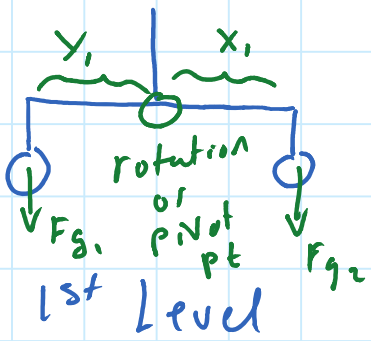
Rotational Equilibrium

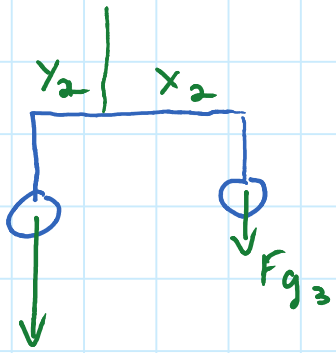
Friday, March 3, 2017 8:54 AM

Rotational Equilibrium → not rotating

- occurs when the twisting forces (Torque) in each direction are balanced.
- Torque: - based on an applied force that is ⊥ (or has a ⊥ component) to the beam and the distance from a point of rotation (fulcrum)
- $\tau = F_{\perp} \cdot d$, units N·m



1st Level



2nd Level

Direction

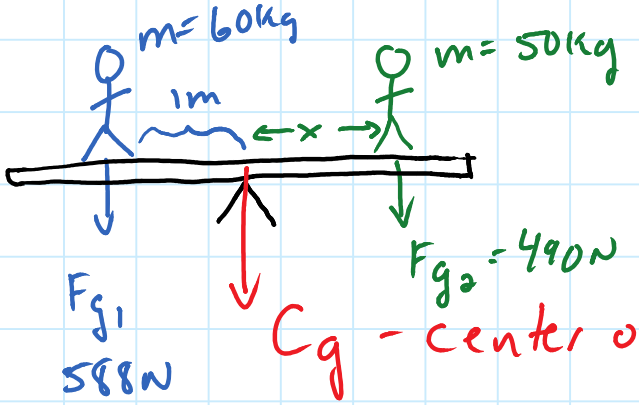
Clockwise (cw)

Counter Clockwise (ccw)


If the torques on an object add to zero, the object will be in rotational equilibrium

$$\sum \tau = 0 \rightarrow CW\,\tau = CCW\,\tau$$

ex: Teeter Totter - uniform mass of 20kg

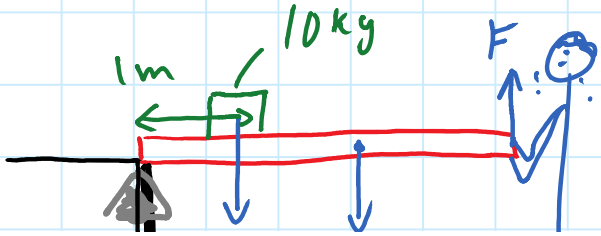


$\sum \tau = 0$ $\quad CW\,\tau = CCW\,\tau$

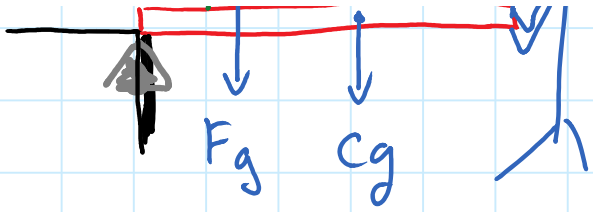
$$F_{g_2} x = F_{g_1}(1)$$

$$\frac{490N(x)}{490} = \frac{588N(1)}{490}, \quad x = 1.2m$$

Ex



Plank is 3.0 m long, uniform, mass = 20kg



uniform, mass = 20kg

What force is required to hold up the plank

$\sum \tau = 0$ CCWτ = CWτ

$F(3.0m) = F_g(1m) + C_g(1.5m)$

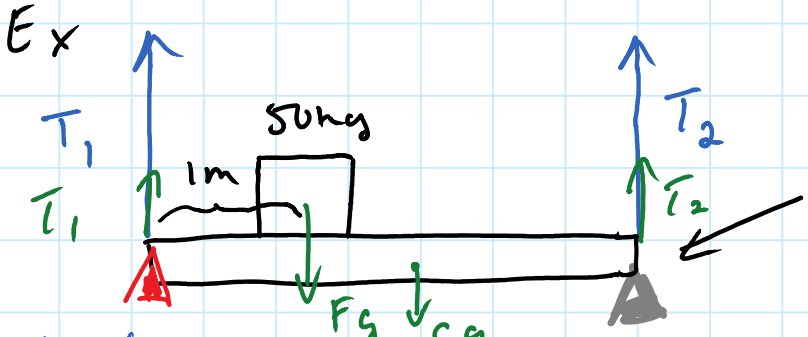
$= 98(1m) + (196)(1.5)$

$F(3) = 392$

$F = 131N$

ex

Ex



uniform 4m, 100kg board

Find the tension in each cable.

$\sum \tau = 0$ CWτ = CCWτ

$F_g(1m) + C_g(2m) = T_2(4m)$

$490N(1) + 980N(2) = T_2(4)$

$2450 = T_2(4)$

$T_2 = 612.5N$

CWτ = CCWτ

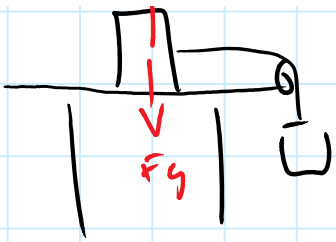
$T_1(4) = F_g(3) + C_g(2)$

$T_1 = 858N$

$\sum F_y = 0$

$F_{up} = F_{down}$

$T_1 + T_2 = F_g + C_g$



ΣF_y 0 up down

$T_1 + T_2 = F_g + C_g$

$858 + 612.5 = 490 + 980$

$1470 \text{ N} = 1470 \text{ N}$