NAME _____ DATE _____

Scenario

Two blocks are being pushed across a surface with an external force F, as shown in the figure at the right. The mass m_2 of block 2 is greater than the mass m_1 of block 1. The blocks begin at rest. The surface is smooth enough that the frictional forces between the surface and the block can be neglected.

Using Representations

PART A: The dots below represent the two blocks. Draw free-body diagrams showing and labeling the forces (not components) exerted on each block. Draw the relative lengths of all vectors to reflect the relative magnitudes of all the forces. Each force must be represented by a distinct arrow starting on and pointing away from the dot.

Quantitative Analysis

PART B: Derive the magnitude of the acceleration of block 2. Express your answers in terms of m_1, m_2, g, and F.

$\Sigma F_x = ma_x$	The sum of the external forces on the system will be equal to the mass of the system times the acceleration of the system.
$F_{push} = ma_x$	The net external force (in the horizontal direction) is F_{push}.
$F_{push} = (m_1 + m_2)a_x$	The mass of the system is the sum of the two masses.
$a_x = \frac{F_{push}}{(m_1 + m_2)}$	The acceleration of the system is then:
$a_2 = \frac{F_{push}}{(m_1 + m_2)}$	And since mass 2 will have the same acceleration as the system, the acceleration of mass 2 is:

Block 3 of mass m_3 is added to the system as shown at right. The three boxes are pushed across the same surface with the same external force F.

Argumentation

PART C: Indicate whether the magnitude of the acceleration of block 2 is now larger, smaller, or the same as in the original situation. Justify your answer.

_____ Larger __X__ Smaller _____ Same

The magnitude of the system's acceleration is now smaller since the system is more massive with the same net external (horizontal) force. The acceleration of the system is equal to the acceleration of Block 2 which is now $a_2 = \frac{F_{push}}{(m_1 + m_2 + m_3)}$