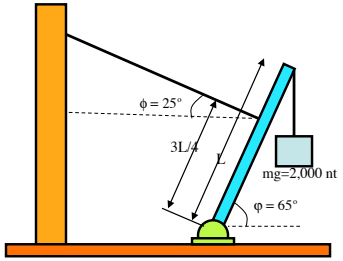
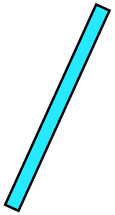
Problem 8.28

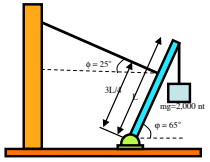
A 1200 newton beam is pinned at the floor. If a 2000 newton weight is suspended from the end of the beam, what will the tension in the cable be and the forces acting at the pin?



f.b.d.



In looking for the tension, the trick is to sum the torques about the pin. (Why? Because the torque due to V and H are zero about the pin, so you can eliminate having to deal with those forces by summing the torques about that point). Doing this, we get:

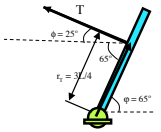


$$\Gamma_T + \Gamma_H + \Gamma_V + \Gamma_w + \Gamma_b = I\alpha$$

$$|r_T|\,|F_T|\sin\theta + 0 + 0 + (-\,r_{\perp,w}\,|F_w|) + (-\,r_{\perp,b}\,|F_b|) = 0$$

$$\left(\frac{3L}{4}\right)(T)\sin 90^\circ + 0 + 0 + \left[-(r_w\cos\varphi)(m_w g)\right] + \left[-(r_b\cos\varphi)(m_b g)\right] = 0$$

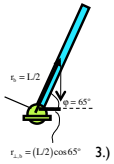
$$\Rightarrow \left(\frac{3\cancel{L}}{4}\right)(T)\sin 90^\circ - \left(\cancel{L}\cos 65^\circ\right)(m_w g) - \left(\frac{\cancel{L}}{2}\cos 65^\circ\right)(m_b g) = 0$$



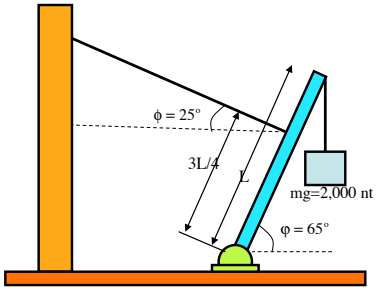
$$\Rightarrow T = \frac{(\cos 65^\circ)(m_w g) + \left(\frac{1}{2}\cos 65^\circ\right)(m_b g)}{3/4}$$

$$\Rightarrow T = \frac{(\cos 65^\circ)(2000\text{ nt}) + \left(\frac{1}{2}\cos 65^\circ\right)(1200\text{ nts})}{3/4}$$

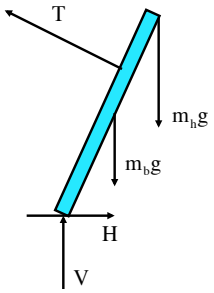
$$\Rightarrow T = 1465\text{ nts}$$



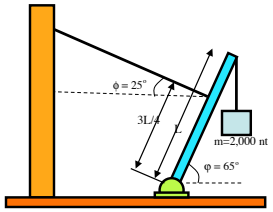
A 1200 newton beam is pinned at the floor. If a 2000 newton weight is suspended from the end of the beam, what will the tension in the cable be and the forces acting at the pin?



f.b.d.



To determine the forces at the pin (V and H), we need two more equations. We can get them by summing the forces in both the x and y directions. That is:



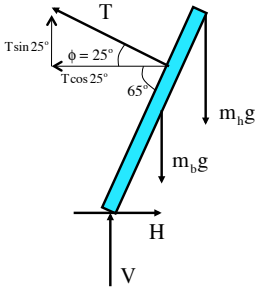
$$\sum F_x:$$

$$-T\cos 25^\circ + H = ma_x$$

$$\Rightarrow H = T\cos 25^\circ$$

$$\Rightarrow H = (1465\text{ nt})\cos 25^\circ$$

$$\Rightarrow H = 1328\text{ nts}$$



$$\sum F_y:$$

$$T\sin 25^\circ + V - m_w g - m_b g = ma_y$$

$$\Rightarrow V = -T\sin 25^\circ + (2000\text{ nt}) + (1200\text{ nt})$$

$$\Rightarrow V = -(1465\text{ nts})\sin 25^\circ + (2000\text{ nt}) + (1200\text{ nt})$$

$$\Rightarrow V = 379\text{ nts}$$