











6.

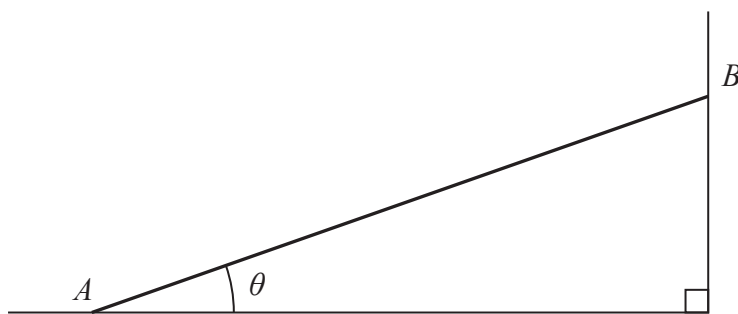


Figure 3

A rod  $AB$  has mass  $M$  and length  $2a$ .

The rod has its end  $A$  on rough horizontal ground and its end  $B$  against a smooth vertical wall.

The rod makes an angle  $\theta$  with the ground, as shown in Figure 3.

The rod is at rest in limiting equilibrium.

(a) State the direction (left or right on Figure 3 above) of the frictional force acting on the rod at  $A$ . **Give a reason for your answer.**

(1)

The magnitude of the normal reaction of the wall on the rod at  $B$  is  $S$ .

In an initial model, the rod is modelled as being **uniform**.

**Use this initial model to answer parts (b), (c) and (d).**

(b) By taking moments about  $A$ , show that

$$S = \frac{1}{2} Mg \cot \theta \quad (3)$$

The coefficient of friction between the rod and the ground is  $\mu$

Given that  $\tan \theta = \frac{3}{4}$

(c) find the value of  $\mu$

(5)

(d) find, in terms of  $M$  and  $g$ , the magnitude of the resultant force acting on the rod at  $A$ .

(3)

In a new model, the rod is modelled as being **non-uniform**, with its centre of mass closer to  $B$  than it is to  $A$ .

A new value for  $S$  is calculated using this new model, with  $\tan \theta = \frac{3}{4}$

(e) State whether this new value for  $S$  is larger, smaller or equal to the value that  $S$  would take using the initial model. **Give a reason for your answer.**

(1)