A uniform rod AB has length 2a and weight W. The end A rests on rough horizontal ground and the end B rests against a smooth vertical wall. The rod is in a vertical plane that is perpendicular to the wall. The angle between the rod and the horizontal is  $\theta$ . A particle of weight 5W hangs from the rod at the point C, with AC = xa, where 0 < x < 1.

(i) By taking moments about A, show that the magnitude of the normal reaction at B is  $\frac{W(5x+1)}{2\tan\theta}$ .

The particle of weight 5W is now moved a distance a up the rod, so that AC = (x+1)a. This results in the magnitude of the normal reaction at B being double its previous value. The system remains in equilibrium with the rod at angle  $\theta$  with the horizontal.

(ii) Show that 
$$x = \frac{4}{5}$$
. [3]

The coefficient of friction between the rod and the ground is  $\frac{2}{3}$ .

(iii) Given that the rod is about to slip when the particle of weight 5W is in its second position, find the value of  $\tan \theta$ .