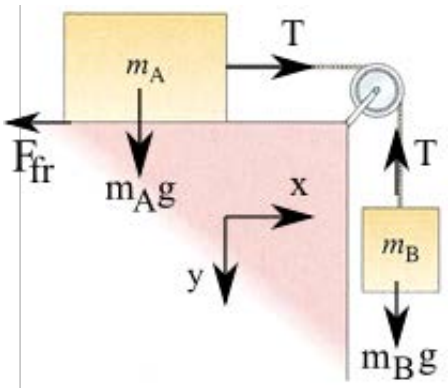
Answer on Question 68545, Physics, Other

Question:

A 5.0 kg mass moves along a horizontal surface when connected by a string passing over a pulley to a 2.5 kg mass. If its coefficient of kinetic friction is 0.25, what is its acceleration and the tension in the string?

Solution:



a) Let $m_A = 5.0\ kg$ and $m_B = 2.5\ kg$. Applying the Newton Second Law of Motion we get:

$$\sum F_x = m_A a_x,$$

$$T - F_{fr} = m_A a,$$

$$T - \mu_k m_A g = m_A a \text{ (1).}$$

$$\sum F_y = m_B a_y,$$

$$m_B g - T = m_B a. \text{ (2)}$$

Let's express T from the equation (1) and substitute it into the equation (2):

$$T = \mu_k m_A g + m_A a,$$

$$m_B g - \mu_k m_A g - m_A a = m_B a,$$

$$m_B g - \mu_k m_A g = (m_A + m_B) a,$$

$$a = \frac{g(m_B - \mu_k m_A)}{m_A + m_B} = \frac{9.8\ \frac{m}{s^2} \cdot (2.5\ kg - 0.25 \cdot 5.0\ kg)}{5.0\ kg + 2.5\ kg} = 1.63\ \frac{m}{s^2}.$$

b) Finally, substituting a into the equation for T we get:

$$T = m_A(\mu_k g + a) = 5.0\ kg \cdot \left(0.25 \cdot 9.8\ \frac{m}{s^2} + 1.63\ \frac{m}{s^2}\right) = 20.4\ N.$$

Answer:

a) $a = 1.63\ \frac{m}{s^2}$.

b) $T = 20.4\ N$.