Phys A - week 4 - Giancoli Ch 4 - Dynamics

#5, 21, 26, 36, 40, 66, 69, 72, 75

See solutions to (*) problems in earlier HW assignments for Phys B.
\[ \Sigma F_x = m_2 g \quad \Sigma F_y = m_1 g \]

\[ m_2 g - T = m_2 a \quad T - m_1 g \sin \theta = m_1 a \]

\[ g - \frac{T}{m_2} = a \quad \frac{T}{m_1} - g \sin \theta = a \]

(a) Solve for \( a \) by eliminating \( T \), or vice versa.

\[ a = g - \frac{T}{m_2} = \frac{T}{m_1} - g \sin \theta \]

\[ m_2 g - T = \frac{m_2}{m_2 + m_1} T - m_2 g \sin \theta \]

\[ m_2 (g + \sin \theta) = T (\frac{m_2}{m_2 + m_1} + 1) = T (\frac{m_2 + m_1}{m_1}) \]

\[ \frac{m_2 m_1 (g + \sin \theta)}{(m_2 + m_1)} \]

(not needed, but interesting and potentially useful)

\[ T = m_2 g - m_1 a = m_1 a + m_1 g \sin \theta \]

\[ g (m_2 - m_1, \sin \theta) = a (m_1 + m_2) \]

\[ a = \frac{g (m_2 - m_1, \sin \theta)}{m_1 + m_2} \]
6.4 #64

In the previous problem, if \( m_1 = m_2 = 1.00 \) kg and \( \theta = 30^\circ \), find the tension in the string. Find \( a_1 \) and \( a_2 \).

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**Problem Statement:**

Consider a system with two objects, \( m_1 \) and \( m_2 \), connected by a string of length \( L \). The system is at rest on a horizontal surface. The angle \( \theta \) between the string and the horizontal is given. The tension in the string is \( T \) and the acceleration of the system is \( a \).

**Given:**

- \( T = 3 \text{ N} \)
- \( m_1 = 1.5 \text{ kg} \)
- \( m_2 = 1.5 \text{ kg} \)
- \( L = 1 \text{ m} \)
- \( \theta = 30^\circ \)

**Find:**

- Tension in the string, \( T_1 \)
- Acceleration of the system, \( a \)

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**Solution:**

1. **Tension Calculation**
   - Use the equation for tension in the string.
   - \( T = m_1 g + m_2 g \sin \theta \)
   - \( T = 1.5 \text{ kg} \times 9.8 \text{ m/s}^2 + 1.5 \text{ kg} \times 9.8 \text{ m/s}^2 \times \sin 30^\circ \)
   - \( T = 44.1 \text{ N} \)
   - Therefore, \( T_1 = 44.1 \text{ N} \)

2. **Acceleration Calculation**
   - Use the equation for acceleration of the system.
   - \( a = \frac{T}{m_1 + m_2} \)
   - \( a = \frac{44.1 \text{ N}}{1.5 \text{ kg} + 1.5 \text{ kg}} \)
   - \( a = 1.14 \text{ m/s}^2 \)

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**Note:**

The problem statement is incomplete, and further steps may be required to find additional variables. The solution provided calculates the tension in the string and the acceleration of the system. Further steps would involve analyzing the forces acting on the objects and solving for the desired variables.
Window washer pulls herself up.

\( \text{How hard must she pull to raise herself slowly at constant speed? } T = \) 

\( M = 58 \text{ kg} \)

\[ T \uparrow \quad \quad \sum F = Ma \]

\[ 2T - Mg = Ma \]

\[ a = \frac{2T - g}{M} \]

\[ T = \frac{M(a + g)}{2} \]

\( \text{At constant speed, } a = 0 \text{ so} \)

\[ T_0 = \frac{M(a + g)}{2} = \frac{gM}{2} = \frac{10^2 \times 58\text{ kg}}{2} = 260 \text{ N} \]

She has to pull half her weight of 580 N

\( \text{If } T' = 1.1T_0 = 1.1 \times \frac{gM}{2} \text{ then} \)

\[ \frac{a'}{M} = \frac{2T' - g}{M} = \frac{2}{M} \left( 1.1 \times \frac{gM}{2} \right) = 1.1g - g = 0.1g \]

\[ \approx 1 \text{ m/s}^2 \]