Answer on Question 78012, Physics, Other

Question:

In an investigation a student placed a $0.85\ kg$ cart on a table. They tie one end of a light string (assume $0\ kg$) to the front of a cart, passes it through a pulley and then onto a $0.50\ kg$ hanging mass. Assume there is no friction.

a) Determine the magnitude of the acceleration of the cart and the hanging object.

b) Determine the magnitude of the tension.

Solution:

a) We can find the magnitude of the acceleration of the cart and the hanging object from the Newton's Second Law of Motion. Let's apply the Newton's Second Law of Motion in projections on axis x and y:

$$\sum F_x = m_1 a_x,$$

$$T = m_1 a. \ (1),$$

$$\sum F_y = m_2 a_y,$$

$$m_2 g - T = m_2 a. \ (2),$$

here, m_1 is the mass of the cart, m_2 is the mass of the hanging object, T is the tension in the string, g is the acceleration due to gravity and a is the acceleration of the cart and the hanging object.

Let's substitute T into equation (2) and find the magnitude of the acceleration of the cart and the hanging object :

$$m_2 g - m_1 a = m_2 a,$$

$$m_2 g = a(m_1 + m_2),$$

$$a = \frac{m_2 g}{(m_1 + m_2)} = \frac{0.50\ kg \cdot 9.8\ \frac{m}{s^2}}{(0.85\ kg + 0.50\ kg\ )} = 3.63\ \frac{m}{s^2}.$$

b) Finally, we can find the magnitude of the tension in the string from the equation (1):

$$T = m_1 a = 0.85\ kg \cdot 3.63\ \frac{m}{s^2} = 3.1\ N.$$

Answer:

a) $a = 3.63\ \frac{m}{s^2}$.

b) $T = 3.1\ N$.