Reminders 11-01-10:

-Next Exam will require use of conservation of energy and free-body analysis. Exam 3 Chapters 7-9 Wednesday November 10.

-No Quiz Wednesday, turn in Torque Conceptual questions by Monday instead.

-Rewrite of Momentum Lab Due Today (turn in old and new versions)

-Extra Credit For Exam Due Today!

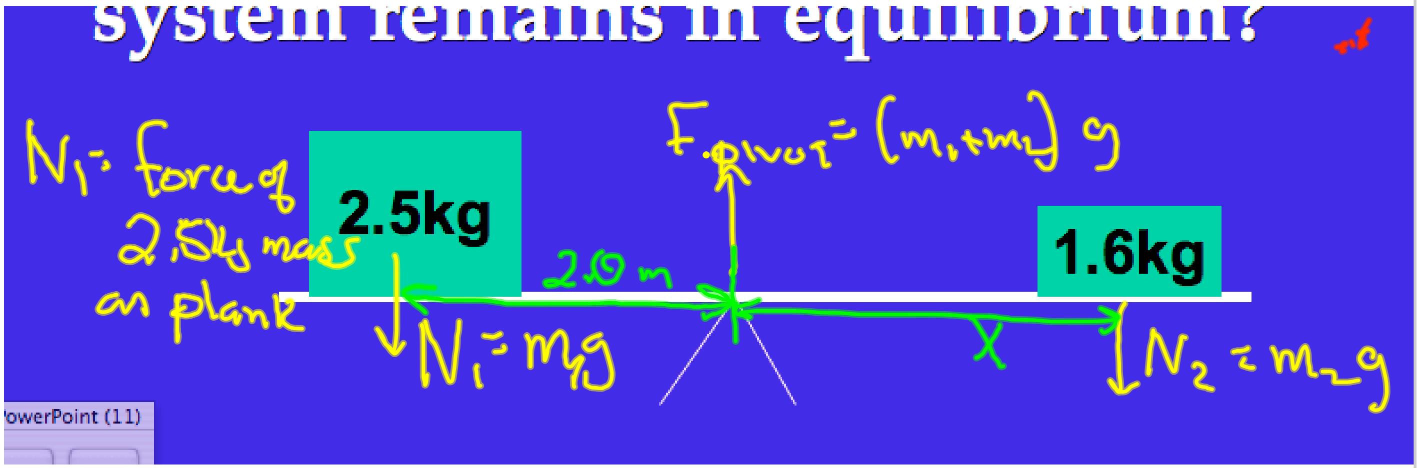
Objectives:

-Discuss Quiz 6

-Conditions for Equilibrium

-Examples

-Discussion of Rotational Dynamics



$$\sum \vec{\tau} = 0$$

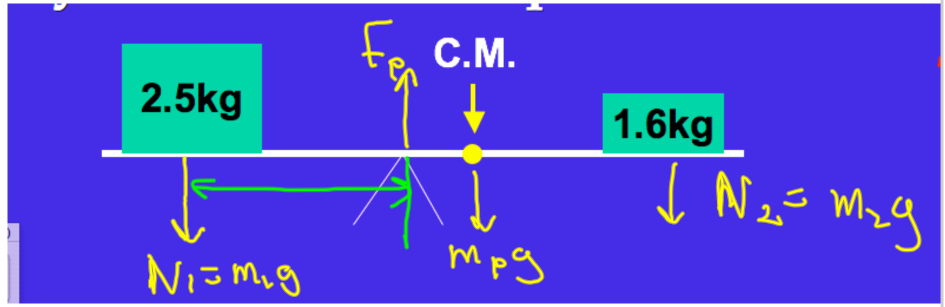
$$N_1(2.0\,m) - N_2(x) = 0$$

$$m_1 \cancel{g}(2.0\,m) - m_2 \cancel{g}(x) = 0$$

$$m_1(2.0\,m) = m_2(x)$$

$$x = \frac{m_1(2.0)}{m_2} = \frac{2.5\,kg}{1.6\,kg}(2.0\,m)$$

$x = 3.1\,m$ to right of fulcrum



$$F_p = N_1 + N_2 + m_p g$$
$$= (m_1 + m_2 + m_p) g$$

$$\sum \tau = m_1 \cancel{g} (2.0m) - m_p \cancel{g} (.5m) - m_2 \cancel{g} x$$

$$m_1 (2.0) - m_p (0.5) - m_2 x = 0$$

$$m_2 x = m_1 (2.0) - m_p (.5)$$

$$x = \frac{m_1 (2.0m) - m_p (0.5m)}{m_2}$$

$$= \frac{(2.5kg)(2.0m) - 2.0kg(0.5)}{1.6kg}$$

$$= \underline{2.5m}$$

Example

$G_y = W_L + W_F$

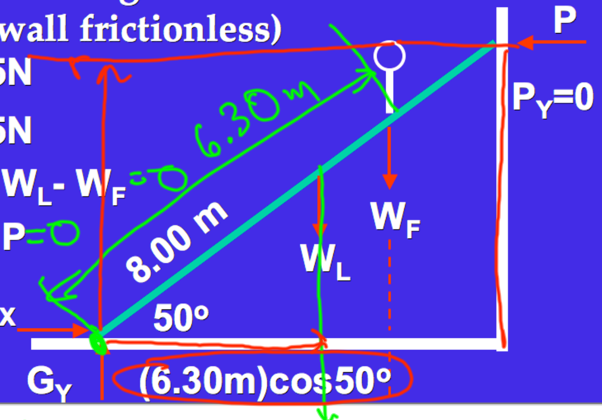
- Consider a firefighter on a ladder (vertical wall frictionless)

$W_F = 875N$

$W_L = 355N$

$\Sigma F_Y = G_Y - W_L - W_F = 0$

$\Sigma F_X = G_X - P = 0$



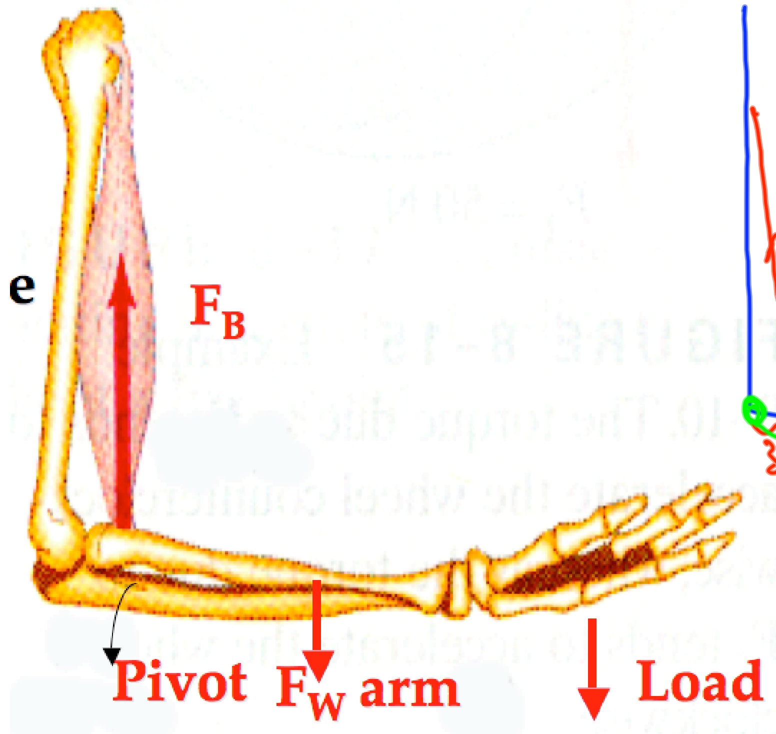
$G_x - P = 0$

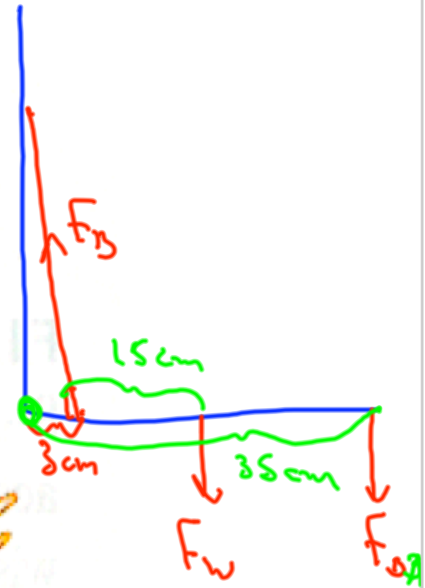
$$\Sigma \vec{\tau} = 0 = -W_L(4.00m)\cos 50 - W_f(6.30m)\cos 50 + P(8.00m)\sin 50 = 0$$

$$P(8)\sin 50 = W_L(4)\cos 50 + W_f(6.30)\cos 50$$

$$P = \frac{\overset{355N}{W_L}(4)\cos 50 + \overset{875N}{W_f}(6.30)\cos 50}{8\sin 50}$$

$P = 727N$ so $G_x = 727N$





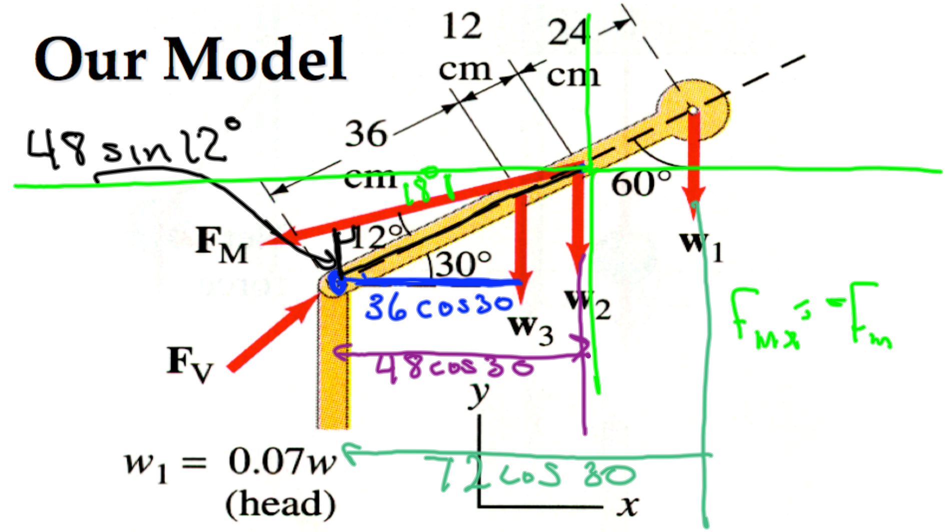
$$\sum \tau = 0 = F_B(3\,cm) - F_W(15\,cm) - F_{BB}(35\,cm) = 0$$

$$F_B(3\,cm) = F_W(15\,cm) - F_{BB}(35\,cm)$$

$$F_B = \frac{(5\,lb)(15\,cm) + (25\,lb)(35\,cm)}{3\,cm}$$

$$= \underline{320\,lb}$$

Our Model



$w_1 = 0.07w$ (head)

$w_2 = 0.12w$ (arms)

$w_3 = 0.46w$ (trunk)

w = Total weight of person

$$\Sigma\tau = F_M(48)\sin 12 - .46w(36\cos 30) - 48\cos 30(.12w) - .07w(72\cos 30) = 0$$

$$F_m(48)\sin 12 = .46w(36\cos 30) + (.12w)48\cos 30 + .07w(72\cos 30)$$

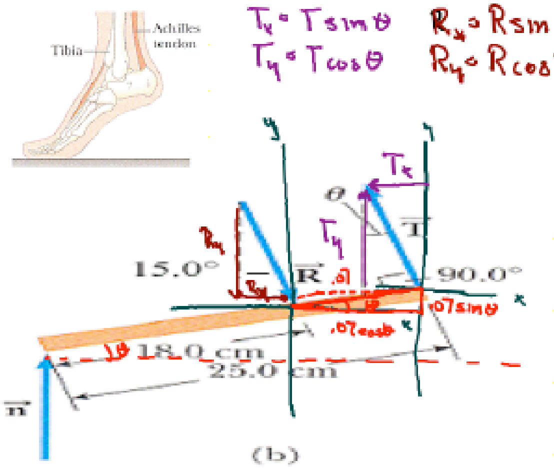
$$F_m = \frac{.46w\,36\cos 30 + .12w\,48\cos 30 + .07w\,72\cos 30}{48\sin 12}$$

$$= \underline{2.4\,w}$$

When a person stands on tiptoe (a strenuous position), the position of the foot is as shown in Figure P8.16a. The total gravitational force on the body, $\vec{F}_g$, is supported by the force $\vec{n}$ exerted by the floor on the toes of one foot. A mechanical model of the situation is shown in Figure P8.16b, where $\vec{T}$ is the force exerted by the achilles tendon on the foot and $\vec{R}$ is the force exerted by the tibia on the foot. Find the magnitudes of $\vec{T}$, $\vec{R}$, and θ when $\vec{F}_g$ = 785 N. You may not assume that $\vec{R}$ is parallel to $\vec{T}$.

$T_x = T\sin\theta \qquad R_x = R\sin 15$

$T_y = T\cos\theta \qquad R_y = R\cos 15$



$\Sigma F_y = n - R\cos 15 + T\cos\theta = 0$

$\Sigma F_y = R\sin 15 - T\sin\theta = 0$

Choose pivot at T; sum torques

$-n(25)\cos\theta + R_y(.07)\cos\theta + R_x(.07)\sin\theta = 0$

$\sin\theta = \frac{R\sin 15}{T}\ ; \quad \cos\theta = \frac{R\cos 15 - n}{T}$

$\left[-n(25) + R_y(.07)\right]\left[\frac{R\cos 15 - n}{T}\right] + R_x(.07)\,\frac{\sin 15\, R}{T} = 0$

T's cancel

$\left[-n(25) + R\cos 15(.07)\right]\left[R\cos 15 - n\right] + R^2\sin^2 15\,(.07) = 0$

Simplify then use quadratic formula to solve for R

finally use the force equations to solve for T & θ. Be careful with algebra, it's easy to make a mistake

$R = 2240\text{ N}$

$\theta = 21.2°$

Title: Nov 1-4:24 PM (7 of 7)