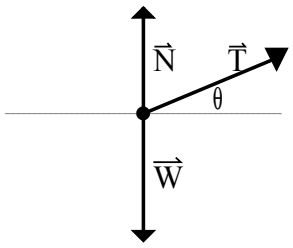
Chapter 5 Problem 17 [†]



Given
$m = 1400\ kg$
$\theta = 25°$
$a = 0.57\ m/s^2$

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 Netwon's 2^{nd} 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

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

$$T = 880\ N$$

[†]Problem from Essential University Physics, Wolfson