Classical Mechanics: Assignment #1

Due 11th September 2018

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Problem 1

Solution

The Lagrangian for the given system can be written as,

$$L = T + V = \frac{1}{2}mx^2\omega^2 + \frac{1}{2}m\left(\dot{x}^2 + \dot{y}^2\right) - mgy$$

From the problem, we know that $y = k\left(\frac{x}{l}\right)^\alpha$, which means that $\dot{y} = k\alpha\frac{x^{\alpha-1}}{l^\alpha}\dot{x}$. Substituting these into the form of the Lagrangian and simplifying, we get,

$$L = \frac{1}{2}m\left(-2gk\left(\frac{x}{l}\right)^\alpha + \dot{x}^2\left(\frac{\alpha^2k^2x^{2\alpha-2}}{l^\alpha} + 1\right) + x^2\omega^2\right)$$