Lecture 17 Checkpoints

1. If two identical wheels, one spinning and one not, have the same zero CM velocity how can their total momentum \( \vec{p}_{\text{net}} = M\vec{v}_{CM} = 0 \) be the same when there are all kinds of pieces of the spinning wheel have nonzero velocities \( \vec{v}_i \)?

   Each \( m\vec{v}_i \) cancelled by rest. \( (z \vec{p}_i \vec{v}_i = 0) \)

   Can see pairwise cancellation - one side against the other

2. If a stick is thrown through the air (neglecting air friction), what is the curve of the stick’s CM trajectory no matter how much the stick is spun before it is thrown?

   a smooth parabola

3. If a uniform straight rod of length \( L \) is folded in half, what is the distance between its original CM and the new CM?

   \[
   \text{original } \frac{L}{4} \quad \text{new } \frac{L}{8} \Rightarrow \frac{L}{2} - \frac{L}{4} = \frac{L}{4}
   \]

4. What is the change in the gravitational potential of a uniform straight rod (mass \( M \), length \( L \)) after a rotation of angle \( \Delta \theta \) around some axis through its CM?

   \[
   \Delta U = Mg \Delta y_{CM} = 0 \quad \text{no matter what the axis,} \ \Delta \theta
   \]

5. Where is \((x_{CM}, y_{CM}, z_{CM})\) for the cubical box on p. 5 if the top WAS included?

   At center: \((20, 20, 20)\) in cm

6. Suppose their various weights are such that the canoe moves 1 foot in the negative x-direction relative to the log, while Ricardo moves 5 feet relative to the canoe in the positive x-direction, when he switches positions with Carmelita.

   a) How far does the overall CM move?

   \( \Delta x_{CM} = 0 \) (all internal forces only)

   b) How far does Carmelita move relative to the log as a result? This is just a relative coordinate question and, unlike HW 17-2, does not involve masses in its calculation.

   \[
   \Delta x_{CM/\log} = \Delta x_{CM/\text{canoe}} + \Delta x_{\text{canoe}/\log} = -6
   \]

   If we put our origin at the center of the big plate, where is \((x_{CM}, y_{CM})\) of a small plate if it were to fill the hole in HW 17-3?

   Read off HW 17-3:

   \[
   x_{CM} = +0.80R, \quad y_{CM} = 0
   \]

   Put an \( \times \) where the Neytiri-board overall CM is approximately. You’ll know \( x_{CM} \) exactly, but you’ll have to approximate \( y_{CM} \). (Note you only need \( x_{CM} \) and \( v_x \) in HW 17-4.)