Strings and Tension
PHYS 2425

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1. Conceptual Questions

Suppose three different blocks are all connected by strings, and are being pulled along the ground plane by someone pulling on them with a rope.
A. Is the tension in all three strings going to be the same? why or why not?

No, becuase each string is responsible for accelerating a diffferent amount of mass.

B. Which of the three strings will have the most tension?

The one used by the person to pull all the blocks.

C. Why does tension remain constant across and ideal pulley?

This is because in an ideal pulley there is no friction or mass to work against the tension. So any change in tension would mean an acceleration in the rope.

2. Newton's Laws

A. A 2.0 kg block rests on a frictionless table and is connected to a 1.0 kg hanging block by a string over a pulley. (a) Find the acceleration of the system. (b) Find the tension in the string.

The acceleration is given by $a = \frac{m_2 g}{m_1 + m_2} = \frac{1.0 \times 9.8}{2.0 + 1.0} = 3.27 \, \frac{m}{s^2}$.

The tension is $T = m_1 a = 2.0 \times 3.27 \approx 6.53 \, \text{N}$.

B. A 4.0 kg block on a frictionless incline at 30° is connected by a string over a pulley to a 2.0 kg hanging block. (a) Determine the acceleration of the system. (b) Determine the tension in the string.

The acceleration is $a = \frac{g(m_2 - m_1 \sin\theta)}{m_1 + m_2} = \frac{9.8(2.0 - 4.0 \times 0.5)}{6.0} = 0 \, \frac{m}{s^2}$. The system is in equilibrium.

The tension equals the hanging weight, $T = m_2 g = 2.0 \times 9.8 = 19.6 \, \text{N}$.