1. Centres of Mass (Non-Uniform Bodies)

The mass of a non-uniform rigid body can be modelled as acting at its centre of mass.

Example

Sam and Tasmin are sitting on a non-uniform plank AB, of mass 28kg and length 5m. The plank is pivoted at M, the midpoint of AB. The centre of mass of AB is at C, where AC is 2.2m. Sam has mass 40kg. Tasmin has mass 35kg and sits at A. Where must Sam sit for the plank to be horizontal?

*Make sure that you put all the forces on the diagram.*

Example

Two sand bags of masses 7kg and 3kg are placed on the ends of a non-uniform rod PQ, of mass 8kg and length 4m, with the 7kg mass placed at P.

The rod rests in equilibrium on the edge of a smooth table, with half of the rod lying on the table's surface. Find the distance of the centre of mass from the edge of the table and the reaction force of the table on the rod.

If the rod were to tilt, where would it pivot? This will be where the reaction of the table on the rod is positioned.
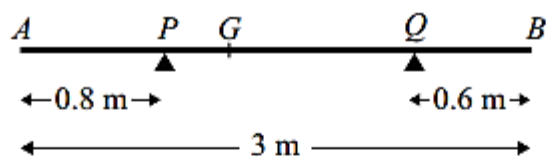
Figure 1

A non-uniform rod AB has length 3 m and mass 4.5 kg. The rod rests in equilibrium, in a horizontal position, on two smooth supports at P and at Q, where $AP = 0.8$ m and $QB = 0.6$ m, as shown in Figure 1. The centre of mass of the rod is at G. Given that the magnitude of the reaction of the support at P on the rod is twice the magnitude of the reaction of the support at Q on the rod, find

(a) the magnitude of the reaction of the support at Q on the rod,

(3)

(b) the distance AG.

(4)

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