today/ wednesday
ch 9

wednesday : start fluids

Read 10.1-10.5

Final Exam prep on class web page

makeup exam Tuesday : see me if any
(if missed exam) Questions

Evaluations available

Equilibrium

object at rest is an example

Forces are balanced so no <u>acceleration</u> and no <u>angular acceleration</u>

→ Constant velocity ($\vec{v}=0$)
→ Constant angular velocity ($\omega=0$)

If an object is not moving ($\vec{v}=0$) / rotating ($\omega=0$) it is in equilibrium.

→ $\Sigma \vec{F} = m\vec{a}$ $\Sigma \vec{\tau} = I\vec{\alpha}$

$\vec{a}=0$ $\vec{\alpha}=0$

$\Sigma \vec{F}=0$ (Done this before)

$\Sigma \vec{\tau}=0$ (new)

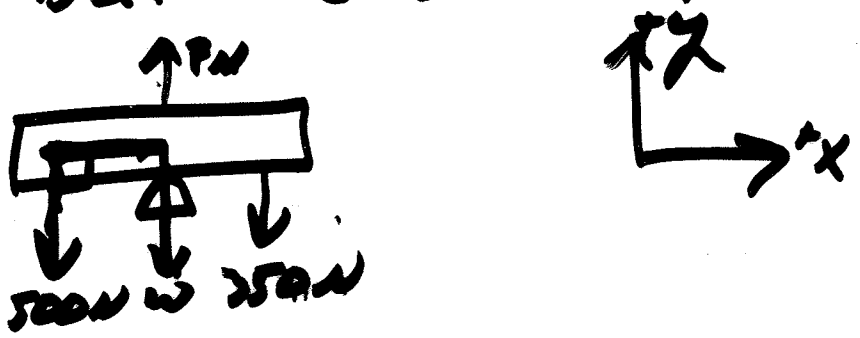
$\Sigma \tau = \Sigma rF\sin\theta = 0$

Note Torque can be measured relative to <u>any</u> axis

ex) A uniform 40 N Board supports 2 children weighing 500 N and 350 N. A support is under center of mass of board. The 500 N child is 1.5 m from center.

a) what is Force that support exerts

b) where should 350 N child sit to balance board?

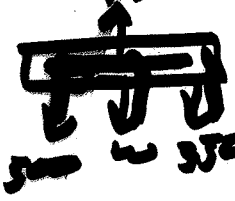


$F_N = ?$ $\quad \Sigma F_y = 0$

$F_N - 500N - 350N - 40N = 0$

a) $\boxed{F_N = 890N}$

$\Sigma \tau = 0$ Choose support as axis of rotation



$\tau_{F_N} = 0 \quad \tau_w = 0 \quad r = 0$

$\tau = rF\sin\theta$

$+500\,N \cdot 1.5\,m \sin 90 - 350\,N \cdot r \cdot \sin 90^\circ = 0$

$r = 2.14\,m$ from support

Choose 500 N child as axis of rotation

$\tau_{500} = 0$

$-40\,N \cdot 1.5\,m \cdot \sin 90^\circ$

$+890\,N \cdot 1.5\,m \cdot \sin 90^\circ$

$-350\,N \cdot r \cdot \sin 90^\circ = 0$

$r = 3.64\,m$ from 500 N child

$3.64 - 1.5\,m \neq 2.14\,m$ from support

Interactive Question

A heavy boy and a lightweight girl are balanced on a massless seesaw. If they both move forward so that they are one-half their original distance from the pivot point, what will happen to the seesaw?

A) The side the boy is sitting on will tilt downward.

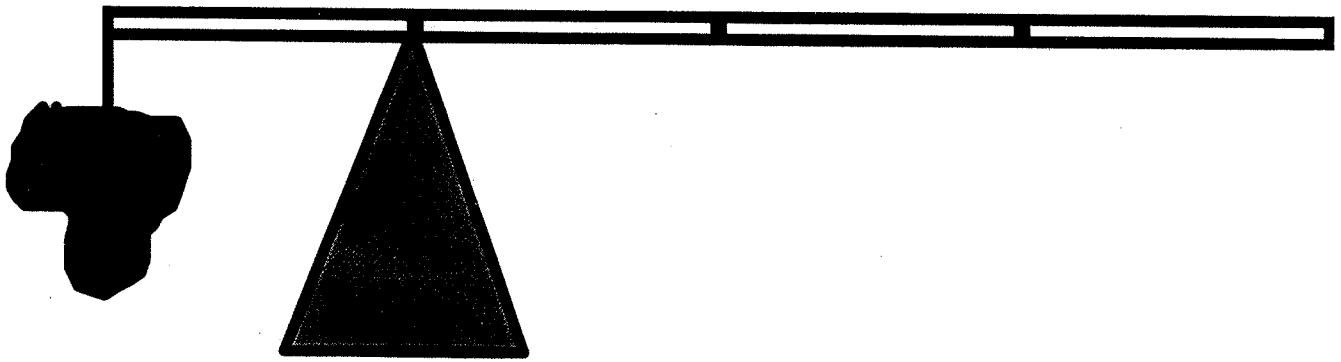
B) The side the girl is sitting on will tilt downward.

C) Nothing, the seesaw will still be balanced.

D) It is impossible to say without knowing the masses and the distances.

Interactive Question

A 1-kg rock is suspended by a massless string from one end of a 1-m measuring stick. What is the weight of the measuring stick if it is balanced by a support force at the 0.25-m mark?



A) 0.25 kg

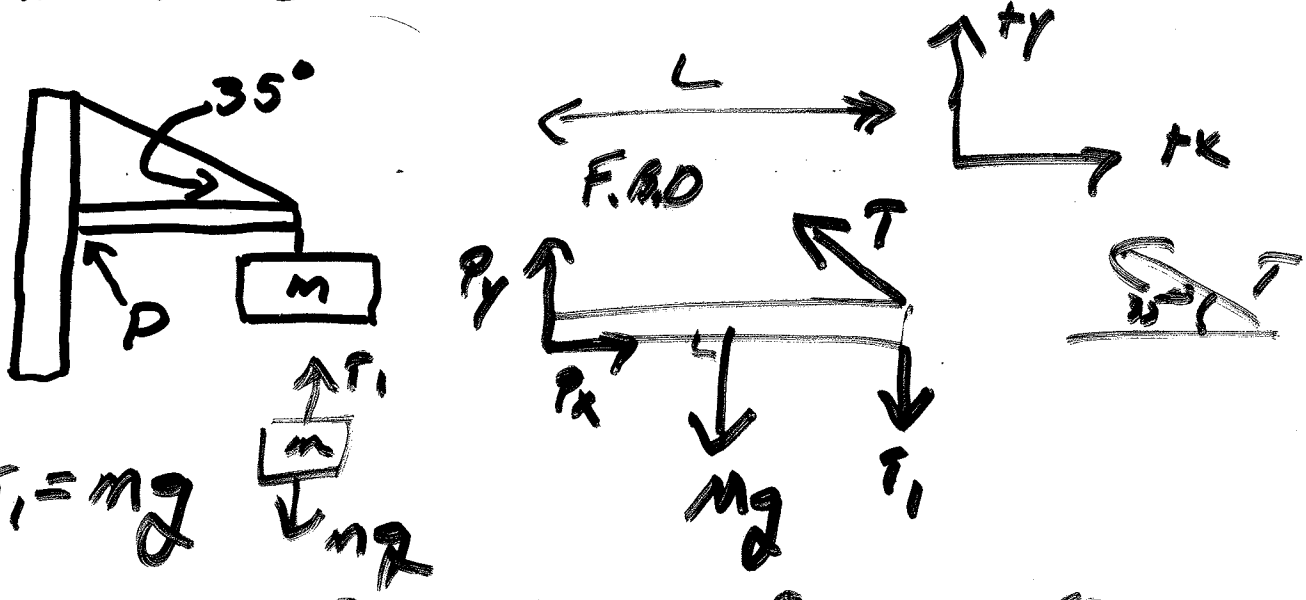
B) 0.5 kg

C) 1kg

D) 2 kg

E) 3kg

ex) A 25 kg sign hangs from a 10 kg pole what is Tension in wire and vertical and horizontal forces on Pivot point P.



$\Sigma F_x = 0$ $\quad P_x - T\cos 35^\circ = 0$ (1)

$\Sigma F_y = 0$ $\quad P_y + T\sin 35^\circ - T_1 - Mg = 0$ (2)

$\Sigma \tau = 0$ $\quad -Mg\left(\frac{L}{2}\right)\sin 90^\circ - T_1 L \sin 90^\circ + TL\sin 35^\circ = 0$ (3)

algebra (3) $\quad -Mg\left(\frac{1}{2}\right) - T_1 + T\sin 35^\circ = 0$

$T_1 = mg$

$$T = \frac{\frac{Mg}{2} + T_1}{\sin 35^\circ} = \boxed{510\ N}$$

(1) $P_x = T\cos 35^\circ = \boxed{420\ N}$

(2) $P_y = Mg + mg - T\sin 35^\circ = \boxed{50\ N}$