



A uniform cylinder with a rough surface and of radius  $a$  is fixed with its axis horizontal. Two identical uniform rods  $AB$  and  $BC$ , each of weight  $W$  and length  $2a$ , are rigidly joined at  $B$  with  $AB$  perpendicular to  $BC$ . The rods rest on the cylinder in a vertical plane perpendicular to the axis of the cylinder with  $AB$  at an angle  $\theta$  to the horizontal.  $D$  and  $E$  are the midpoints of  $AB$  and  $BC$  respectively and also the points of contact of the rods with the cylinder (see diagram). The rods are about to slip in a clockwise direction. The coefficient of friction between each rod and the cylinder is  $\mu$ .

The normal reaction between  $AB$  and the cylinder is  $R$  and the normal reaction between  $BC$  and the cylinder is  $N$ .

(a) Find the ratio  $R : N$  in terms of  $\mu$ .

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(b) Given that  $\mu = \frac{1}{3}$ , find the value of  $\tan \theta$ . [3]

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