Torque Review

1. Define the following:
    a. Torque
    b. Lever arm
    c. Line of action
    d. Fulcrum
    e. Center of mass

2. What can be **observed** about an object in rotational equilibrium?

3. What is true about the **Torques** on an object in rotational equilibrium?

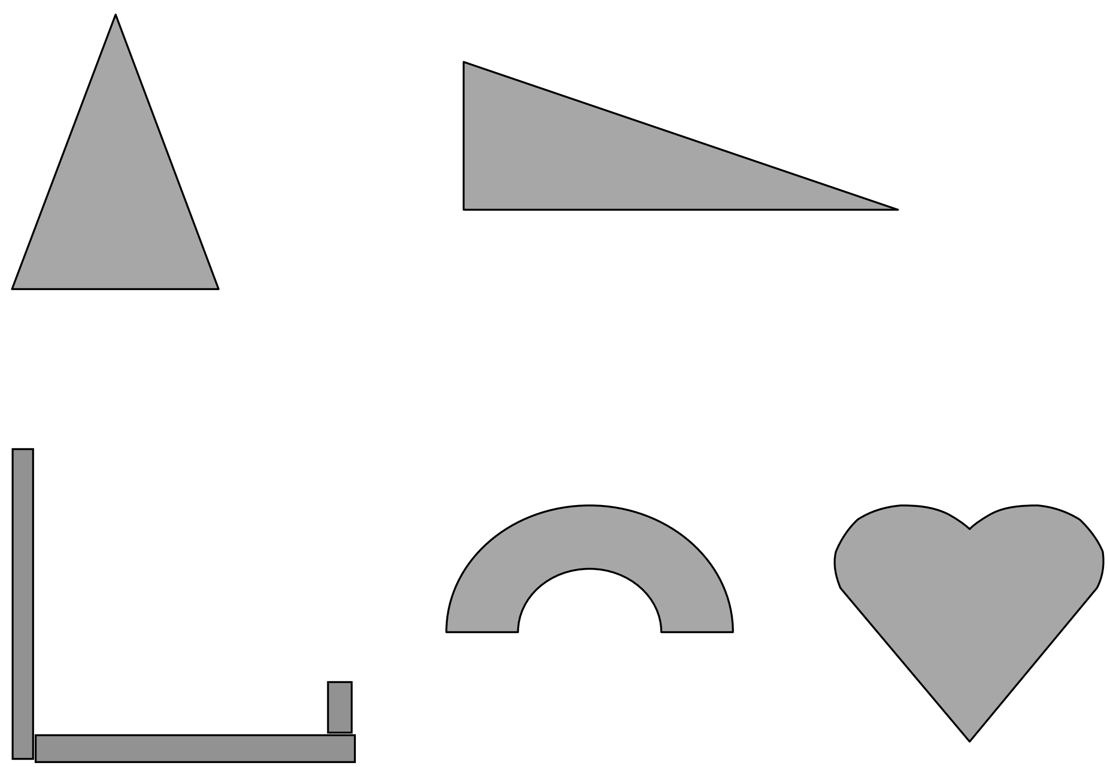
4. What is the difference between a physical fulcrum and a mathematical fulcrum?

5. Using the concept of Torque, explain why the handle of most doors is located at the edge of the door opposite the hinges.

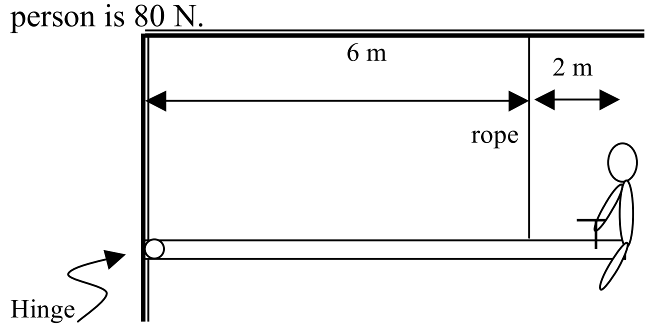
6. A 50 kg person stands on the end of a 2 meter long diving board. How much Torque does the person put on the diving board with respect to the support at the opposite end?

7. Draw the person and diving board in problem six. State whether the Torque the person places on the board is clockwise or anticlockwise (counterclockwise) in your drawing.

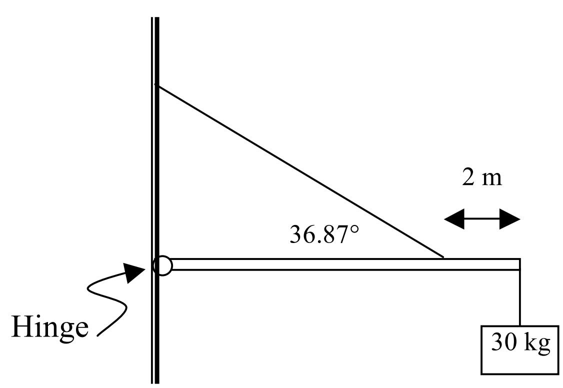
8. Place a noticeable dot at the approximate center of mass of the uniform objects below:



9. Find the tension in the rope and the force the hinge provides in both the horizontal and vertical directions. Note: The weight of the board is 60 N & the weight of the person is 80 N.



10. Find the tension in the supporting cable and the forces exerted by the hinge in the diagram below if the mass of the beam is 10 kg and the total length of the beam is 10 meters.



Torque Review KEY

1. Define the following:
   a. Torque

      A force that produces or tends to produce rotation. The rotational analog of force.

   b. Lever arm

      The perpendicular distance between the line of action of a force and fulcrum.

   c. Line of action

      A line of action is the line in the direction of the force vector.

   d. Fulcrum
      Sometimes called the pivot point.
      Physical fulcrum is the point about which an object rotates.
      Mathematical fulcrum is the point about which torque is calculated.
   e. Center of mass
      The center of mass is the point at which the weight of an object (with uniform gravity) acts on the object. This is sometimes referred to as the balance point.

2. What can be **observed** about an object in rotational equilibrium?

   It spins at a constant rotational speed which may be (though it need not be) zero.

3. What is true about the **Torques** on an object in rotational equilibrium?

   The torques on an object in rotational equilibrium balance each other.

4. What is the difference between a physical fulcrum and a mathematical fulcrum?
   A physical fulcrum is the point about which an object is actually rotating. A mathematical fulcrum can be any point on or away from the object about which torques are calculated. It is possible to choose the mathematical fulcrum to coincide with the physical fulcrum.
5. Using the concept of Torque, explain why the handle of most doors is located at the edge of the door opposite the hinges.
   In order to increase the torque available to close the door, one of two things must be increased. Increasing the force applied perpendicular to the pivot will increase torque. Increasing the length of the lever arm also increases torque. Placing the handle far from the hinge increases the level arm for forces applied at the handle.

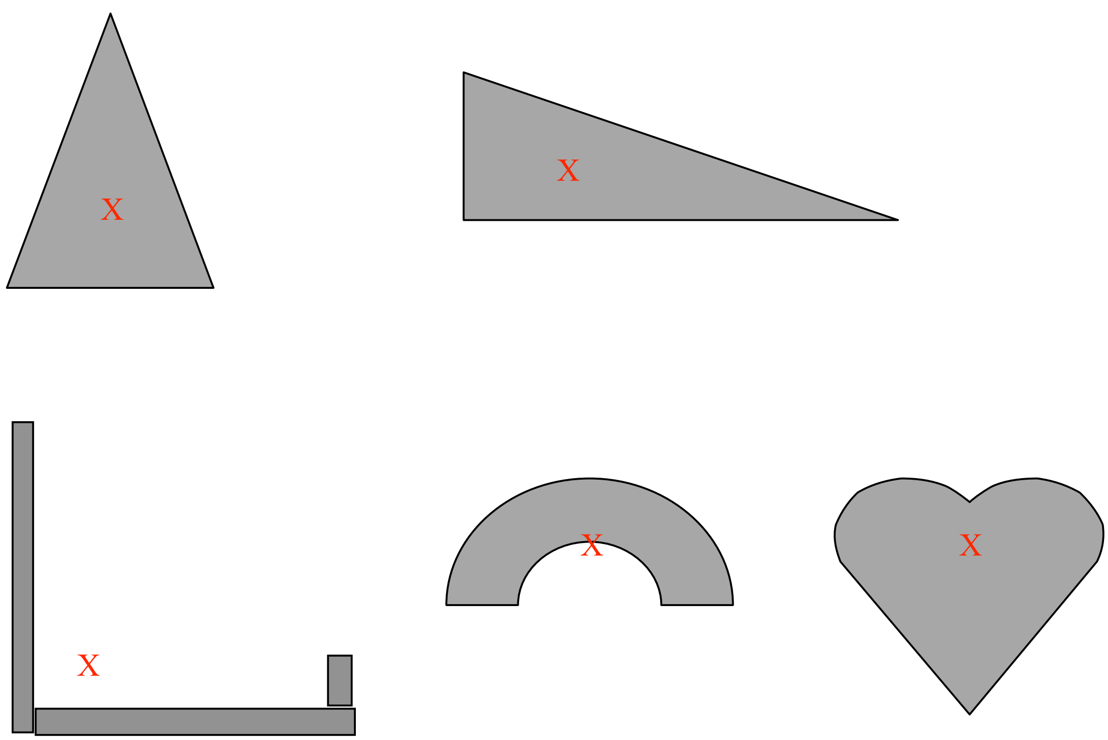
6. A 50 kg person stands on the end of a 2 meter long diving board. How much Torque does the person put on the diving board with respect to the support at the opposite end?

$$\tau = r \times F = (2m)(500N) = 1000N \cdot m$$

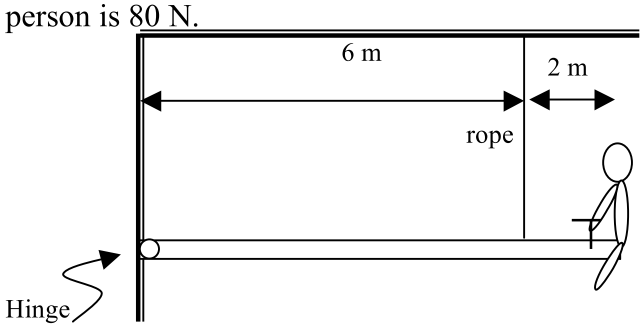
7. Draw the person and diving board in problem six. State whether the Torque the person places on the board is clockwise or anticlockwise (counterclockwise) in your drawing.

As draw, Mr. Lollipop gives the diving board a clockwise torque.

8. Place a noticeable dot at the approximate center of mass of the uniform objects below:

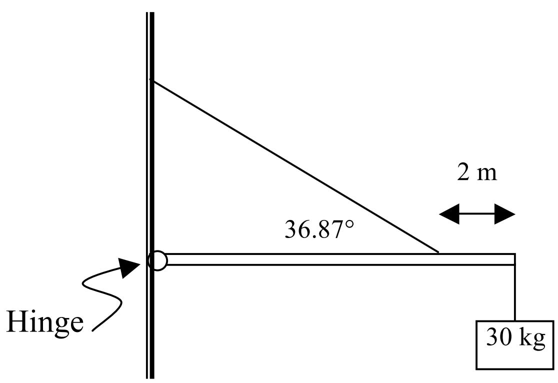


9. Find the tension in the rope and the force the hinge provides in both the horizontal and vertical directions. Note: The weight of the board is 60 N & the weight of the person is 80 N.



F_{hx}= 0 N
F_{hy}= 6.7 N (down)
F_T = 146.7 N

10. Find the tension in the supporting cable and the forces exerted by the hinge in the diagram below if the mass of the beam is 10 kg and the total length of the beam is 10 meters.



F_{hx}= 583.3 N (right)
F_{hy}= 37.5 N (down)
F_T = 729.2 N