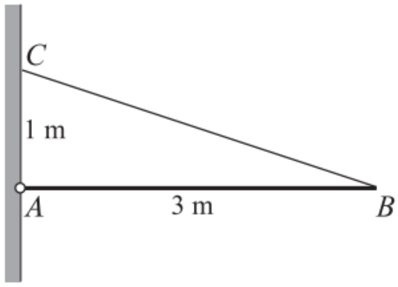
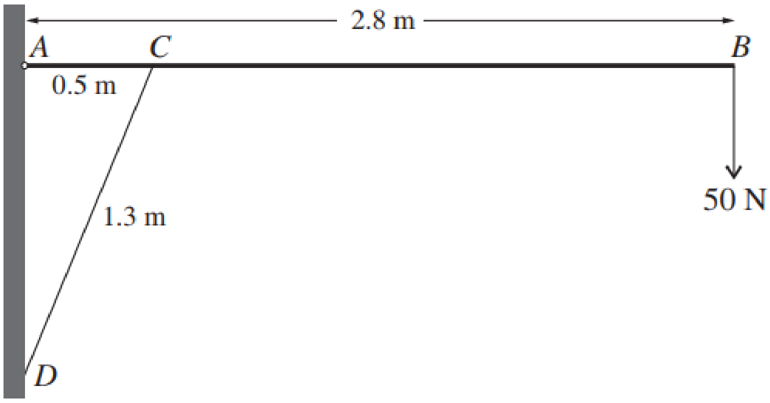
Moments in 2 Dimensions (From OCR 4729)

Q1, (Jan 2006, Q1)



A uniform rod AB has weight 20 N and length 3 m. The end A is freely hinged to a point on a vertical wall. The rod is held horizontally and in equilibrium by a light inextensible string. One end of the string is attached to the rod at B. The other end of the string is attached to a point C, which is 1 m directly above A (see diagram). Calculate the tension in the string. [4]

Q2, (Jun 2009, Q3)

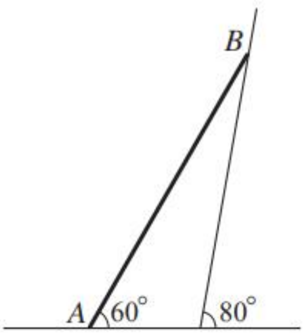


A uniform beam AB has weight 70 N and length 2.8 m. The beam is freely hinged to a wall at A and is supported in a horizontal position by a strut CD of length 1.3 m. One end of the strut is attached to the beam at C, 0.5 m from A, and the other end is attached to the wall at D, vertically below A. The strut exerts a force on the beam in the direction DC. The beam carries a load of weight 50 N at its end B (see diagram).

(i) Calculate the magnitude of the force exerted by the strut on the beam. **[4]**

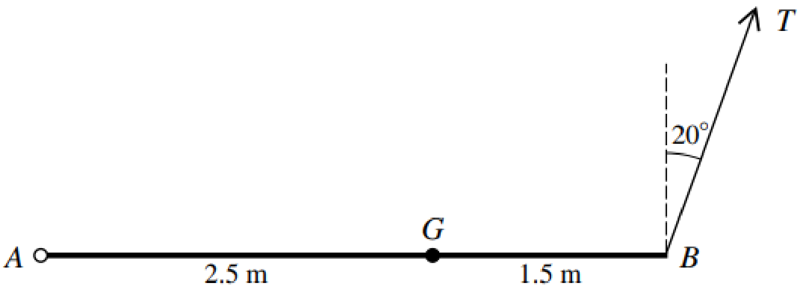
(ii) Calculate the magnitude of the force acting on the beam at A. **[6]**

Q3, (Jan 2008, Q3)



A uniform rod AB, of weight 25 N and length 1.6 m, rests in equilibrium in a vertical plane with the end A in contact with rough horizontal ground and the end B resting against a smooth wall which is inclined at 80° to the horizontal. The rod is inclined at 60° to the horizontal (see diagram). Calculate the magnitude of the force acting on the rod at B. [6]

Q4, (Jun 2010, Q4)

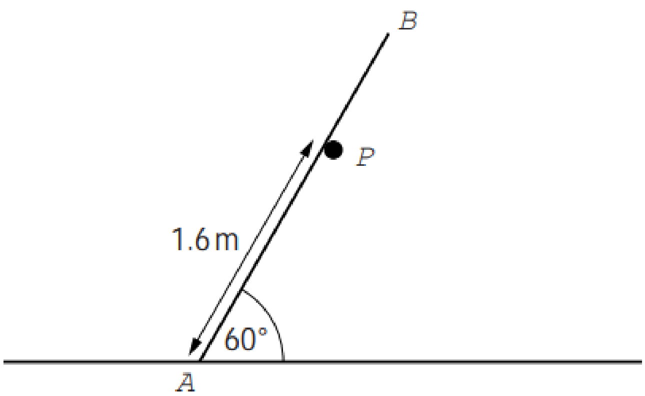


A non-uniform beam AB of length 4 m and mass 5 kg has its centre of mass at the point G of the beam where $AG = 2.5$ m. The beam is freely suspended from its end A and is held in a horizontal position by means of a wire attached to the end B. The wire makes an angle of 20° with the vertical and the tension is T N (see diagram).

(i) Calculate T. **[3]**

(ii) Calculate the magnitude and the direction of the force acting on the beam at A. **[7]**

Q5, (Jan 2012, Q3)

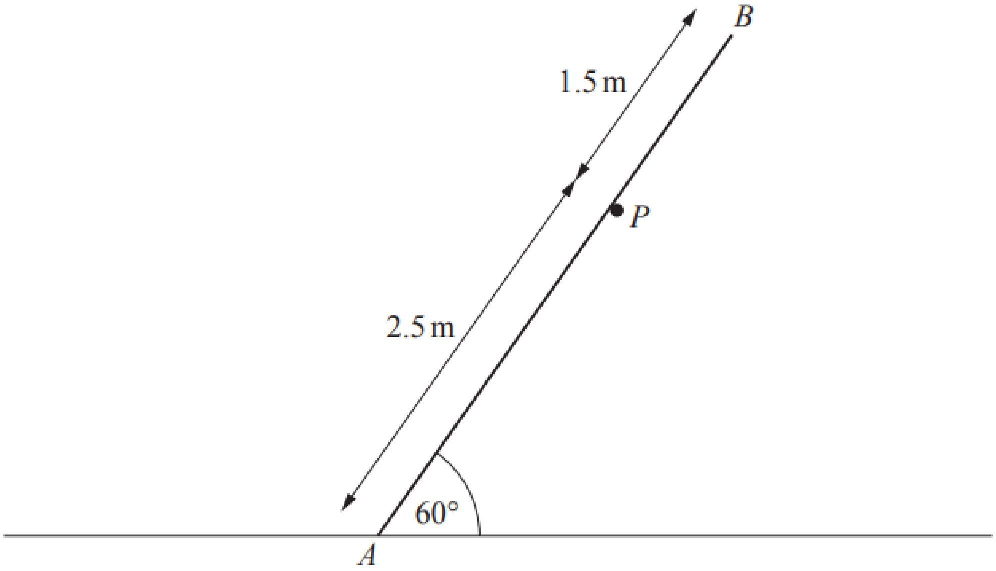


A uniform rod AB of mass 10 kg and length 2.4 m rests with A on rough horizontal ground. The rod makes an angle of 60° with the horizontal and is supported by a fixed smooth peg P. The distance AP is 1.6 m (see diagram).

(i) Calculate the magnitude of the force exerted by the peg on the rod. **[3]**

(ii) Find the least value of the coefficient of friction between the rod and the ground needed to maintain equilibrium. **[5]**

Q6, (Jan 2013, Q5)

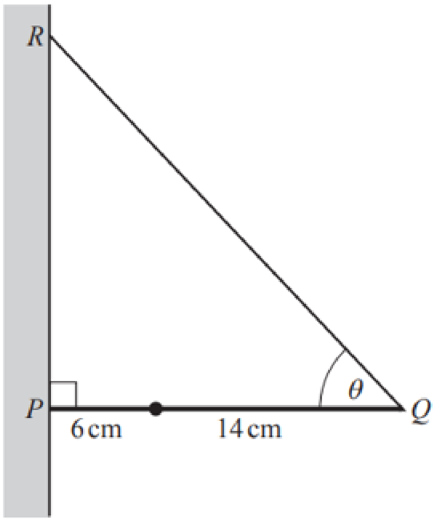


A uniform rod AB, of mass 3 kg and length 4 m, is in limiting equilibrium with A on rough horizontal ground. The rod is at an angle of 60° to the horizontal and is supported by a small smooth peg P, such that the distance AP is 2.5 m (see diagram). Find

(i) the force acting on the rod at P, **[3]**

(ii) the coefficient of friction between the ground and the rod. **[5]**

Q7, (Jun 2014, Q4)



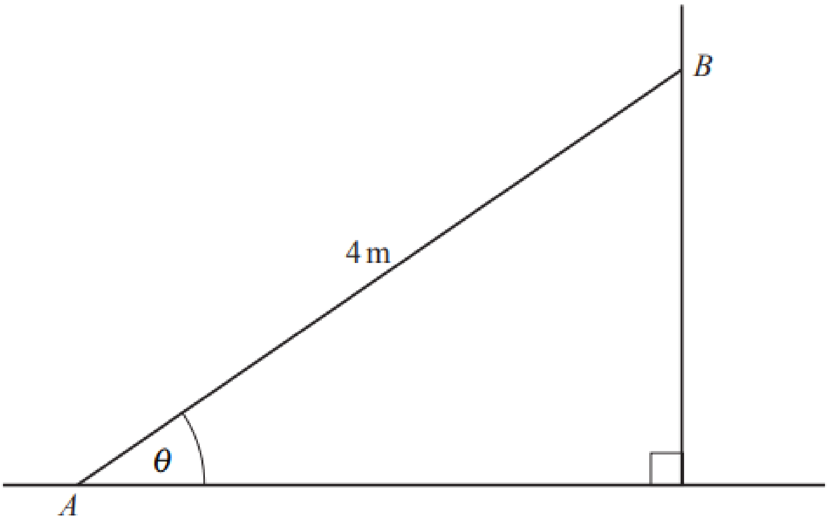
A uniform rod PQ has weight 18 N and length 20 cm. The end P rests against a rough vertical wall. A particle of weight 3 N is attached to the rod at a point 6 cm from P. The rod is held in a horizontal position, perpendicular to the wall, by a light inextensible string attached to the rod at Q and to a point R on the wall vertically above P, as shown in the diagram. The string is inclined at an angle θ to the horizontal, where $\sin\theta = \frac{3}{5}$. The system is in limiting equilibrium.

(i) Find the tension in the string. **[3]**

(ii) Find the magnitude of the force exerted by the wall on the rod. **[4]**

(iii) Find the coefficient of friction between the wall and the rod. **[2]**

Q8, (Jun 2015, Q7)



A uniform ladder AB of weight W N and length 4 m rests with its end A on rough horizontal ground and its end B against a smooth vertical wall. The ladder is inclined at an angle θ to the horizontal where $\tan\theta = \frac{1}{2}$ (see diagram). A small object S of weight $2W$ N is placed on the ladder at a point C, which is 1 m from A. The coefficient of friction between the ladder and the ground is μ and the system is in limiting equilibrium.

(i) Show that $\mu = \frac{2}{3}$. **[6]**

A small object of weight aW N is placed on the ladder at its mid-point and the object S of weight $2W$ N is placed on the ladder at its lowest point A.

(ii) Given that the system is in equilibrium, find the set of possible values of a. **[5]**