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### Worksheet 16: Rotational Kinematics

1. A 45.0-kg woman stands up in a 60.0-kg canoe that is 5.00 m long. She walks from a point 1.00 m from one end to a point 1.00 m from the other end. Neglect drag from the water on the canoe.
  - a. If the woman walks a distance  $D$  relative to the canoe and the canoe moves a distance  $\Delta x$  relative to the shore, how far does the woman travel relative to the shore?
  - b. The center of mass of the woman + canoe is  $(m_1x_1 + m_2x_2)/(m_1 + m_2)$ , where the index 1 refers to the woman and 2 to the canoe. Tell me  $m_1$ ,  $m_2$ ,  $x_1$ , and  $x_2$  before and after the woman moves.
  - c. How far does the canoe move during this process?
  
- b. Relative to solid ground, how far does the woman move during this process?
  
2. Three 1-kg point masses are placed on a grid at positions  $(0, 0)$ ,  $(L, 0)$ , and  $(0, H)$ . What is the location of the center of mass of the three points?

3. A particle moves in a circular path of radius  $r$ .
  - a. What is its angular displacement  $\theta$  after 2.0 complete rotations?
  - b. What is its path length  $s$  after 2.0 complete rotations?
  - c. If it takes time  $t$  to complete 2.0 rotations, what is its average tangential speed  $v$ ?
  - d. If it takes time  $t$  to complete 2.0 rotations, what is its average angular speed  $\omega$ ?
  
4. A solid sphere with radius 7.50 cm and a mass of 13.2 kg rolls without slipping at a translational speed of 2.50 m/s.
  - a. What is its rotational speed?
  - b. What is its translational kinetic energy?
  - c. What is its moment of inertia?
  - d. What is its rotational kinetic energy?
  - e. What is its total kinetic energy?