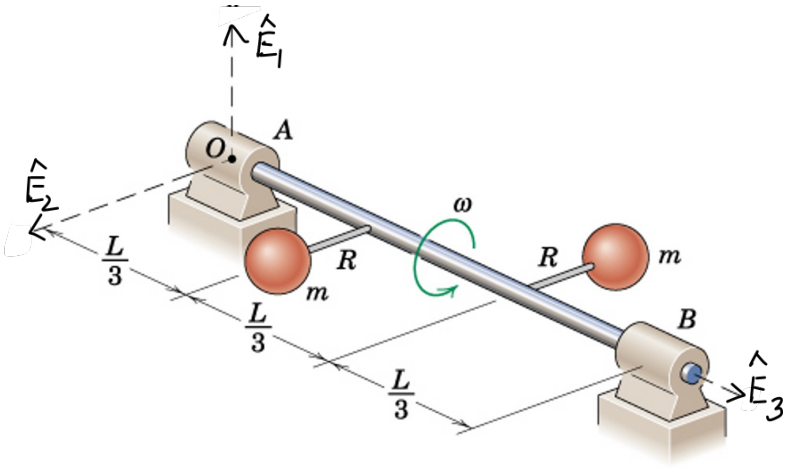
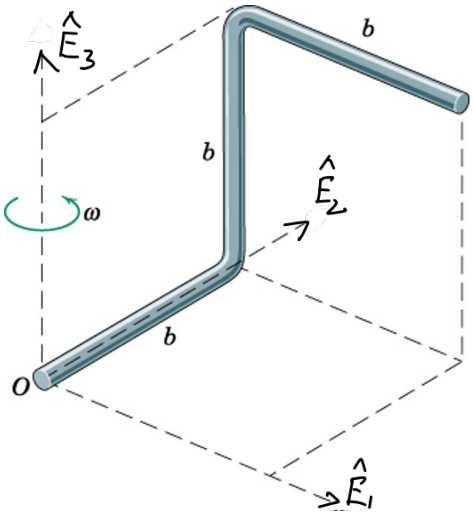
ESO 209A: Dynamics: HW 7 & 8

Due: Tuesday, 11 Oct. 2022

1. Find the angular momentum $\mathbf{H}^O$ of the system at the moment shown (below left) about the origin O and express in the CS $\left\{ \mathscr{E}_0, O, \hat{\mathbf{E}}_i \right\}$.



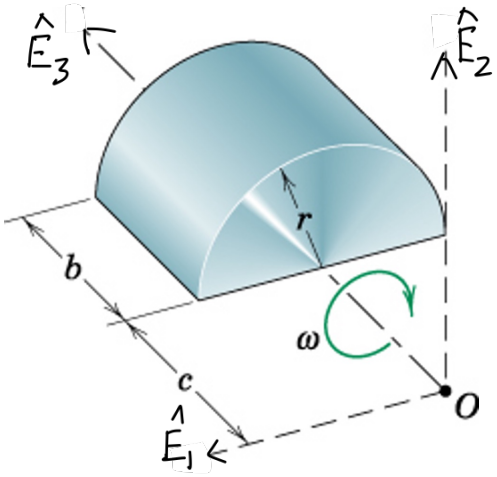


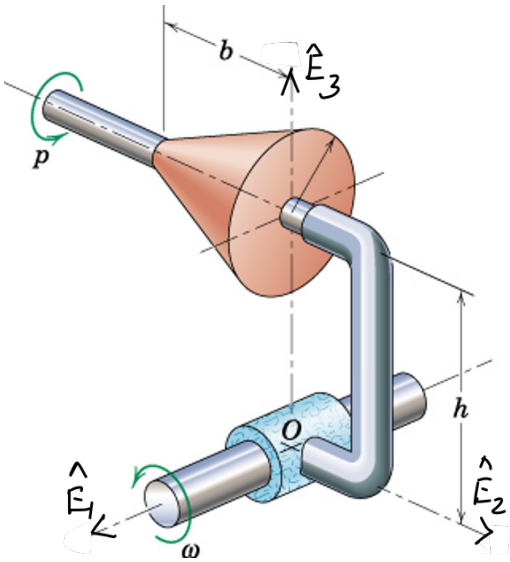
2. The bent rod (shown above right) has mass per unit length ρ and rotates as shown. Find the

- angular momentum $\mathbf{H}^O$ of the rod at the moment shown about the origin of the CS $\left\{ \mathscr{E}_0, O, \hat{\mathbf{E}}_i \right\}$;
- angular momentum $\mathbf{H}^G$ of the rod at the moment shown about the the system's mass center G.

Express all answers in $\left\{ \mathscr{E}_0, O, \hat{\mathbf{E}}_i \right\}$.

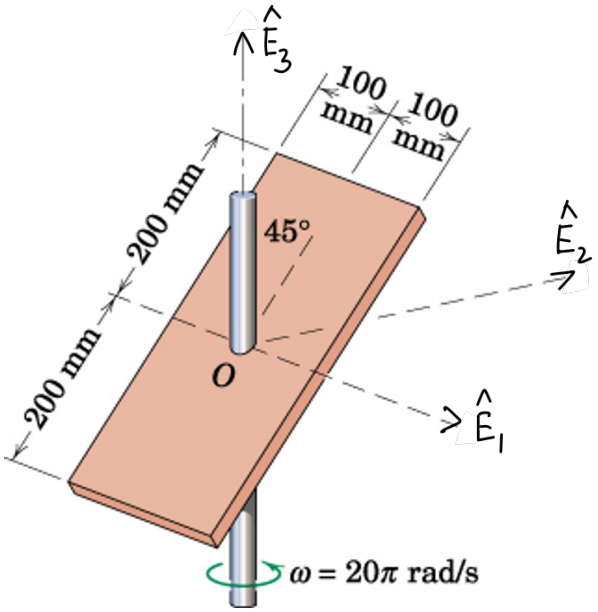
3. Find angular momentum $\mathbf{H}^O$ of the solid semi-circular cylinder of mass m as it rotates as shown (left below). Also find $\mathbf{H}^G$, where G is the mass center. Express answers in $\left\{ \mathscr{E}_0, O, \hat{\mathbf{E}}_i \right\}$.

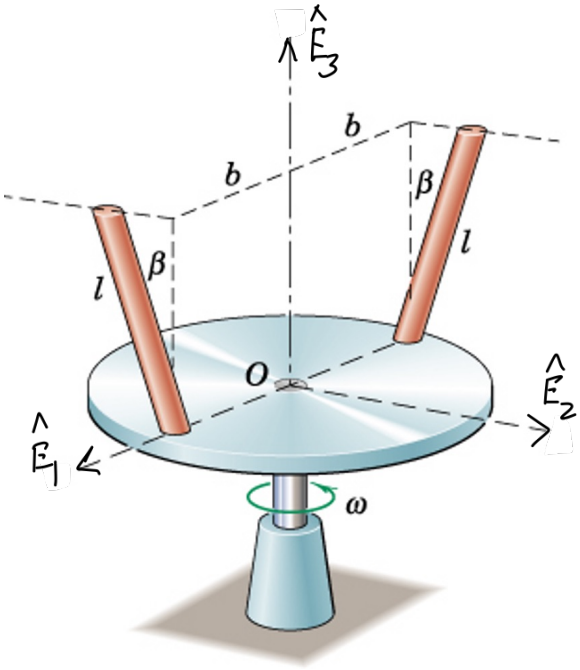




4. The solid cone (above right) of mass m, length b and base radius r spins at the rate about its symmetry axis. Simultaneously the bracket and attached shaft axis revolve at the rate ω about the $\hat{\mathbf{e}}_1$. Find the angular momentum $\mathbf{H}^O$ of the cone. Express your answer in $\left\{ \mathscr{E}_0, O, \hat{\mathbf{E}}_i \right\}$.

5. The rectangular plate of mass 3 kg and a uniform small thickness is welded at an angle of 45° to the vertical shaft. The shaft rotates as shown (below left). Find the angular momentum $\mathbf{H}^O$. Express your answer in $\left\{\mathscr{E}_0, O, \hat{\mathbf{E}}_i\right\}$.





6. Each of the slender rods of mass m and length l is welded to the circular disk that rotates about the vertical axis as shown (above right). Each rod makes an angle β with the vertical and lies in a plane parallel to the $\hat{\mathbf{E}}_2 - \hat{\mathbf{E}}_3$ plane. Find the system's angular momentum $\mathbf{H}^O$ and express your answer in $\left\{\mathscr{E}_0, O, \hat{\mathbf{E}}_i\right\}$.

7. Crankshaft ABC rotates at the constant rate $\omega = 900$ rev/min. The connecting rod CD is pinned to cap C, which is free to rotate about axis BC. The connection at collar D is a ball-and-socket joint. For the instant shown in the figure, find the velocity and acceleration of collar D, and the angular velocity and angular acceleration of the connecting rod.