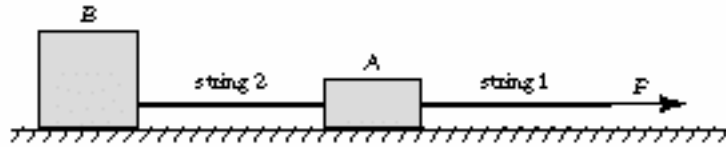


In-Class Problem 4 Concept Question: (*Newton's third law*)

In the situation below, a person pulls a string attached to block A, which is in turn attached to another, heavier block B via a second string. Assume the strings are massless and inextensible; and ignore friction.

- a) Does block A have a larger, equal, or smaller acceleration than block B?
- b) What is the force of string 1 on block A? What is the force of string 2 on block B? Explain your answers.



Answer:

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Physics

Physics 8.01T

Fall Term 2004

In-Class Problems 4, and 5: Newton's Laws of Motion Solutions

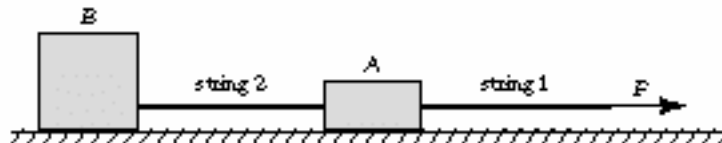
We would like each group to apply the problem solving strategy with the four stages (see below) to answer the following two problems.

- I. Understand – get a conceptual grasp of the problem
- II. Devise a Plan - set up a procedure to obtain the desired solution
- III. Carry out your plan – solve the problem!
- IV. Look Back – check your solution and method of solution

In-Class Problem 4 Concept Question: (*Newton's third law*)

In the situation below, a person pulls a string attached to block A, which is in turn attached to another, heavier block B via a second string. Assume the strings are massless and inextensible; and ignore friction.

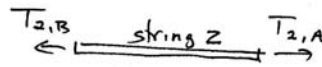
- a) Does block A have a larger, equal, or smaller acceleration than block B?
- b) What is the force of string 1 on block A? What is the force of string 2 on block B? Explain your answers.



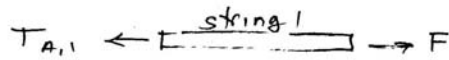
a) Since string 2 doesn't stretch, both block A and block B move together, so the accelerations of the blocks are equal

$$a_B = a_A = a$$

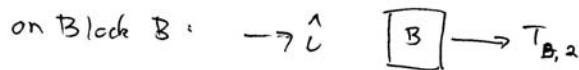
b) Free Body Diagrams:



on string 2: $T_{2,A} - T_{2,B} \approx 0$ string 2 is massless
 $\Rightarrow T_{2,A} = T_{2,B} \equiv T_2$ tension passes through string 2



on string 1: $F - T_{A,1} \approx 0$ string 1 is massless
 $F \approx T_{A,1} \equiv T_1$



$$T_{B,2} = m_B a \quad T_2 = m_B a$$

on Block A:



$$T_{A,1} - T_1 - T_2 = m_A a$$

$$\left. \begin{aligned} F &= T_1 \\ T_2 &= m_B a \\ T_1 - T_2 &= m_A a \end{aligned} \right\} \text{add equations}$$

$$T_1 = (m_A + m_B) a \Rightarrow a = \frac{T_1}{(m_A + m_B)} = \frac{F}{(m_A + m_B)}$$

Solve $T_1 - T_2 = m_A a$ for tension T_2

$$T_2 = T_1 - m_A a$$

$$T_2 = F - \frac{m_A}{m_A + m_B} F = \frac{m_B}{m_A + m_B} F$$