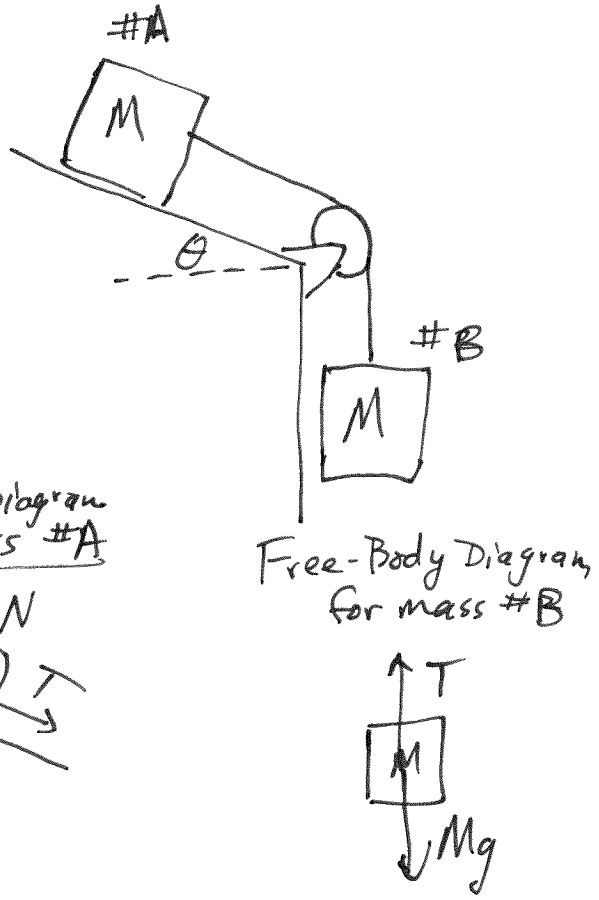
Chapter 6 Problem 95

$\theta = 30°$
$M = 6.0\,kg$
Frictionless surface

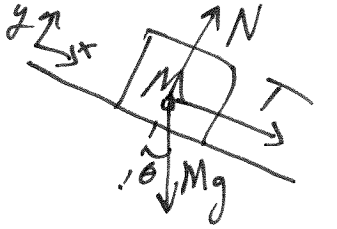


What is the tension in the connecting string?

Apply Newton's 2nd Law

Mass #A $\quad \sum \vec{F} = m\vec{a}$

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



Align the coordinate system with the x-axis parallel to the slope. Then

$$N\hat{j} + T\hat{i} + Mg\sin\theta\,\hat{i} - Mg\cos\theta\,\hat{j} = Ma\hat{i}$$

x-dir $\quad T + Mg\sin\theta = Ma$ (#1)

y-dir $\quad N - Mg\cos\theta = 0$ (#2)

Mass #B $\quad \sum \vec{F} = m\vec{a}$

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

Align y-axis with the positive vertical direction (to be consistent with the equations for Mass #A, the acceleration is in the downward direction)

$$T\hat{j} - Mg\hat{j} = -Ma\hat{j}$$

y-dir $\quad T - Mg = -Ma$ (#3)

With No friction, we don't need equation (#2)

Take (#3) + solve for acceleration

$$\frac{T - Mg}{-M} = \frac{-Ma}{-M} \rightarrow a = g - \frac{T}{M} \quad (\#4)$$

Sub into (#1)

$$T + Mg\sin\theta = M\left(g - \frac{T}{M}\right)$$

$$T + Mg\sin\theta = Mg - T$$

$$2T = Mg - Mg\sin\theta$$

$$2T = Mg(1 - \sin\theta)$$

$$T = \frac{Mg}{2}(1 - \sin\theta) = \frac{(6\,kg)(9.8\,m/s^2)(1 - \sin 30)}{2}$$

$$T = 14.7\,N$$