

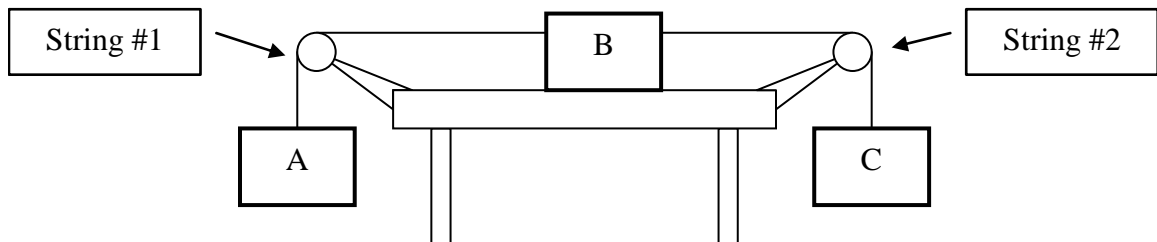
Quiz #6 Physics 201

NAME: **SOUTION**

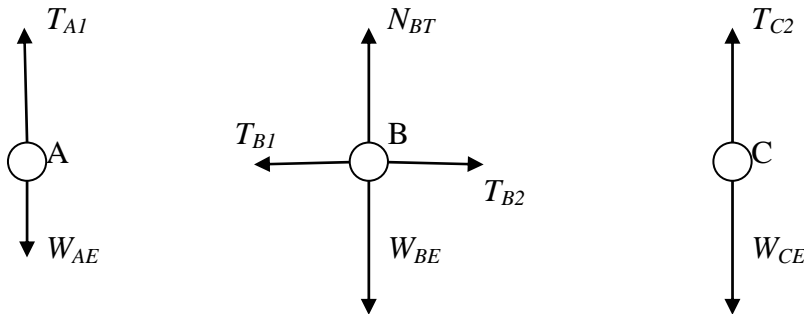
$$\sum \vec{F} = \frac{d\vec{p}}{dt} = m\vec{a} \text{ (if mass is constant),} \quad \vec{F}_{AB} = -\vec{F}_{BA} \text{ (always),} \quad 1 \text{ newton} = 1 \frac{\text{kg m}}{\text{s}^2}$$

Two blocks (block A and block C) hang from strings that run over pulleys attached to opposite ends of a small table. The other end of each string is attached to a third block (block B) which is on the horizontal surface of the table. The strings that attach to block B are horizontal. For the purposes of this question ignore the masses of the strings, the masses of the pulleys and friction in the pulleys.

Throughout this quiz: Block A has a mass of 1.1 kg, Block B has a mass of 1.9 kg, and Block C has a mass of 2.0 kg. The acceleration of objects in free fall is 10.0 m/s^2 .



- a) For part (a) of this quiz, assume there is no friction between the table and block B (so there is no friction anywhere).
- i) Find the acceleration of block B.



$$T_{A1} = T_{B1} = T_1 \quad T_{A2} = T_{B2} = T_2 \quad (\text{massless strings})$$

$$\text{Block A: } \Sigma F_y = T_1 - W_{AE} = m_A a$$

$$\text{Block B: } \Sigma F_y = N_{BT} - W_{BE} = 0$$

$$\Sigma F_x = T_2 - T_1 = m_B a$$

$$\text{Block C: } \Sigma F_y = W_{CE} - T_2 = m_C a$$

$$\text{Add 'em up: } W_{CE} - W_{AE} = (m_A + m_B + m_C) a$$

$$a = \frac{m_C g - m_A g}{(m_A + m_B + m_C)} = 1.8 \text{ m/s}^2$$

ii) (part a, continued: still no friction)

Find the tension in the cord that connects block B to block C.

$$\text{Block C: } \Sigma F_y = W_{CE} - T_2 = m_C a$$

$$a = \frac{m_C g - m_A g}{(m_A + m_B + m_C)} = 1.8 \text{ m/s}^2$$

$$W_{CE} - T_2 = m_C a = m_C (1.8 \text{ m/s}^2)$$

$$T_2 = m_C g - m_C (1.8 \text{ m/s}^2) = 16.4 \text{ N}$$

b) Now assume that there is friction between the table and block B but nowhere else. The velocity of block B points to the right and the coefficient of friction between block B and the table is 0.24.

i) Find the acceleration of block B.

We need to add a friction force pointing to the left on Block B.

$$\text{Block A: } \Sigma F_y = T_1 - W_{AE} = m_A a$$

$$\text{Block B: } \Sigma F_y = N_{BT} - W_{BE} = 0 \quad f_{BT} = \mu N_{BT} = \mu W_{BE}$$

$$\Sigma F_x = T_2 - T_1 - f_{BT} = m_B a$$

$$\text{Block C: } \Sigma F_y = W_{CE} - T_2 = m_C a$$

$$\text{Add 'em up: } W_{CE} - W_{AE} - \mu W_{BE} = (m_A + m_B + m_C) a$$

$$a = \frac{m_C g - m_A g - \mu m_B g}{(m_A + m_B + m_C)} = 0.85 \text{ m/s}^2$$

ii) Find the tension in the cord that connects block B to block C.

$$\text{Block C: } \Sigma F_y = W_{CE} - T_2 = m_C a$$

$$a = \frac{m_C g - m_A g - \mu m_B g}{(m_A + m_B + m_C)} = 0.85 \text{ m/s}^2$$

$$W_{CE} - T_2 = m_C a = m_C (0.85 \text{ m/s}^2)$$

$$T_2 = m_C g - m_C (0.85 \text{ m/s}^2) = 18.3 \text{ N}$$