Section 1: The moment of a force

Exercise level 3 (Extension)

1. A horizontal plank has two particles, of masses m_1 and m_2, resting upon it distant respectively x and y from one end. Let P be a general point, a distance a from the same end.
   (i) Find an expression for the total moment of weight due to the two masses about the point P.
   (ii) Find an expression for a that gives minimum magnitude of that moment. Show that the point P_0 of minimum moment is always between the resting points of the two masses.

2. Paula and Quentin have masses 60 and 90 kg respectively. They stand on a rigid uniform plank AB, of length 6 metres and mass 20 kg, supported on two trestles H and K, as shown in the diagram. AH = 1 metre, and BK = 1 metre.

   (i) Paula stands right at the end B and Quentin stands midway between H and K. Find the reactions at the trestles H and K.
   (ii) Is it possible for Quentin to move slowly towards and reach trestle K while the plank remains horizontal?
   (iii) Now the trestle at H is moved so that it is at the midpoint of the plank. Paula again stands at end B. Determine the region of the plank where Quentin can stand so that the plank may remain horizontal.

3. The diagram shows a uniform plank which rests horizontally on a garden fence and maintains contact under a horizontal rail. The coefficient of friction between the plank and the top of the fence is μ_1 and between the plank and the rail is μ_2. The plank is of length 2 metres, it projects 20 cm beyond the rail and the distance between fence and rail is 30 cm. The weight of the plank is 40 N.

   (i) Find the horizontal force just sufficient to move the plank to the left.
   (ii) Once the plank begins to move, is the force just sufficient to continue to move it increased or decreased?