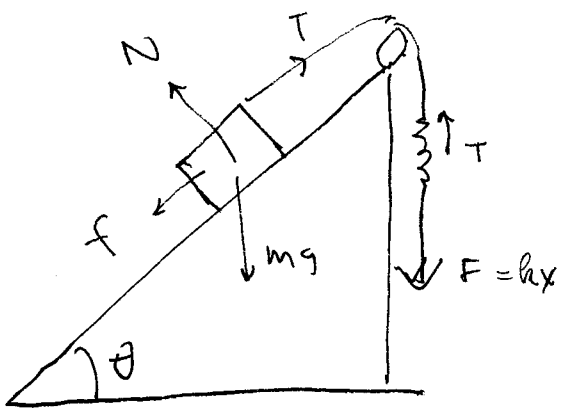
PHY 247 HW# 7 Solutions

7-25



Force acting on block

$$ma = T - mg\sin\theta - f$$

$$= T - mg\sin\theta - \mu mg\cos\theta$$

Force acting on spring

$$T = kx = F$$

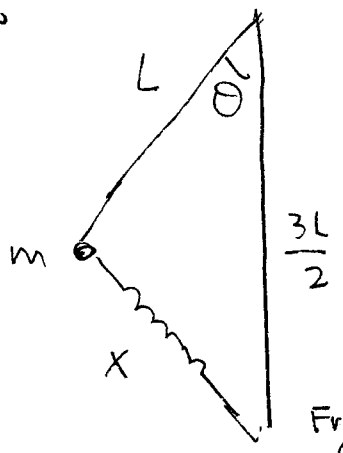
If $a = 0$

$$\Rightarrow T = mg\sin\theta + \mu mg\cos\theta = kx$$

$$\Rightarrow x = \frac{mg\sin\theta + \mu mg\cos\theta}{k}$$

$$\Rightarrow \boxed{U = \frac{kx^2}{2} = \frac{(mg\sin\theta + \mu mg\cos\theta)^2}{2k}}$$

7-41



Energy conservation ⇒

$$E = mgL(1-\cos\theta) + \frac{1}{2}k\left(x-\frac{L}{2}\right)^2 = K$$

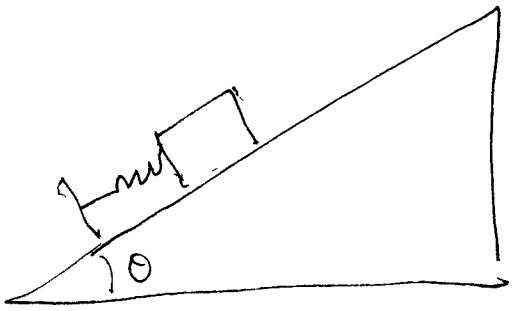
From figure: $X^2 = \left(\frac{3L}{2}\right)^2 + L^2 - 2L\frac{3L}{2}\cos\theta$

$$\Rightarrow \quad K = mgL(1-\cos\theta) + \frac{1}{2}k\left(\sqrt{\frac{13L^2}{4} - 3L^2\cos\theta} - \frac{L}{2}\right)^2$$

$$\Rightarrow \quad \frac{1}{2}mv^2 = mgL(1-\cos\theta) + \frac{1}{2}k\left(\sqrt{\frac{13L^2}{4} - 3L^2\cos\theta} - \frac{L}{2}\right)^2$$

$$\Rightarrow \quad v = \left[2gL(1-\cos\theta) + \frac{kL^2}{m}\left(\sqrt{\frac{13}{4} - 3\cos\theta} - \frac{1}{2}\right)^2\right]^{\frac{1}{2}}$$

7-74



X= compression length

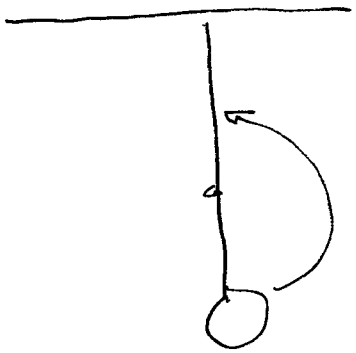
Conservation of energy ⇒

$$mgh = \frac{1}{2}kx^2 - mg\,x\sin\theta$$

$$x^2 - \frac{2mg\sin\theta}{k}x - \frac{2mgh}{k} = 0$$

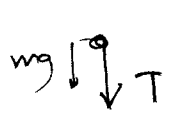
$$x = \frac{1}{2}\left[\frac{2mg\sin\theta}{k} + \sqrt{\left(\frac{2mg\sin\theta}{k}\right)^2 + \frac{8mgh}{k}}\right]$$

7-85



Conservation of energy $\Rightarrow$

$$mgL = \frac{1}{2}mv^2 + 2mgR$$

At apex, $\frac{mv^2}{R} = T + mg$ 

with $T > 0$ to make it over top

$\therefore \quad mv^2 > mgR$

Hence $mgL > \frac{1}{2}mgR + 2mgR = \frac{5}{2}mgR$

$\Rightarrow$ $\boxed{R < \frac{2}{5}L}$