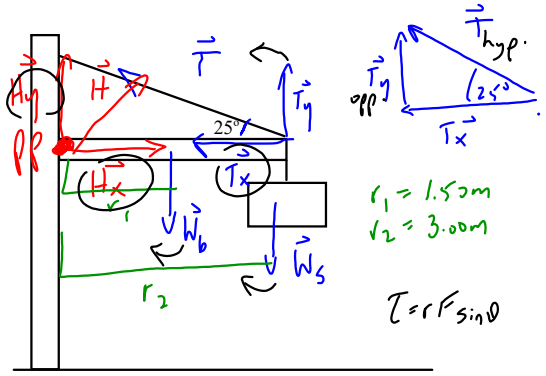
Torque Type II - Forces Acting at Angles

Example: A uniform beam of mass 50.0 kg and length 3.00 m is attached to a wall with a hinge. The beam supports a sign of mass 300 kg which is suspended from its end. The beam is also supported by a wire that makes an angle of 25 ° with the beam. Determine the components of the force that the hinge exerts and the tension in the wire.



$$\tau_{net} = 0\ Nm$$

$$-\tau_{W_b} - \tau_{W_s} + \tau_{T_y} = 0$$

$$-r_1 W_b \sin 90.0^\circ - r_2 W_s \sin 90.0^\circ + r_2 T_y \sin 90.0^\circ = 0$$

$$-r_1 m_b g - r_2 m_s g + r_2 T \sin 25^\circ = 0$$

$$T = \frac{r_1 m_b g + r_2 m_s g}{r_2 \sin 25^\circ}$$

$$T = \frac{(1.50)(52.0)(9.80) + (3.00)(300)(9.80)}{3.00 \sin 25^\circ}$$

$$T = 7.5 \times 10^3\ N \leftarrow$$

$$F_{net} = ma \quad (hor.)$$

$$+H_x - T_x = 0$$

$$H_x = T_x$$

$$H_x = T\cos 25^\circ$$

$$H_x = (7.5 \times 10^3)\cos 25^\circ$$

$$H_x = 6.8 \times 10^3\ N$$

$$F_{net} = ma \quad (vert.)$$

$$+T_y + H_y - W_b - W_s = 0$$

$$T\sin 25^\circ + H_y - m_b g - m_s g = 0$$

$$H_y = m_b g + m_s g - T\sin 25^\circ$$

$$H_y = (52.0)(9.80) + (300)(9.80) - (7.5 \times 10^3)\sin 25^\circ$$

$$H_y = 2.6 \times 10^2\ N$$

W5