$$\frac{\partial L}{\partial \theta} = -Mga\cos\theta - k\left[2a\sin\left(\pi/4 - \frac{\theta}{2}\right) - l_0\right] 2a\cos\left(\pi/4 - \frac{\theta}{2}\right)\left(-\frac{1}{2}\right).$$

So the equation of motion becomes

$$\boxed{Ma^2\ddot{\theta} + Mga\cos\theta - ka\cos\left(\pi/4 - \frac{\theta}{2}\right)\left[2a\sin\left(\pi/4 - \frac{\theta}{2}\right) - l_0\right] = 0}$$

Assume $\theta = \theta_0$ is an equilibrium solution. Then one must have

$$\boxed{Mga\cos\theta_0 - ka\cos(\pi/4 - \theta_0/2)\left[2a\sin(\pi/4 - \theta_0/2) - l_0\right] = 0}$$

Work on this eqn to solve for θ_0. One finds

$$\begin{aligned} Mga\cos\theta_0 &= 2ka^2\sin(\pi/4 - \theta_0/2)\cos(\pi/4 - \theta_0/2) - kal_0\cos(\pi/4 - \theta_0/2) \\ &= ka^2\sin(\pi/2 - \theta_0) - kal_0\cos(\pi/4 - \theta_0/2) \\ &= ka^2\cos\theta_0 - kal_0\cos(\pi/4 - \theta_0/2) \quad \Rightarrow \end{aligned}$$

$$(Mga - ka^2)\cos\theta_0 = -kal_0\cos(\pi/4 - \theta_0/2).$$