

Physics 101Rec

Quiz # 6

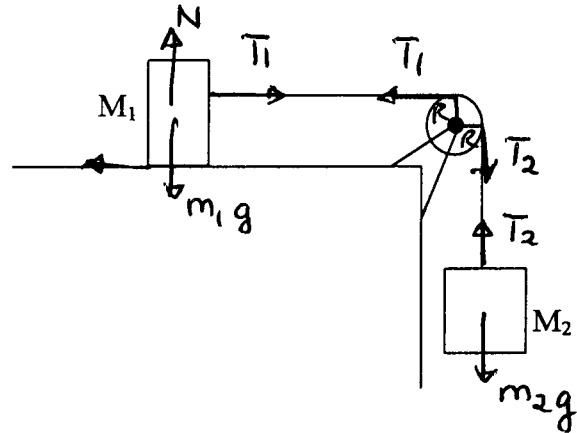
Chapter 11

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Name: Key Id: _____ Sect: _____

An $M_1 = 10$ kg mass and $M_2 = 15$ kg mass are suspended by a pulley that has a radius of 10 cm and mass 3.0 kg. The cord has a negligible mass and causes the pulley to rotate without slipping. The table has a coefficient of kinetic friction of 0.20. Find the tension in the string and the linear acceleration of the masses.

Given : $I_{CM} = 1/2 MR^2$



For mass m_1 :

$$T_1 - f_k = m_1 a$$

$$f_k = \mu_k N = \mu_k m_1 g$$

$$\Rightarrow T_1 - \mu_k m_1 g = m_1 a \quad \text{--- (1)}$$

For mass m_2 :

$$m_2 g - T_2 = m_2 a \quad \text{--- (2)}$$

For pulley:

$$T_2 R - T_1 R = I \alpha = I \frac{a}{R} \Rightarrow T_2 - T_1 = \frac{I a}{R^2} \quad \text{--- (3)}$$

$$(1) \Rightarrow T_1 = m_1 a + \mu_k m_1 g$$

$$(2) \Rightarrow T_2 = m_2 g - m_2 a$$

$$(3) \Rightarrow m_2 g - m_2 a - m_1 a - \mu_k m_1 g = \frac{I a}{R^2}$$

$$a \left(\frac{I}{R^2} + m_1 + m_2 \right) = m_2 g - \mu_k m_1 g$$

$$\Rightarrow a = \frac{m_2 g - \mu_k m_1 g}{m_1 + m_2 + \frac{I}{R^2}} = \frac{m_2 g - \mu_k m_1 g}{m_1 + m_2 + \frac{M}{2}} = 4.8 \frac{m}{s^2}$$

$$\Rightarrow T_1 = 67.5 \text{ N}$$

$$\text{and } T_2 = 75.0 \text{ N}$$