
1. Please use a separate sheet of paper to show your work.

The goal of this homework is to find the equation of motion for the simple pendulum using both the Newtonian and Lagrangian methods.

- a. Develop the equation of motion for the simple pendulum,

$$ml\ddot{\theta} = -mg \sin(\theta)$$

using Newtonian methods. Start from Newton's Second Law.

- b. Use the Lagrangian method developed in tutorial to find the equation of motion for the simple pendulum:

- i. How many generalized coordinates are needed? What is/are the most appropriate coordinate(s)?
- ii. Write the kinetic and potential energies in terms of the generalized coordinate. If you get stuck, try writing the energies in x and y coordinates, then convert to your generalized coordinate(s), as in the tutorial *Generalized coordinates*.
- iii. Write the Lagrangian $L = T - V$.

- iv. Find the equation of motion using $\frac{d}{dt} \left(\frac{\partial L}{\partial \dot{q}_i} \right) - \frac{\partial L}{\partial q_i} = 0$.