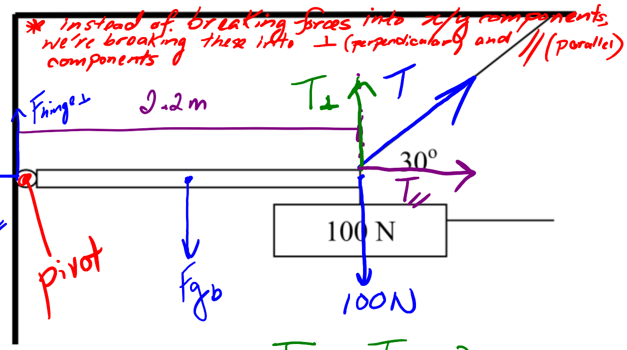
Name: ______________________________ Phys 12

3.6 Torque (part 2)

Last class, we looked at torques caused by perpendicular forces acting on lever arms. What if these forces are **not** acting perpendicular on our lever arm?

Key point: we need to find the component of the force acting perpendicular to the beam and use this to find torque.

Ex. 1: A 2.2m long 50.0N uniform bean is attached to the wall by a hinge. A 100N weight is attached to the end of the uniform beam.
a) What is the tension in the rope?
b) What are the vertical and horizontal components of the supporting force provided by the hinge? $\tau = F_\perp d$



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

$\tau_b + \tau_{mass} = \tau_{tension}$

$F_{gb}(1.1m) + 100(2.2m) = T_\perp(2.2m)$

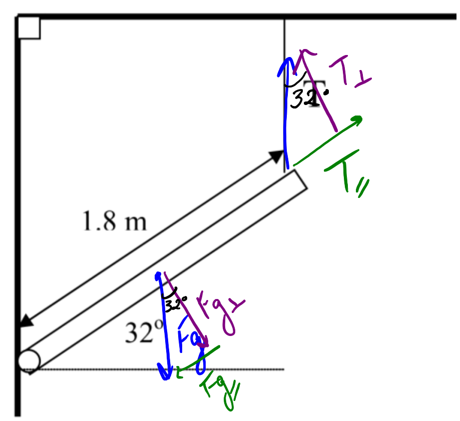
$\frac{50.0(1.1) + 100(2.2)}{\sin 30\,(2.2)} = \frac{T\sin 30(2.2)}{\sin 30(2.2)}$

$T = \frac{50.0(1.1) + 100(2.2)}{\sin 30(2.2)} = \boxed{250N}$

b) $\Sigma F_y = 0$, $\Sigma F_x = 0$

x direction: $F_{h//} = T_{//}$

Ex. 2: A 12.0kg uniform beam is attached to the celling by the rope shown on the right. What is the tension in the rope?



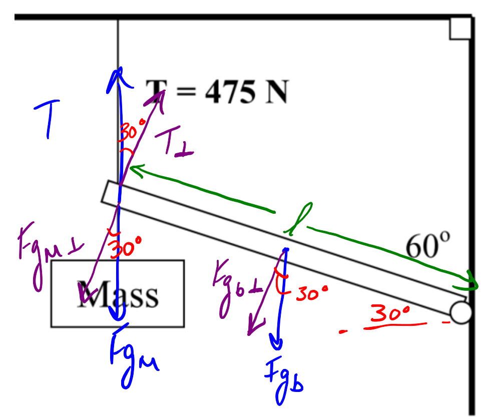
$\Sigma \tau_{cw} = \Sigma \tau_{ccw}$ $\qquad \tau = F_\perp d$

$T_\perp(1.8) = F_{g\perp}\left(\frac{1.8}{2}\right)$

$\frac{T\cos 32(1.8)}{\cos 32(1.8)} = \frac{mg\cos 32\left(\frac{1.8}{2}\right)}{\cos 32\,(1.8)}$

$T = \frac{12(9.8)\cos 32\,(0.9)}{\cos 32\,(1.8)} = \boxed{59N}$

Ex. 3: A mass is tied to the very end of a 115N uniform beam. A rope is tied at the end of this beam and has a tension force of 475N. What is the mass tied to the end of this rope?



$\Sigma \tau_{cw} = \Sigma \tau_{ccw}$ $\qquad \tau = F_\perp d$

$T_\perp \ell = F_{gM\perp}\ell + F_{gb\perp}\frac{\ell}{2}$

$T\cos 30 = Mg\cos 30 + \frac{m_b g\cos 30}{2}$

$-\frac{m_b g\cos 30}{2} \qquad -\frac{m_b g\cos 30}{2}$

$\frac{T\cos 30 - \frac{m_b g\cos 30}{2}}{g\cos 30} = \frac{Mg\cos 30}{g\cos 30}$

$M = \frac{T - mg/2}{g} = \frac{475 - 115/2}{9.8} = \boxed{43kg}$

HW: Worksheet 3.4 ALL