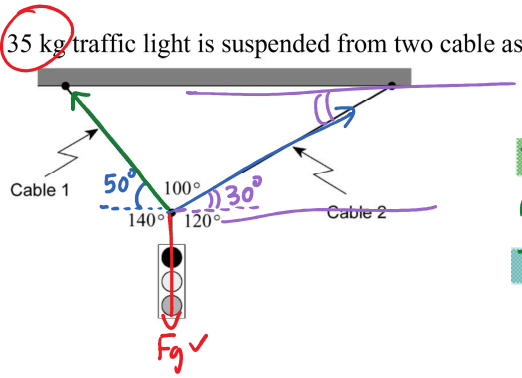
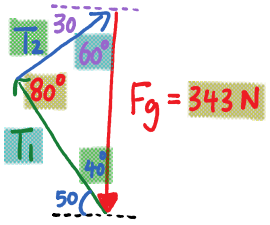
Physics 12 – Equilibrium Test Review

1. A 35 kg traffic light is suspended from two cable as show in the diagram. What is the tension on Cable 2?





$$\frac{343}{\sin 80^\circ} = \frac{T_2}{\sin 40^\circ}$$

$$T_2 = 224\ N$$

2. A 6.0 m uniform beam of mass 32 kg is suspended horizontally by a hinged end and a cable. A 93 kg object is connected to one end of the beam. What is the total force on the hinge? (magnitude and dir)

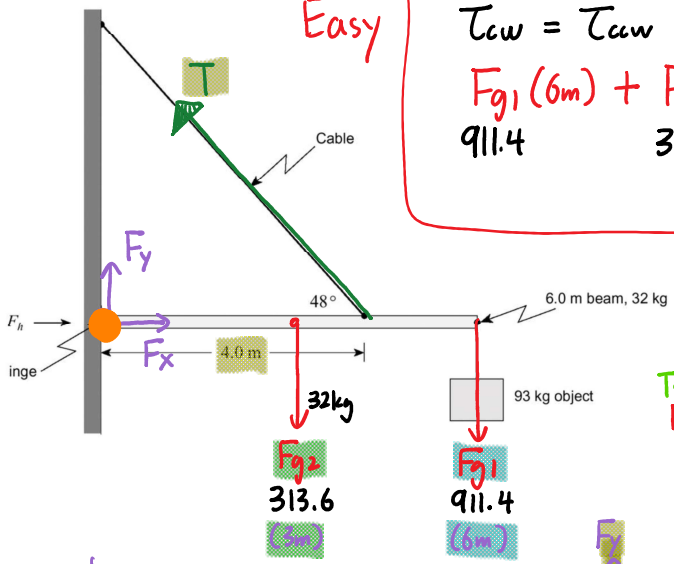
Easy

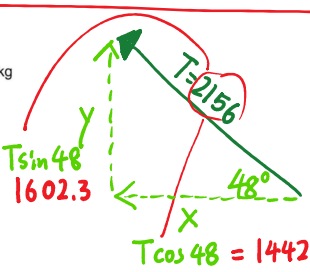
$$\tau_{cw} = \tau_{ccw}$$

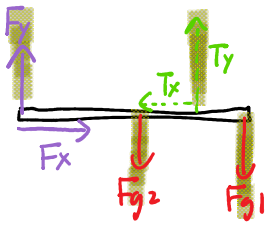
$$F_{g1}(6m) + F_{g2}(3m) = T(4m)\sin 48^\circ$$

$$911.4 \qquad 313.6$$

$$T = 2156.1\ N$$

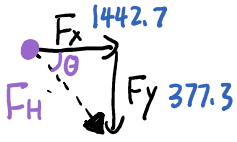






$$\Sigma F_x = \emptyset$$

$$F_x = T_x = 1442.7\ N \quad \rightarrow F_x$$



$$\Sigma F_y = \emptyset$$

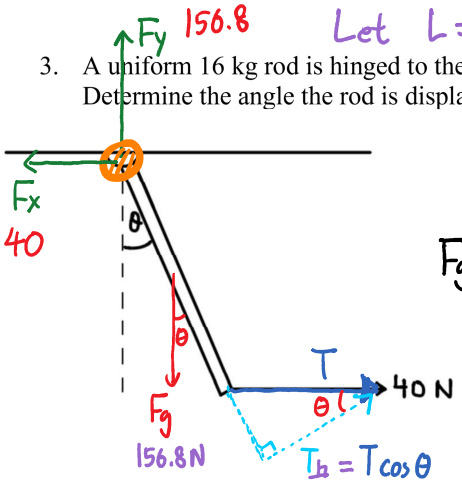
$$F_y + T_y = F_{g1} + F_{g2}$$

$$F_y + 1602.3 = 911.4 + 313.6$$

$$F_y = -377.3\ N \quad \downarrow F_y$$

$$F_H = 1491\ N \qquad \theta = 14.7^\circ$$

3. A uniform 16 kg rod is hinged to the ceiling. A horizontal force of 40 N is exerted at the bottom end of the rod. a) Determine the angle the rod is displaced from the vertical. b) Determine the force the hinge exerts on the rod.



$$T_{cw} = T_{ccw}$$

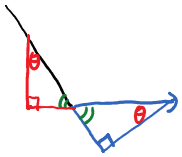
$$F_g(5m)\sin\theta = T_h(10m)$$

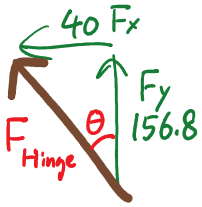
$$156.8(5)\sin\theta = \overset{40}{T}\cos\theta(10)$$

$$\frac{\sin\theta}{\cos\theta} = \frac{40(10)}{156.8(5)}$$

$$\tan\theta = 0.51$$

$$\theta = 27°$$



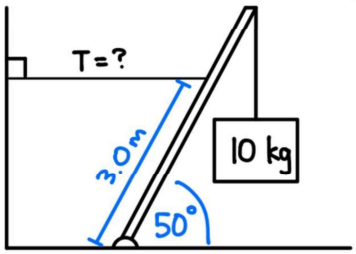


$a^2+b^2=c^2$

$$F_{Hinge} = 161.8\ N$$

$$\theta = \tan^{-1}\left(\frac{40}{156.8}\right) = 14.3°$$

4. A uniform 5.0 m long beam of mass 50 kg is hinged to the floor. A 10 kg load hangs from the end of the beam. The apparatus is prevented from falling with a cable attached to the wall as shown. a) What is the tension in the cable? b) What are the magnitude and direction of the force of the hinge?



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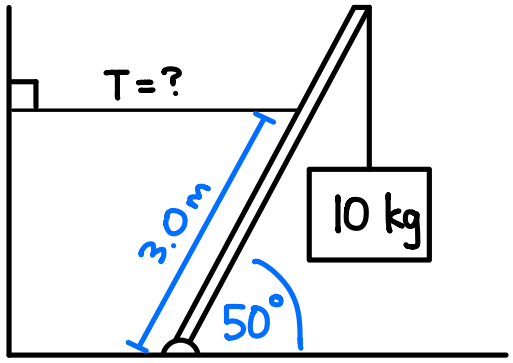
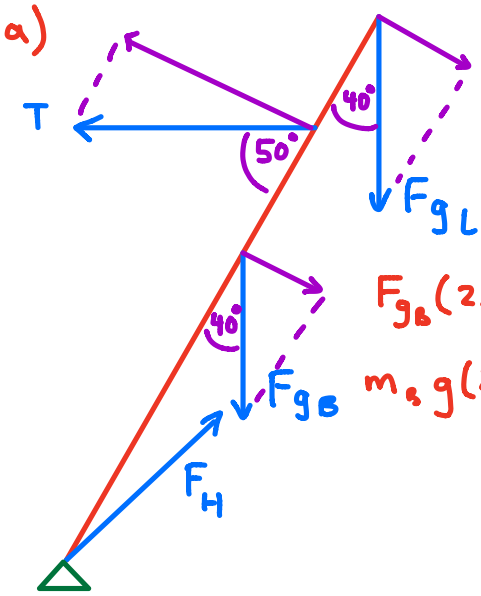




$\tau_{cw} = \tau_{ccw}$

$F_{g_B}(2.5)\sin 40^\circ + F_{g_L}(5.0)\sin 40^\circ = T(3.0)\sin 50^\circ$

$m_B g(2.5)\sin 40^\circ + m_L g(5.0)\sin 40^\circ = T(3.0)\sin 50^\circ$

$$T = \frac{m_B g(2.5)\sin 40^\circ + m_L g(5.0)\sin 40^\circ}{3.0\sin 50^\circ}$$

$= \boxed{480\ \text{N}}$

b)

$F_{NET} = 0$

$\Sigma F_x = 0$

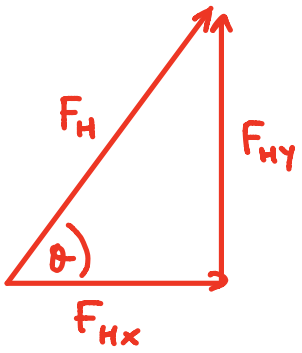
$F_{Hx} = T = 480\ N$

$\Sigma F_y = 0$

$F_{HY} = F_{gB} + F_{gL}$

$= (m_B + m_L)\, g$

$= 588\ N$



$$F_H = \sqrt{F_{Hx}^2 + F_{HY}^2}$$

$= 759\ N$

$$\theta = \tan^{-1}\left(\frac{F_{HY}}{F_{Hx}}\right)$$

$= 50.8^\circ$

759 N 50.8° ABOVE THE HORIZONTAL