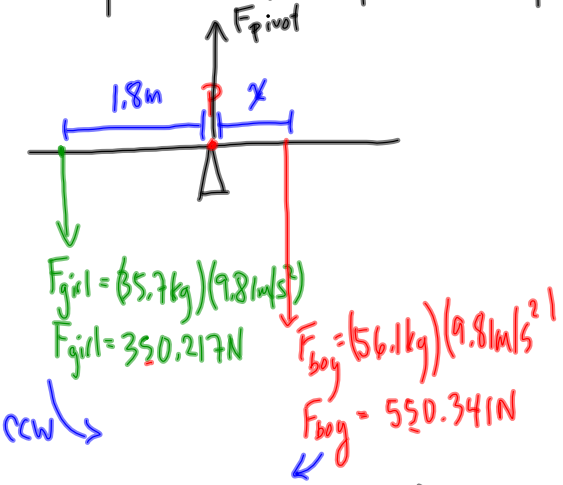
A teeter-totter Example

Two children sit on a teeter-totter made from a ~~uniform~~, 15.3kg plank and rests on a frictionless pivot at its center. A 35.7kg girl sits at the left end, 1.8m from the point of rotation. A 56.1kg boy moves back and forth on the right side until the teeter-totter stays balanced horizontally.

a) Where does he finally sit?

b) What is the upward force of the pivot on the plank?



a) In static equilibrium, $\vec{\tau}_{net} = 0$

$$\sum \tau_{ccw} = \sum \tau_{cw}$$

$$\tau_{girl} = \tau_{boy} \qquad \text{recall: } \tau = r_\perp F$$

$$(1.8m)(350.217N) = x(550.341N)$$

$$x = 1.1m$$

b) $\vec{F}_{net} = 0$ for static equilibrium, so

vertically: $F_{pivot} = F_{girl} + F_{boy}$

$$F_{pivot} = (350.217N) + (550.341N)$$

$$F_{pivot} = 9.0 \times 10^2 N$$

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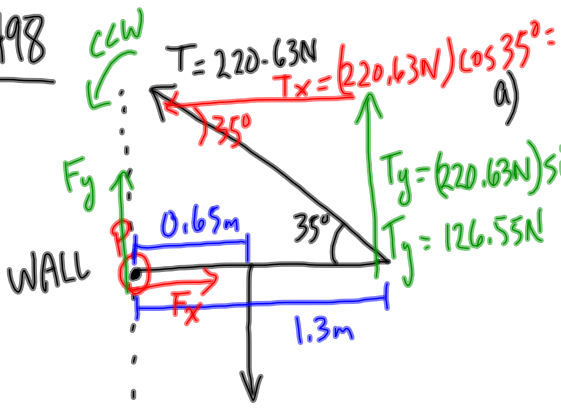


a) $\sum \tau_{CCW} = \sum \tau_{CW}$

$\tau_T = \tau_{rod+sign}$

Recall: $\tau = rF\sin\theta$

$= (7.8kg + 18kg)(9.8m/s^2)$

$= 253.098N$

$(1.3m)T(\sin 35°) = (0.65m)(253.098N)$

$T = \dfrac{(0.65m)(253.098N)}{(1.3m)(\sin 35°)}$

a) T = ?

b) F_{wall} = ?

$T = 2.2 \times 10^2 N$

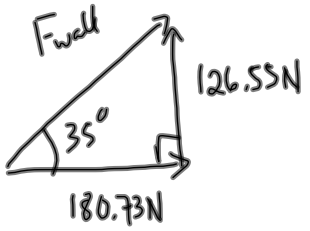
Vertically: $F_y + T_y = F_{rod+sign}$ (220.63 N)

$F_y = 253.098N - 126.55N$

$F_y = 126.55N$

Horizontally: $F_x = T_x$

$F_x = 180.73N$



$c^2 = a^2 + b^2$

$c^2 = (126.55N)^2 + (180.73N)^2$

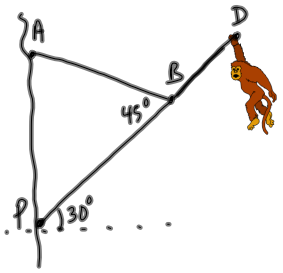
$c = 2.2 \times 10^2 N$

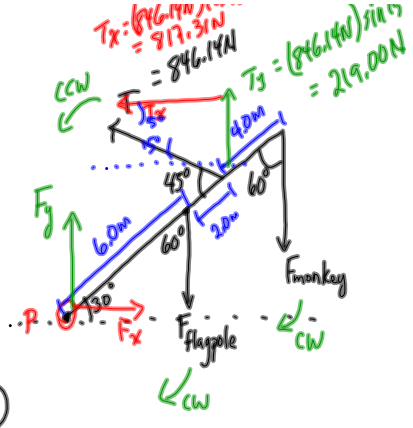
The force at the wall is $2.2 \times 10^2 N$ [35° above horizontal, outward]

$\tan\theta = \dfrac{126.55N}{180.73N}$

$\theta = 35°$

Monkey + Flagpole





$m_{flagpole} = 16.3\,kg$ (159.903N)

$m_{monkey} = 38.8\,kg$ (380.628N)

$T = ?$ (in cable AB)

F_x and $F_y = ?$

$\Sigma\tau_{ccw} = \Sigma\tau_{cw}$

$\tau_T = \tau_{flagpole} + \tau_{monkey}$

$(8.0m)T(\sin 45°) = (6.0m)(159.903N)\sin 60° + (12.0m)(380.628N)\sin 60°$

$(8.0m)T(\sin 45°) = 830.98N\cdot m + 3955.60N\cdot m$

$T = \dfrac{4786.48N\cdot m}{(8.0m)(\sin 45°)}$

$T = 846.14N$

$T \doteq 8.5\times10^2 N$

Vertically:

$T_y + F_y = F_{flagpole} + F_{monkey}$

$F_y = 159.903N + 380.628N - 219.00N$

$F_y = 321.531N$

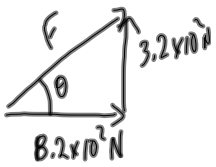
$F_y = 3.2\times10^2 N$

Horizontally:

$F_x = T_x$

$F_x = 817.3N$

$F_x \doteq 8.2\times10^2 N$



To DO:

- PP|501 (not 34)
- FOP|§6-3|2-4

Tomorrow: FOP|Problems|12-23 (No Torque!)