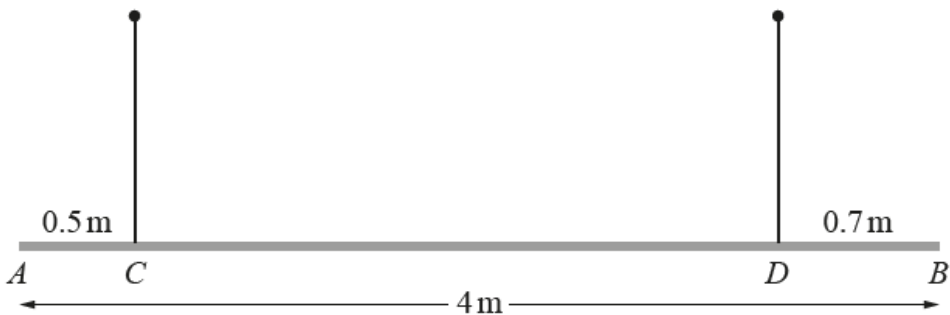**Moments – 2021/20 GCE Mechanics Mathematics A**

1. Nov/2021/Paper_H240/03/No.12

A beam, AB, has length $4\,m$ and mass $20\,kg$. The beam is suspended horizontally by two vertical ropes. One rope is attached to the beam at C, where $AC = 0.5\,m$. The other rope is attached to the beam at D, where $DB = 0.7\,m$ (see diagram).

The beam is modelled as a non-uniform rod and the ropes as light inextensible strings.

It is given that the tension in the rope at C is three times the tension in the rope at D.

(a) Determine the distance of the centre of mass of the beam from A. **[5]**

A particle of mass $m\,kg$ is now placed on the beam at a point where the magnitude of the moment of the particle's weight about C is $3.5mg\,N\,m$. The beam remains horizontal and in equilibrium.

(b) Determine the largest possible value of m. **[2]**

2. Nov/2020/Paper_H240/03/No.10
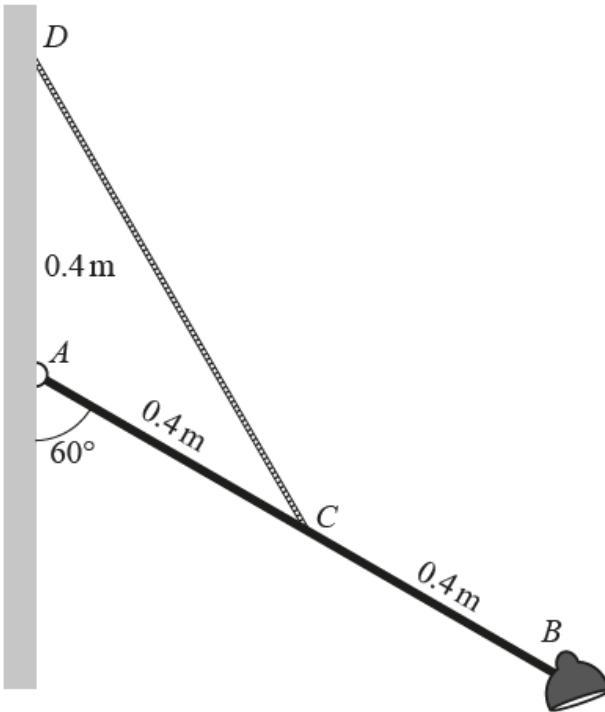
The diagram shows a wall-mounted light. It consists of a rod AB of mass $0.25\,\text{kg}$ and length $0.8\,\text{m}$ which is freely hinged to a vertical wall at A, and a lamp of mass $0.5\,\text{kg}$ fixed at B. The system is held in equilibrium by a chain CD whose end C is attached to the midpoint of AB. The end D is fixed to the wall a distance $0.4\,\text{m}$ vertically above A. The rod AB makes an angle of $60°$ with the downward vertical.

The chain is modelled as a light inextensible string, the rod is modelled as uniform and the lamp is modelled as a particle.

(a) By taking moments about A, determine the tension in the chain. **[4]**

(b) (i) Determine the magnitude of the force exerted on the rod at A. **[4]**

   (ii) Calculate the direction of the force exerted on the rod at A. **[2]**

(c) Suggest one improvement that could be made to the model to make it more realistic. **[1]**