Remember: $\sum \vec{F} = m \vec{a}$; $\sum \vec{\tau} = \vec{I} \vec{\alpha} = r \times \vec{F}$

Moment of inertia of slender rod, axis through one end: $I = \frac{ML^2}{3}$

Give answers with correct units and two significant figures

A block of weight $W = 50.0\text{N}$ is suspended from the center of a horizontal ruler of length $L = 50\text{ cm}$ of negligible mass. The ruler is supported at its right-hand end by a cable at an angle of $\theta = 30^\circ$ from the horizontal and at its left-hand end by a hinge at point $P$.

(a) What is the net torque on the ruler? What is the net force on the rule? Is this system in equilibrium?

(b) What is the tension in the cable?

(c) What is the horizontal hinge force?

(d) What is the vertical hinge force?
Nothing is moving ⇒

a) In equilibrium at
\[ \Sigma F = 0 \quad \Sigma \tau = 0 \]

b) Tension in the cable? Use \( \Sigma \tau = 0 \)
\[ \Sigma \tau = 0 = \Sigma T \sin \theta \cdot L \]
Use point P as pivot from which measure \( r \).
\[ 0 = -WL/2 + T \sin \theta \cdot L \Rightarrow T = \frac{WL/2}{\sin \theta} = \frac{W}{\sin \theta} \cdot L \]
\[ T = 50N \cdot \frac{1}{2} = 25N = T \]

(c) Want \( P_h = \) Horizontal hinge force.
\[ \Sigma F = 0 \Rightarrow \Sigma F_x = 0 \quad \Sigma F_y = 0 \]
\[ \Sigma F_x = 0 = P_h - T \cos \theta \Rightarrow P_h = T \cos \theta = 50N \cdot \frac{\sqrt{3}}{2} \]
\[ P_h = 43N \]

(d) \( \Sigma F_y = 0 = P_v - W + T \sin \theta = 0 \)
\[ P_v = W - T \sin \theta = 50N - 50N \cdot \frac{1}{2} = 25N = P_v \]