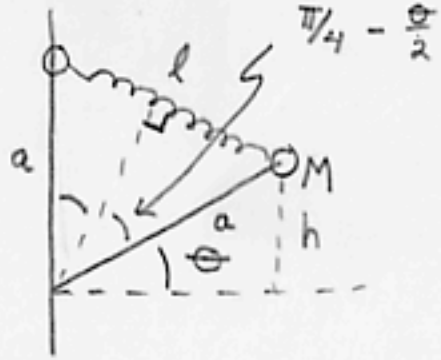

a) $L = T - V$

$T = \frac{1}{2} M (a\dot{\theta})^2$

$V = V_{gravity} + V_{spring}$

$V_{gravity} = Mgh = Mga\sin\theta$, $V_{spring} = \frac{1}{2} k (l - l_0)^2$. From geometry,

$l/2 = a\sin(\pi/4 - \frac{\theta}{2}) \Rightarrow l = 2a\sin(\pi/4 - \frac{\theta}{2})$. Therefore,

$V_{spring} = \frac{1}{2} k \left[2a\sin(\pi/4 - \frac{\theta}{2}) - l_0 \right]^2$. Consequently, L is given by

$$\boxed{L = \frac{1}{2} M (a\dot{\theta}^2) - Mga\sin\theta - \frac{1}{2} k \left[2a\sin(\pi/4 - \frac{\theta}{2}) - l_0 \right]^2}$$

The equation of motion is $\frac{d}{dt}\frac{\partial L}{\partial \dot{\theta}} - \frac{\partial L}{\partial \theta} = 0$.

$\frac{\partial L}{\partial \dot{\theta}} = Ma^2\dot{\theta}$, $\frac{d}{dt}\frac{\partial L}{\partial \dot{\theta}} = Ma^2\ddot{\theta}$.