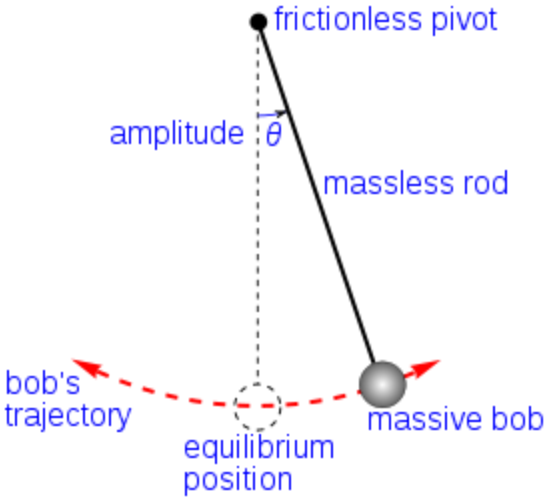
Answer on Question #43416, Physics, Other

A 2.85 m long pendulum has a 5.60 kg bob. The bob is pulled to the right and given a push back towards its rest position so that when the bob passes through its rest position, its kinetic energy is 85 J. If when the pendulum bob passes through a position that is at a distance of d m to the rights of its rest position, it has a kinetic energy of 35 J. The value of d is?

Solution:



I will assume that the distance r is measured along the path of the pendulum - rather than directly from the rest position (=lowest position) to the final position at d.

The total mechanical energy (ME) of a body, is the sum of its kinetic energy (KE) and its gravitational potential energy (PE):

$$\text{ME} = \text{KE} + \text{PE} = \text{constant}$$

Energy is conserved, so the

$$KE_{initial} = KE_{final} + PE_{final}$$

where $KE_{initial}$ = 85J and KE_{final} = 35J.

What is the potential energy at d?

Well, the angle cosα from the vertical is d / L, so the height above rest position is L * cos (α), and the change in potential energy is mass * gravity * height

Thus,

$$PE_{final} = KE_{initial} - KE_{final}$$

$$mgh = 85 - 35 = 50 \text{ J}$$

$$h = \frac{KE_{initial} - KE_{final}}{mg} = \frac{50}{5.6 \cdot 9.8} = 0.911 \text{ m}$$

$$h = Lcos\left(\frac{d}{L}\right)$$

$$d = L\cos^{-1}\left(\frac{h}{L}\right) = 2.85 \cdot \cos^{-1}\left(\frac{0.911}{2.85}\right) = 3.55 \text{ m}$$

Answer: $d = 3.55$ m.