

**Edexcel (U.K.) Pre 2017**

**Questions By Topic**

**M2 Chap05 Statics**

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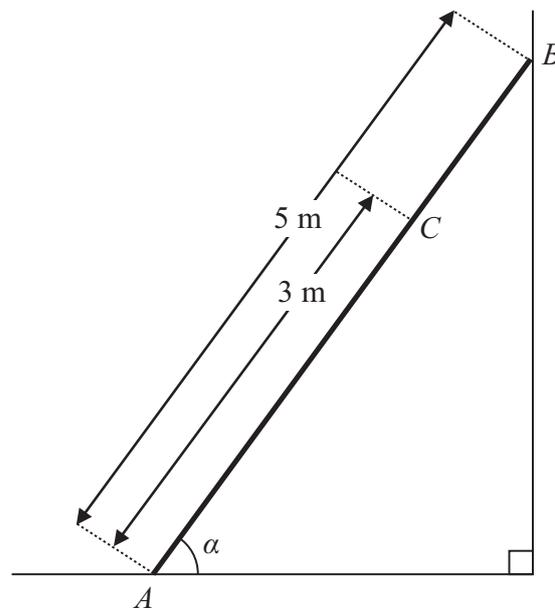


Figure 1

A ladder, of length 5 m and mass 18 kg, has one end  $A$  resting on rough horizontal ground and its other end  $B$  resting against a smooth vertical wall. The ladder lies in a vertical plane perpendicular to the wall and makes an angle  $\alpha$  with the horizontal ground, where  $\tan \alpha = \frac{4}{3}$ , as shown in Figure 1. The coefficient of friction between the ladder and the ground is  $\mu$ . A woman of mass 60 kg stands on the ladder at the point  $C$ , where  $AC = 3$  m. The ladder is on the point of slipping. The ladder is modelled as a uniform rod and the woman as a particle.

Find the value of  $\mu$ .

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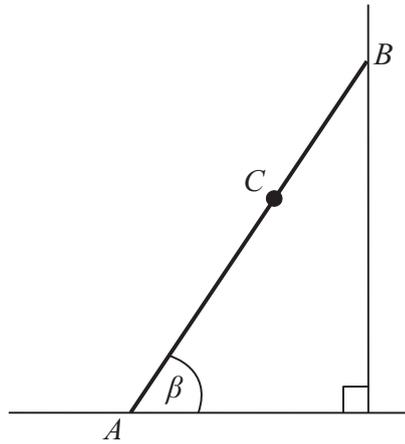


Figure 1

Figure 1 shows a ladder  $AB$ , of mass 25 kg and length 4 m, resting in equilibrium with one end  $A$  on rough horizontal ground and the other end  $B$  against a smooth vertical wall. The ladder is in a vertical plane perpendicular to the wall. The coefficient of friction between the ladder and the ground is  $\frac{11}{25}$ . The ladder makes an angle  $\beta$  with the ground. When Reece, who has mass 75 kg, stands at the point  $C$  on the ladder, where  $AC = 2.8$  m, the ladder is on the point of slipping. The ladder is modelled as a uniform rod and Reece is modelled as a particle.

- (a) Find the magnitude of the frictional force of the ground on the ladder. (3)
- (b) Find, to the nearest degree, the value of  $\beta$ . (6)
- (c) State how you have used the modelling assumption that Reece is a particle. (1)

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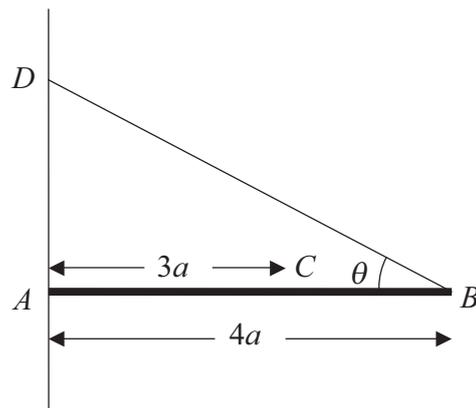




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Figure 2



A horizontal uniform rod  $AB$  has mass  $m$  and length  $4a$ . The end  $A$  rests against a rough vertical wall. A particle of mass  $2m$  is attached to the rod at the point  $C$ , where  $AC = 3a$ . One end of a light inextensible string  $BD$  is attached to the rod at  $B$  and the other end is attached to the wall at a point  $D$ , where  $D$  is vertically above  $A$ . The rod is in equilibrium in a vertical plane perpendicular to the wall. The string is inclined at an angle  $\theta$  to the horizontal, where  $\tan \theta = \frac{3}{4}$ , as shown in Figure 2.

- (a) Find the tension in the string. (5)
- (b) Show that the horizontal component of the force exerted by the wall on the rod has magnitude  $\frac{8}{3}mg$ . (3)

The coefficient of friction between the wall and the rod is  $\mu$ . Given that the rod is in limiting equilibrium,

- (c) find the value of  $\mu$ . (4)

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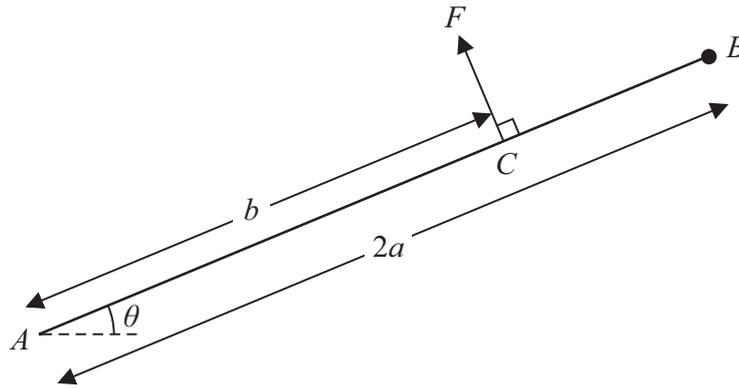


Figure 3

A uniform rod  $AB$ , of mass  $m$  and length  $2a$ , is freely hinged to a fixed point  $A$ . A particle of mass  $m$  is attached to the rod at  $B$ . The rod is held in equilibrium at an angle  $\theta$  to the horizontal by a force of magnitude  $F$  acting at the point  $C$  on the rod, where  $AC = b$ , as shown in Figure 3. The force at  $C$  acts at right angles to  $AB$  and in the vertical plane containing  $AB$ .

(a) Show that  $F = \frac{3amg \cos \theta}{b}$ . (4)

(b) Find, in terms of  $a$ ,  $b$ ,  $g$ ,  $m$  and  $\theta$ ,

(i) the horizontal component of the force acting on the rod at  $A$ ,

(ii) the vertical component of the force acting on the rod at  $A$ .

(5)

Given that the force acting on the rod at  $A$  acts along the rod,

(c) find the value of  $\frac{a}{b}$ . (4)

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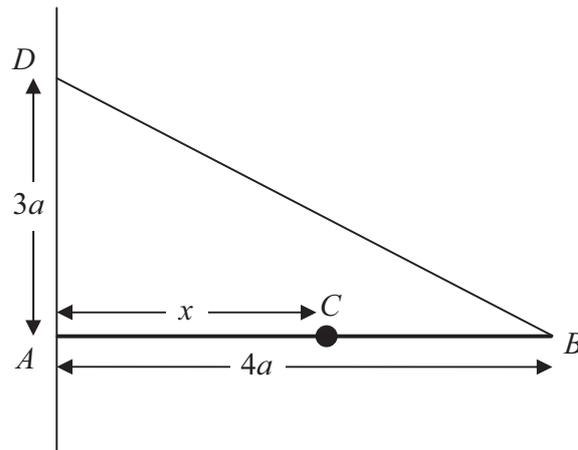


Figure 3

A uniform rod  $AB$ , of mass  $3m$  and length  $4a$ , is held in a horizontal position with the end  $A$  against a rough vertical wall. One end of a light inextensible string  $BD$  is attached to the rod at  $B$  and the other end of the string is attached to the wall at the point  $D$  vertically above  $A$ , where  $AD = 3a$ . A particle of mass  $3m$  is attached to the rod at  $C$ , where  $AC = x$ . The rod is in equilibrium in a vertical plane perpendicular to the wall as shown in Figure 3. The tension in the string is  $\frac{25}{4}mg$ .

Show that

(a)  $x = 3a$ , (5)

(b) the horizontal component of the force exerted by the wall on the rod has magnitude  $5mg$ . (3)

The coefficient of friction between the wall and the rod is  $\mu$ . Given that the rod is about to slip,

(c) find the value of  $\mu$ . (5)

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