Refer class slides

$$L = PE - KE$$

Eqn of motion

$$\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{p}}\right) - \frac{\partial L}{\partial p} = 0$$

for pendulum

$$P = \begin{bmatrix} l\sin\theta \\ -l\cos\theta \end{bmatrix} \Rightarrow KE = \frac{1}{2} m \|\dot{P}\|^2$$

$$L = \frac{1}{2} m l^2 \dot{\theta}^2 + mgl\cos\theta$$