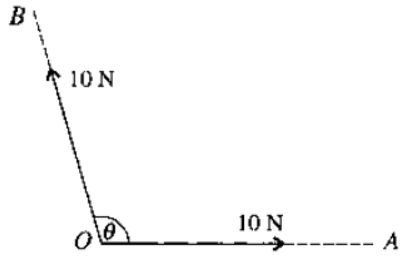
Chapter 1 Forces and equilibrium

May/June 2002

3



Two forces, each of magnitude 10 N, act at a point O in the directions of OA and OB, as shown in the diagram. The angle between the forces is θ. The resultant of these two forces has magnitude 12 N.

(i) Find θ. [3]

(ii) Find the component of the resultant force in the direction of OA. [2]

4 A box of mass 4.5 kg is pulled at a constant speed of $2\,\text{m s}^{-1}$ along a rough horizontal floor by a horizontal force of magnitude 15 N.

(i) Find the coefficient of friction between the box and the floor. [3]

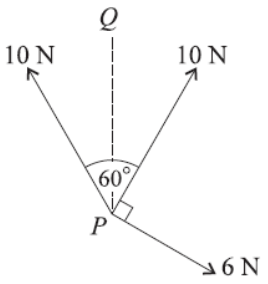
The horizontal pulling force is now removed. Find

(ii) the deceleration of the box in the subsequent motion, [2]

(iii) the distance travelled by the box from the instant the horizontal force is removed until the box comes to rest. [2]

May/June 2003

2



Three coplanar forces of magnitudes 10 N, 10 N and 6 N act at a point P in the directions shown in the diagram. PQ is the bisector of the angle between the two forces of magnitude 10 N.

(i) Find the component of the resultant of the three forces

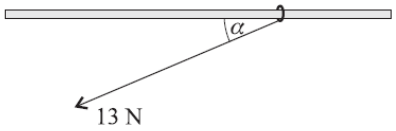
(a) in the direction of PQ, [2]

(b) in the direction perpendicular to PQ. [1]

(ii) Find the magnitude of the resultant of the three forces. [2]

May/June 2004

1



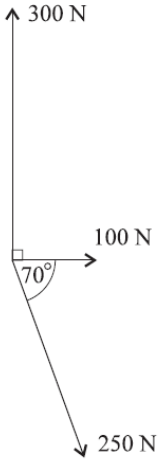
A ring of mass 1.1 kg is threaded on a fixed rough horizontal rod. A light string is attached to the ring and the string is pulled with a force of magnitude 13 N at an angle α below the horizontal, where $\tan\alpha = \frac{5}{12}$ (see diagram). The ring is in equilibrium.

(i) Find the frictional component of the contact force on the ring. [2]

(ii) Find the normal component of the contact force on the ring. [2]

(iii) Given that the equilibrium of the ring is limiting, find the coefficient of friction between the ring and the rod. [1]

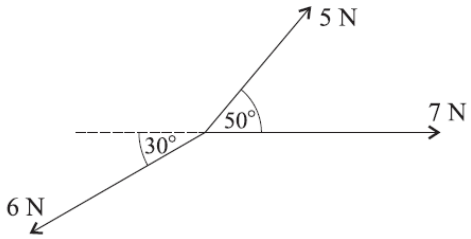
2



Coplanar forces of magnitudes 250 N, 100 N and 300 N act at a point in the directions shown in the diagram. The resultant of the three forces has magnitude R N, and acts at an angle $\alpha°$ anticlockwise from the force of magnitude 100 N. Find R and α. [6]

May/June 2005

2



Three coplanar forces act at a point. The magnitudes of the forces are 5 N, 6 N and 7 N, and the directions in which the forces act are shown in the diagram. Find the magnitude and direction of the resultant of the three forces. [6]

May/June 2006

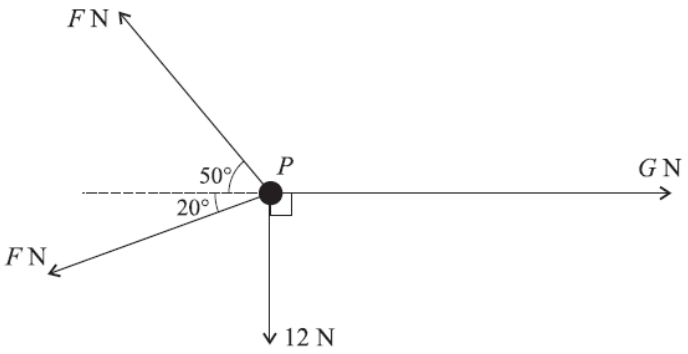
1 A car of mass 1200 kg travels on a horizontal straight road with constant acceleration a m s^{-2}.

(i) Given that the car's speed increases from 10 m s^{-1} to 25 m s^{-1} while travelling a distance of 525 m, find the value of a. [2]

The car's engine exerts a constant driving force of 900 N. The resistance to motion of the car is constant and equal to R N.

(ii) Find R. [2]

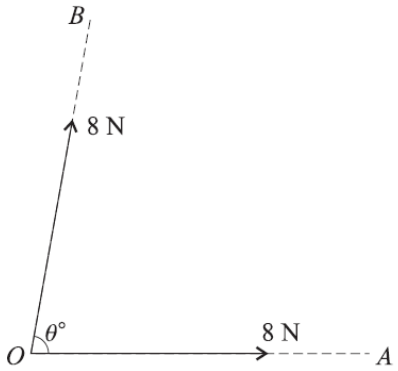
3



A particle P is in equilibrium on a smooth horizontal table under the action of horizontal forces of magnitudes F N, F N, G N and 12 N acting in the directions shown. Find the values of F and G. [6]

May/June 2007

2

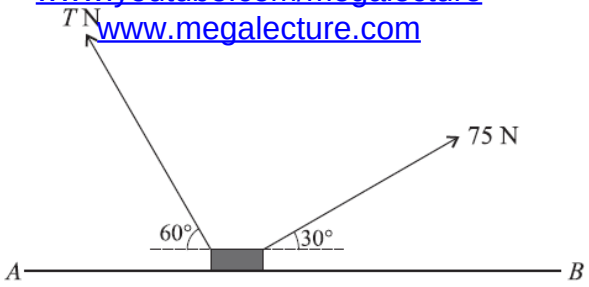


Two forces, each of magnitude 8 N, act at a point in the directions OA and OB. The angle between the forces is $\theta°$ (see diagram). The resultant of the two forces has component 9 N in the direction OA. Find

(i) the value of θ, [2]

(ii) the magnitude of the resultant of the two forces. [3]

7



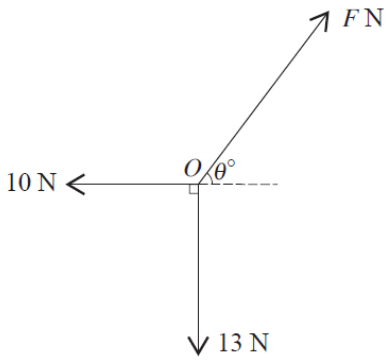
Two light strings are attached to a block of mass 20 kg. The block is in equilibrium on a horizontal surface AB with the strings taut. The strings make angles of 60° and 30° with the horizontal, on either side of the block, and the tensions in the strings are T N and 75 N respectively (see diagram).

(i) Given that the surface is smooth, find the value of T and the magnitude of the contact force acting on the block. [5]

(ii) It is given instead that the surface is rough and that the block is on the point of slipping. The frictional force on the block has magnitude 25 N and acts towards A. Find the coefficient of friction between the block and the surface. [6]

May/June 2008

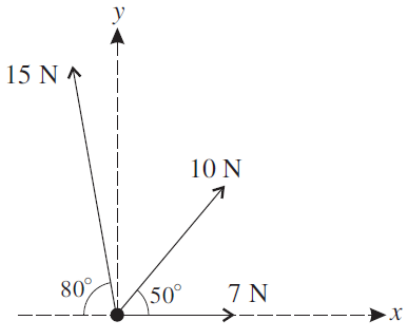
3



Three horizontal forces of magnitudes F N, 13 N and 10 N act at a fixed point O and are in equilibrium. The directions of the forces are as shown in the diagram. Find, in either order, the value of θ and the value of F. [5]

May/June 2009

3



Forces of magnitudes 7 N, 10 N and 15 N act on a particle in the directions shown in the diagram.

(i) Find the component of the resultant of the three forces

(a) in the x-direction,

(b) in the y-direction.

[3]

(ii) Hence find the direction of the resultant. [2]