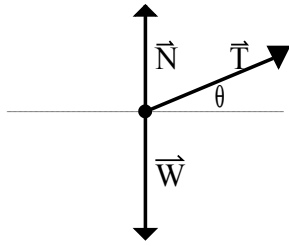


Chapter 5 Problem 17 †



Given

$$m = 1400 \text{ kg}$$

$$\theta = 25^\circ$$

$$a = 0.57 \text{ m/s}^2$$

Solution

Find the tension in the cable.

The free-body diagram is given above. The x-coordinate is chosen to be in the horizontal direction. Applying Newton's 2nd law gives

$$\Sigma \vec{F} = m\vec{a}$$

$$\vec{T} + \vec{W} + \vec{N} = m\vec{a}$$

The acceleration is in the $+x$ direction. Therefore, the equation in unit vector notation is

$$T \cos \theta \hat{i} + T \sin \theta \hat{j} - mg \hat{j} + N \hat{j} = ma \hat{i}$$

The x-component equation is then

$$T \cos \theta = ma \tag{1}$$

The y-component equation is

$$T \sin \theta - mg + N = 0 \tag{2}$$

From equation (1) the value of tension is

$$T = \frac{ma}{\cos \theta} = \frac{(1400 \text{ kg})(0.57 \text{ m/s}^2)}{\cos(25^\circ)}$$

$$T = 880 \text{ N}$$

†Problem from Essential University Physics, Wolfson