Module 4 - Energy Methods

ME3050 - Dynamics Modeling and Controls

Mechanical Engineering

Tennessee Technological University

Topic 3 - Example: Swinging Pendulum

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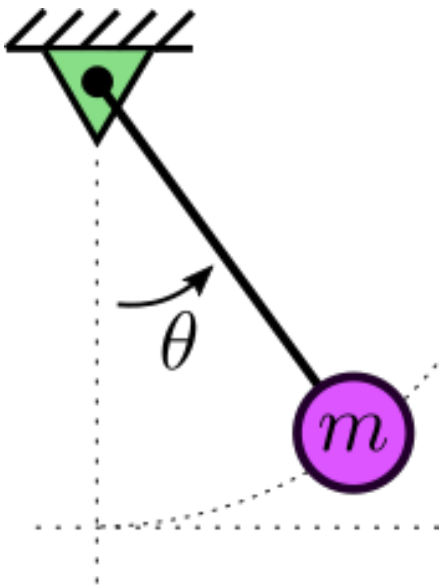
- Model Description and Assumptions
- Sketches and FBDs
- Kinetic and Potential Energies
- Apply Convervation of Energy
- Standard Form of EOM

Model Description and Assumptions

Model:

A Swinging Pendulum



Description:

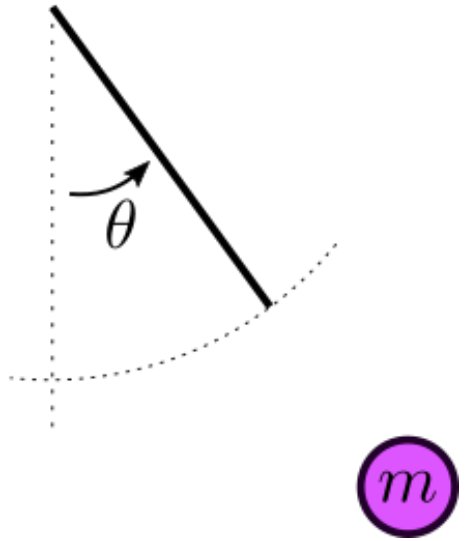
A mass is suspended by a rigid link from a pin.

Assumptions:

- the mass is treated as a point mass
- the link is rigid aand mass-less
- the pin is frictionless
- the air drag is negligable

Sketches and FBDs

First *separate* the bodies of interest to draw a **free** body diagram.



Also, choose a zero-pontential reference.

Kinetic and Potential Energies

Now, identify all kinetic and potential energies present.

Kinetic Energy

Potential Energy

Apply Convervation of Energy

Apply the conservation of energy.

$$\frac{d}{dt}\left(KE + PE\right) = \frac{d}{dt}\left(Constant\right) = 0$$

Standard Form of EOM

Finally Re-arrange the resulting equation to get the equations of motion in a standard form.