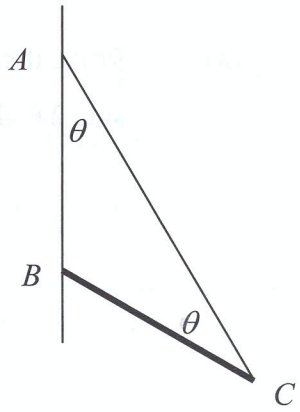
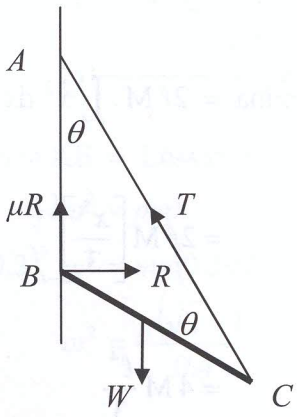
2011

7. (b) A uniform rod BC, of length $2p$ and weight W, rests in equilibrium with B in contact with a rough vertical wall.
One end of a light inextensible string is fixed to a point A on the wall vertically above B, the other end is attached to C.



The coefficient of friction between the rod and the wall is μ.

If $|\angle CAB| = |\angle BCA| = \theta$, prove that $\mu \geq \tan\theta$.



$$T\sin\theta(2p) = W\sin 2\theta(p)$$
$$T\sin\theta(2p) = W2\sin\theta\cos\theta(p)$$
$$T = W\cos\theta \qquad 5$$

$$R = T\sin\theta \qquad 5$$

$$\mu R + T\cos\theta = W \qquad 5$$

$$\mu T\sin\theta + T\cos\theta = \frac{T}{\cos\theta}$$
$$\mu\sin\theta = \frac{1}{\cos\theta} - \cos\theta = \frac{1-\cos^2\theta}{\cos\theta} \qquad 5$$
$$\mu\sin\theta = \sin\theta\tan\theta$$
$$\mu = \tan\theta$$

$$\Rightarrow \mu \geq \tan\theta \qquad 5$$

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