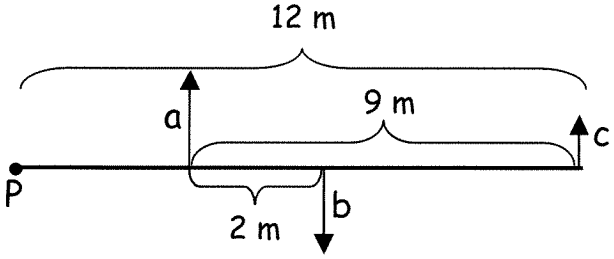
Worksheet: Torque **Name**_____

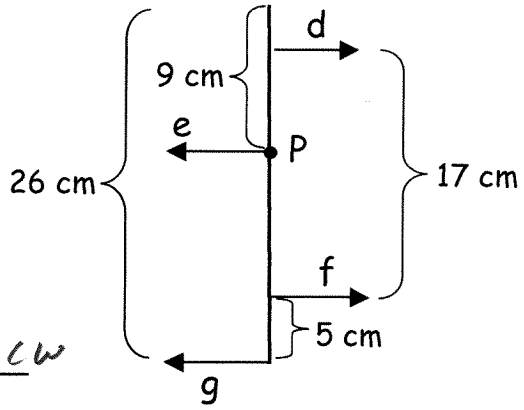
1. The formula for calculating torque is T = F l d. What is the unit? N·M

2. The direction for a torque is always either CW or CCW.

3. A *lever arm* is the distance from the pivot point to the point where the perpendicular force is applied.

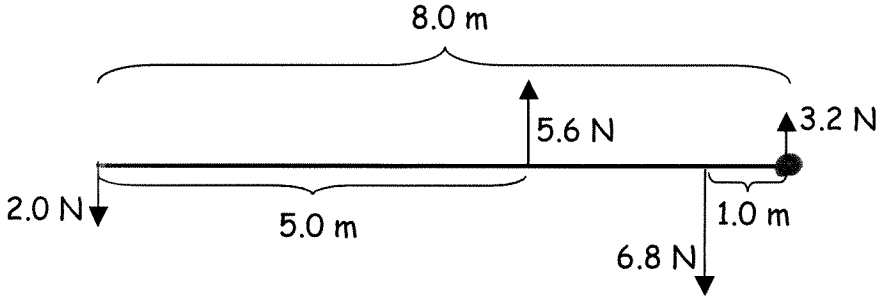
4. Find the lever arm for each of these forces and label the direction of each torque.





a. 3m CCW b. 5m CW c. 12m CCW d. 5m CW
e. 0m f. 12m CCW g. 17m CW

5. Calculate the net torque. NOTE: You will need to place the pivot point.

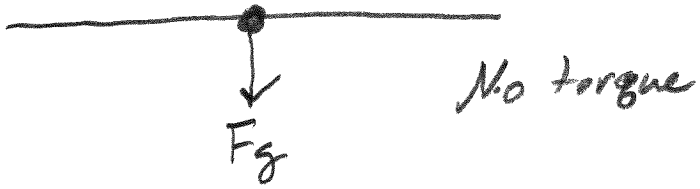


$\Sigma\tau = (3.2)(0) + (6.8)(1.0) + (-5.6)(2.0) + (2.0)(8.0)$

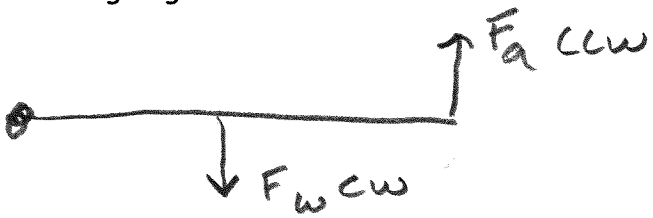
$\Sigma\tau = 11.6\ N\cdot m\ CCW$

Worksheet: Torque **Name**_____

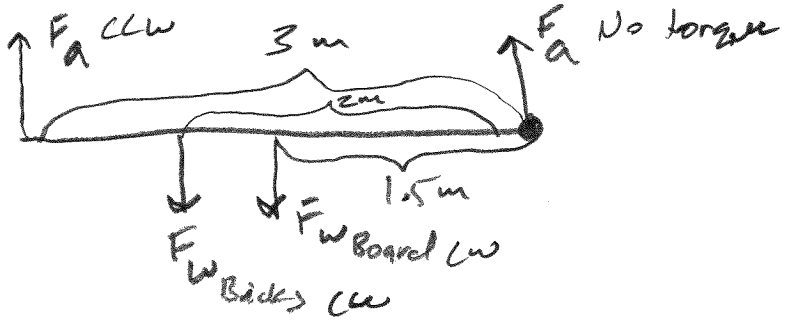
6. To solve torque problems, diagrams must be drawn. Complete the diagram for each situation described below. Draw a bold dot for the pivot point. Draw and label each force vector. (Bars, boards, etc. are considered uniform unless stated otherwise.) Label each torque as "cw" or "ccw".
   a. A see saw weighs 500 N and is pivoted at the center.



   b. A railroad tie weighing 1200 N is lifted at the left end.



   c. A 3.0 m long board weighing 150 N is lifted at its ends by two people. A stack of bricks weighing 75 N is placed 1.0 m from the left end. To solve a problem, the pivot point is arbitrarily placed at the right end.



   In #6c, give the length of the lever arm for each force from left to right. (HINT: Four forces should be drawn.)

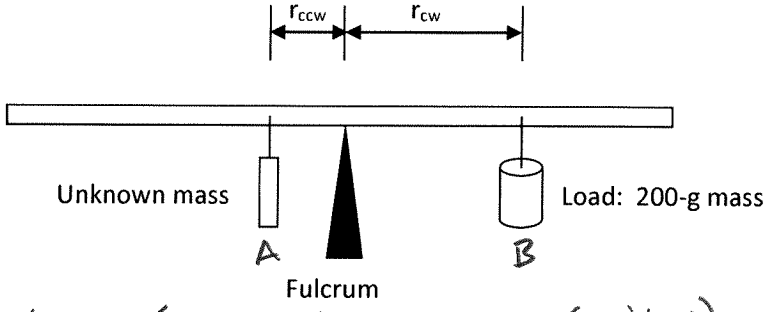
   3m, 2m, 1.5m, 0m

Practice Problems: Torque

Physics

$$\tau = r \times F\sin\varphi$$

1. A 200 g mass is placed on the meter stick 20 cm from the fulcrum. An unknown mass is positioned 8 cm from the fulcrum to balance the system. What is the mass of this unknown object?



$\Sigma\tau = \tau_A + \tau_B = (.08)(m)(10) + (.20)(.200)(-10)$

$\Sigma\tau = 0$ $\quad 0 = (.8)(m) + -.4$

$m = .5$ kg

ans. $m = 0.5$ kg

2. A 250 g mass is placed on the meter stick 30 cm from the fulcrum. An unknown mass is positioned 40 cm from the fulcrum to place the system in equilibrium. What is the mass of the unknown object?

$\Sigma\tau = \tau_K + \tau_{UK} = (.30)(.250)(10) + (.40)(m)(-10)$

$\Sigma\tau = 0$ $\quad 0 = .75 + -4(m)$ $\quad m = .188$ kg

ans. $m = 0.1875$ kg

3. A 100 g mass is placed on the meter stick 25 cm from the fulcrum. An unknown mass is positioned 20 cm from the fulcrum to balance the system. What is the mass of the unknown object?

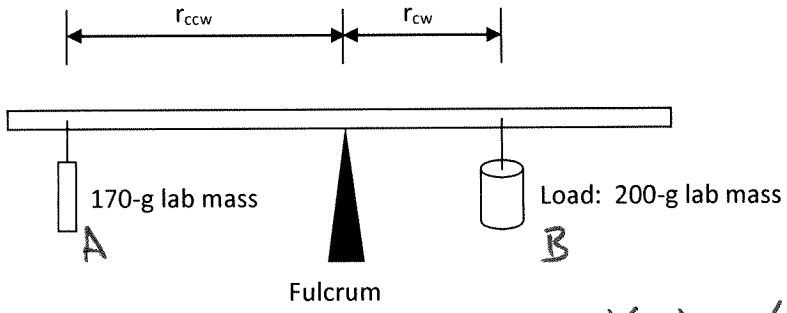
$\Sigma\tau = \tau_K + \tau_{UK} = (.25)(.100)(10) + (.20)(m)(-10)$

$\Sigma\tau = 0$ $\quad 0 = .25 + -2(m)$

$m = .125$ kg

ans. $m = 0.125$ kg

4. A 200 g mass is placed on the meter stick 20 cm from the fulcrum. A 170 g mass is used to balance the system. How far will it have to be located from the fulcrum to keep the system in balance?



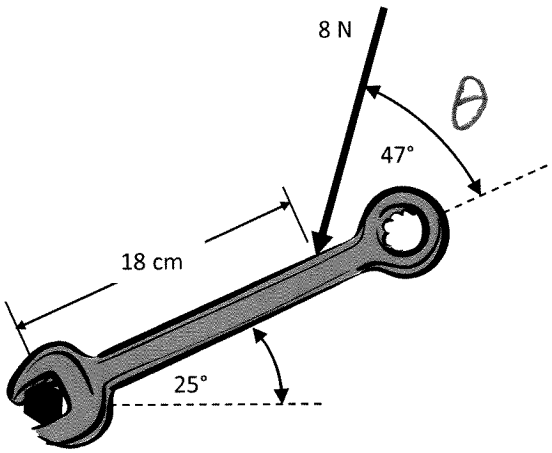
$\Sigma\tau = \tau_A + \tau_B = (x)(.170)(10) + (.20)(.200)(-10)$

$\Sigma\tau = 0 \qquad 0 = (x)(1.7) + -.4$

$x = .235\,m$

ans. $d = 0.235$ m

5. Calculate the torque supplied by the wrench when an 8 N force is applied as shown in the following figure.



$\tau = F_\perp d = F \sin\theta\, d$

$\tau = (8)(\sin 47)(.18)$

$\tau = 1.05\ N\cdot m\ ccw = -1.05\ N\cdot m$

ans. $\tau = -1.05$ N·m