

6.

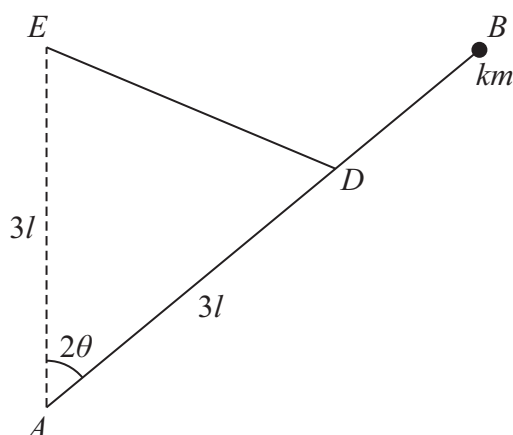


Figure 2

A uniform rod AB has mass $4m$ and length $4l$. The rod can turn freely in a vertical plane about a fixed smooth horizontal axis through A . A particle of mass km , where $k < 7$, is attached to the rod at B . One end of a light elastic string, of natural length l and modulus of elasticity $4mg$, is attached to the point D of the rod, where $AD = 3l$. The other end of the string is attached to a fixed point E which is vertically above A , where $AE = 3l$, as shown in Figure 2. The angle between the rod and the upward vertical is 2θ , where $\arcsin\left(\frac{1}{6}\right) < \theta \leq \frac{\pi}{2}$.

(a) Show that, while the string is stretched, the potential energy of the system is

$$8mgl\{(7 - k)\sin^2 \theta - 3 \sin \theta\} + \text{constant} \tag{6}$$

There is a position of equilibrium with $\theta \leq \frac{\pi}{6}$.

(b) Show that $k \leq 4$ (5)

Given that $k = 4$,

(c) show that this position of equilibrium is stable. (5)



