Upcoming deadlines

- Homework assignment 2 is due at the beginning of class on Thursday.
- Reading assignment (sections 2.1-2.4) and warm-up quiz due next Tuesday.
- Today: Activity 5 (which is the same as problem 4 from homework 2) and activity 6 (Lagrangian, Lagrange's Equation, ignorable coordinates, constants of motion)

Cyclic coordinates

$$L = \frac{1}{2} m(\dot{\mathrm{x}}^2 + \dot{y}^2 + \dot{z}^2)$$

$$L = \frac{1}{2} m(\dot{\mathrm{x}}^2 + \dot{y}^2 + \dot{z}^2) - mgz$$

$$L = \frac{1}{2} I\dot{\theta}^2$$

$$L = \frac{1}{2} ml^2\left(\dot{\theta}^2 + sin^2\theta\ \dot{\phi}^2\right) - mgl\cos\theta$$

$$L = \frac{1}{2} m\left(\dot{\mathrm{r}}^2 + r^2\dot{\theta}^2\right) + GmM/r^2$$

Cyclic coordinates

$L = \frac{1}{2}m(\dot{\mathrm{x}}^2 + \dot{y}^2 + \dot{z}^2)$ free particle

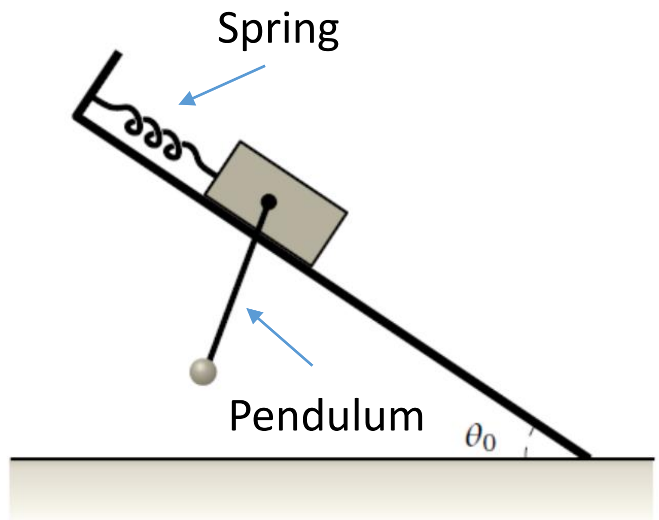
$L = \frac{1}{2}m(\dot{\mathrm{x}}^2 + \dot{y}^2 + \dot{z}^2) - mgz$ particle in a gravitational field

$L = \frac{1}{2}I\dot{\theta}^2$ freely rotating wheel

$L = \frac{1}{2}ml^2\left(\dot{\theta}^2 + sin^2\theta\ \dot{\phi}^2\right) - mgl\cos\theta$ spherical pendulum (exercise 1.21)

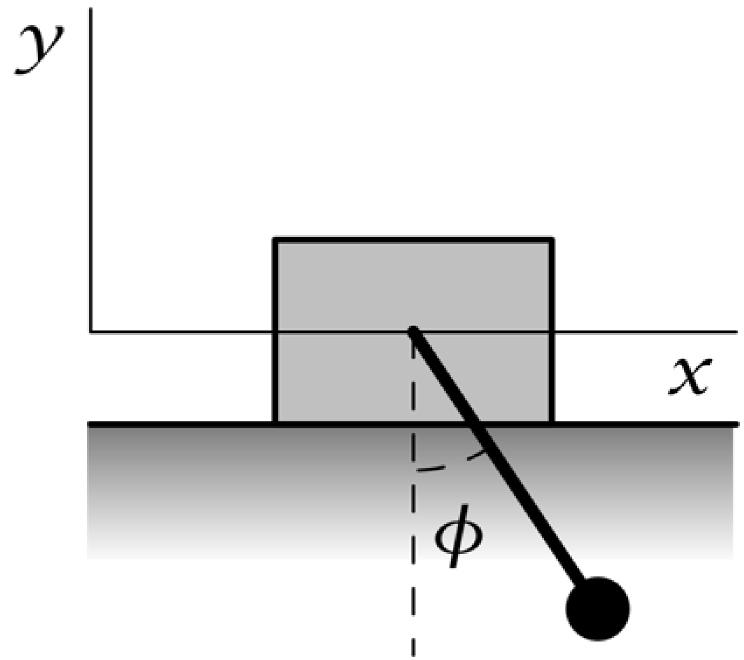
$L = \frac{1}{2}m\left(\dot{\mathrm{r}}^2 + r^2\dot{\theta}^2\right) + GmM/r^2$ planet orbiting a star (exercise 1.19)

Activity 5:



- How many degrees of freedom?
- How many independent variables required?
- Which ones make the problem simple?
- What are the equations of constraint?
- Lagrangian $L = T - V$, same strategy as for total energy
- Equations of motion by plugging the Lagrangian into the Lagrange equations $\frac{d}{dt}\frac{\partial L}{\partial \dot{q}_i} = \frac{\partial L}{\partial q_i}$
- One equation for each generalized coordinate

Activity 6:



- How many degrees of freedom does this system have?
- What generalized coordinates should we use?
- Can you predict which of these coordinates should be ignorable?
- Can you predict what they equation of motion should be if the mass of the block is much greater that the mass of the pendulum?