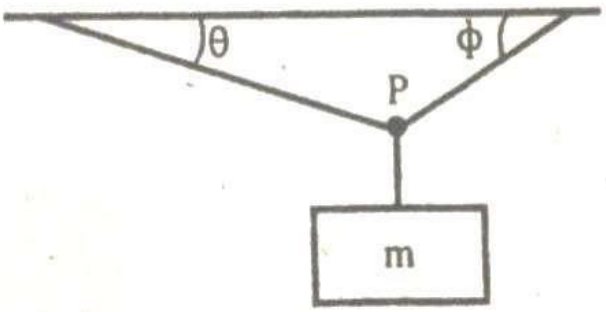
Answer on Question #57701, Physics / Mechanics | Relativity

A rope is hung at both ends from a horizontal beam, and a weight m is suspended from it. The left part of the rope exerts a force G at P, while the right part of the rope exerts a force H. Find the indicated quantities from the given data.

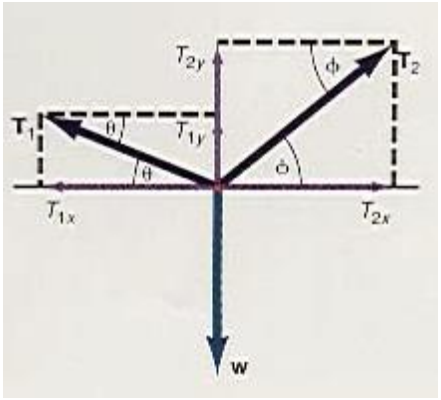
m = 50 kg
θ (theta) = 17°
Ø = 6°

|G| = ?
|H| = ?

Solution:



All the forces that are acting are drawn in figure:



The weight is

$$w = mg = 50 \cdot 9.8 = 490 \text{ N}$$

The forces are resolved into their components, as shown in figure, where

$$T_{1x} = G\cos\theta$$
$$T_{1y} = G\sin\theta$$
$$T_{2x} = H\cos\phi$$
$$T_{2y} = H\sin\phi$$

The first condition of equilibrium must hold. Setting the forces in the x-direction to zero

$$\sum F_x = 0$$

gives

$$T_{2x} - T_{1x} = 0$$
$$H\cos\phi = G\cos\theta \quad (1)$$

Taking all the forces in the y-direction and setting them equal to zero,

$$\sum F_y = 0$$
$$T_{1y} + T_{2y} - w = 0$$

Using equations for the components, this becomes

$$G\sin\theta + H\sin\phi = w \quad (2)$$

From equation (1)

$$G = \frac{H\cos\phi}{\cos\theta}$$

If we substitute this equation for G into equation (2)

$$\frac{H\cos\phi}{\cos\theta}\sin\theta + H\sin\phi = w$$

$$H(\cos\phi \cdot \tan\theta + \sin\phi) = w$$

Hence,

$$H = \frac{w}{\cos\phi \cdot \tan\theta + \sin\phi} = \frac{490\ \text{N}}{\cos 6° \cdot \tan 17° + \sin 6°} = 1199\ \text{N}$$

$$G = \frac{H\cos\phi}{\cos\theta} = \frac{1199 \cdot \cos 6°}{\cos 17°} = 1247\ \text{N}$$

Answer: |G| =1247 N; |H| =1199 N.