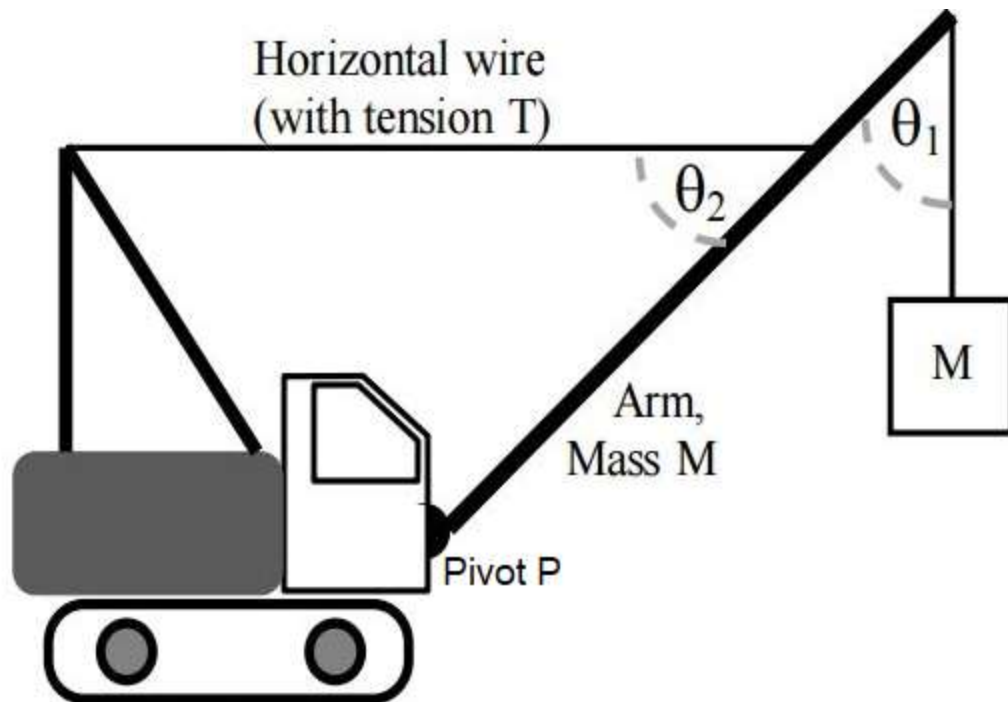


1. The crane shown in the picture holds a uniform beam of mass  $M = 200 \text{ kg}$  and length  $10 \text{ m}$ . At the end of the beam hangs a mass which also has mass  $M=200 \text{ kg}$ . A horizontal wire is attached  $8.0 \text{ m}$  from the pivot point P.  $\theta_1 = 50^\circ$  and  $\theta_2 = 40^\circ$ . For both questions below, show all your work on paper. Enter just your final answers on Canvas. 70 points.
- What is the tension in the wire?
  - What are the x and y components of the force exerted on the beam at the location of the pivot P? (Just give the x and y components separately; you do not need to give the force magnitude. Do be sure to indicate whether the x and y components are in the + or - directions).



2. The woman shown is initially spinning on the stool at a rate of  $0.5 \text{ rad/s}$ . She holds two  $1.0 \text{ kg}$  sandbags  $1.0 \text{ m}$  away from her body as seen in the first picture. She then brings the sandbags in so that they are a negligible distance away from the axis of rotation. If we model her body as a solid cylinder of mass  $m = 50 \text{ kg}$  and radius  $0.20 \text{ m}$ , what is her final angular velocity (in  $\text{rad/s}$ ). The moment of inertia of a solid cylinder rotating about its axis of symmetry is  $I = \frac{1}{2}MR^2$ . Show all your work on paper. Enter just your final answer on Canvas. 20 points.



Before

After

3. A bucket attached to a pulley moves downwards as shown in the diagram. For both questions below, write your answers on paper and also on Canvas. Explanations are not needed. 10 points
- What is the direction of the torque vector acting on the pulley from the tension in the rope?
  - What is the direction of the angular momentum vector of the pulley?

