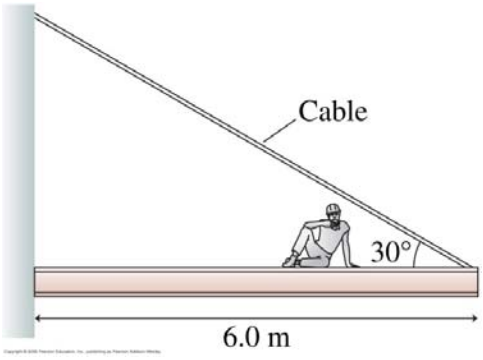
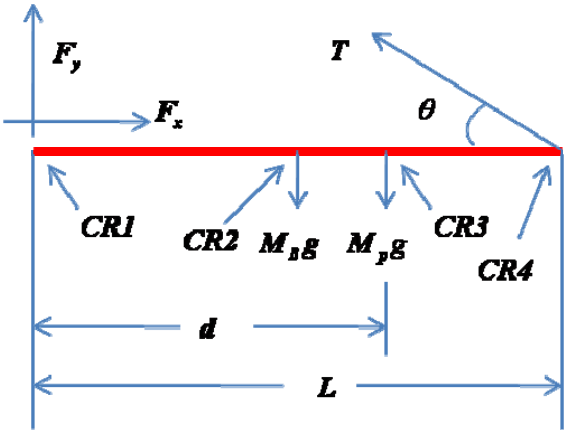
Physics 2211K, 11/2/ 2010
Quiz # 9 Solutions

In the system below, the uniform beam has mass M_B **& length** L, the person has mass M_p, and the cable's breaking strength is T_{max}. (Use g = 10 m/s^2.)

a. What is the maximum ***distance from the wall*** (***d***) the person can be without the tension in the cable exceeding the breaking point?

b. Calculate the *x*- and *y*- components of the force the wall exerts on the beam.





Analysis:

Forces

$$x: \quad 0 = F_x - T\cos\theta \Rightarrow \boxed{F_x = T\cos\theta}$$

$$y: \quad 0 = F_y + T\sin\theta - M_Bg - M_pg \Rightarrow \boxed{F_y = (M_B + M_p)g - T\sin\theta}$$

Torques

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

$$CR1: \quad \left(\frac{L}{2}\right)M_Bg + (d)M_pg = (L)T\sin\theta$$

$$\text{Thus,} \quad \boxed{d_{max} = \frac{(L)T_{max}\sin\theta - \left(\frac{L}{2}\right)M_Bg}{M_pg}}$$

Other possible CR's :

$$CR2: \quad \left(\frac{L}{2}\right)F_y + \left(d - \frac{L}{2}\right)M_pg = \left(\frac{L}{2}\right)T\sin\theta$$

$$CR3: \quad (d)F_y = \left(d - \frac{L}{2}\right)M_Bg + (L - d)T\sin\theta$$

$$CR4: \quad (L)F_y = \left(\frac{L}{2}\right)M_Bg + (L - d)T\sin\theta$$

Note : ***The relations for all CR's reduce to that for CR1 after substituting the expression for*** F_y***. Thus, the choice of CR is unimportant if the torques are expressed correctly.***

Ver. 1 M_B **= 1800 kg,** M_p **= 75 kg,** and T_{max} **= 17,500 N.** (Use g = 10 m/s^2.)
d_{max} **= -2m (beam will fall regardless!!) @** T_{max}**,** F_x **= 15155 N ;** F_y **= 10000 N**

Ver. 2 M_B **= 1500 kg,** M_p **= 100 kg,** and T_{max} **= 15,000 N.** (Use g = 10 m/s^2.)
d_{max} **= 0m (Can't be on the beam!!) @** T_{max}**,** F_x **= 12990 N ;** F_y **= 8500 N**

Ver. 3 M_B **= 2000 kg,** M_p **= 100 kg,** and T_{max} **= 18,000 N.** (Use g = 10 m/s^2.)
d_{max} **= -6m (beam will fall regardless!!) @** T_{max}**,** F_x **= 15588 N ;** F_y **= 12000 N**