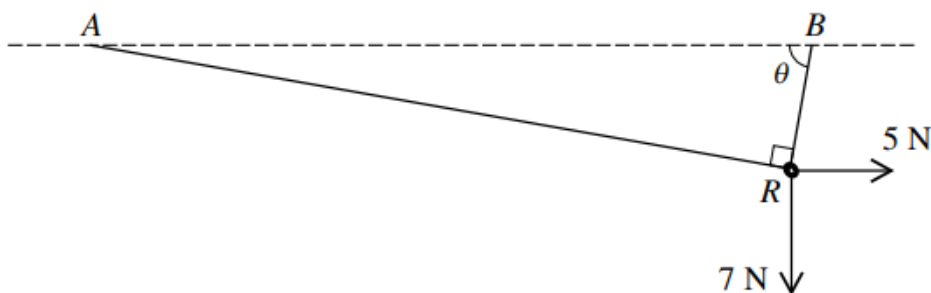
(a) the tension in the string, [3]

(b) the value of W . [3]

(iii) For the case when $P = 0$,

(a) describe the position of R , [1]

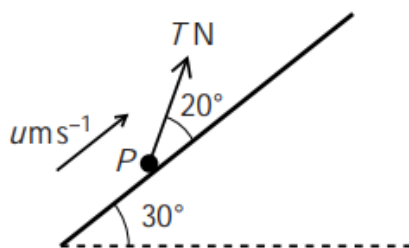
(b) state the tension in the string. [1]



A small smooth ring R of weight 7 N is threaded on a light inextensible string. The ends of the string are attached to fixed points A and B at the same horizontal level. A horizontal force of magnitude 5 N is applied to R . The string is taut. In the equilibrium position the angle ARB is a right angle, and the portion of the string attached to B makes an angle θ with the horizontal (see diagram).

- (i) Explain why the tension $T\text{ N}$ is the same in each part of the string. [1]
- (ii) By resolving horizontally and vertically for the forces acting on R , form two simultaneous equations in $T \cos \theta$ and $T \sin \theta$. [4]
- (iii) Hence find T and θ . [6]

Q6, (Jan 2013, Q3)



A particle P of mass 0.25 kg moves upwards with constant speed $u\text{ ms}^{-1}$ along a line of greatest slope on a smooth plane inclined at 30° to the horizontal. The pulling force acting on P has magnitude $T\text{ N}$ and acts at an angle of 20° to the line of greatest slope (see diagram). Calculate

- (i) the value of T , [3]
- (ii) the magnitude of the contact force exerted on P by the plane. [3]

The pulling force $T\text{ N}$ acting on P is suddenly removed, and P comes to instantaneous rest 0.4 s later.

- (iii) Calculate u . [4]

Q7, (Jun 2016, Q1)

A particle P is projected down a line of greatest slope on a smooth inclined plane. P has velocity 5 ms^{-1} at the instant when it has been in motion for 1.6 s and travelled a distance of 6.4 m . Calculate

- (i) the initial speed and the acceleration of P , [5]
- (ii) the inclination of the plane to the vertical. [3]
-