NAME _____ DATE _____

Scenario

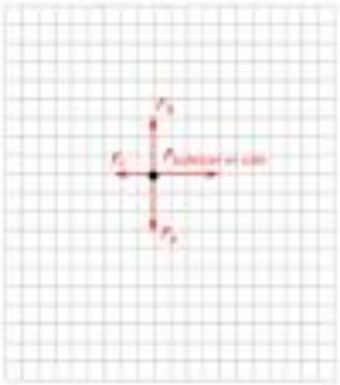
A bulldozer of mass M pushes a cube of cement of mass m across rough ground. The bulldozer and cube are speeding up.

Using Representations

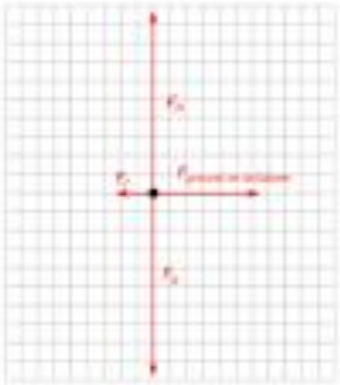
PART A: The dots below represent the bulldozer, cube, and bulldozer-cube system. Draw free-body diagrams showing and labeling the forces (not components) exerted on each system. Draw the relative lengths of all vectors to reflect the relative magnitudes of all the forces. For the bulldozer/cube system, draw an "external force" diagram.

Forces on Bulldozer

Forces on Cube



External Forces on Bulldozer/Cube System



$F_{\text{ground on bulldozer}} - F_{\text{cube on bulldozer}} = Ma_x$ $\quad F_{\text{bulldozer on cube}} - F_{\text{friction}} = ma_x$ $\quad F_{\text{ground on bulldozer}} - F_{\text{friction}} = (M + m)a_x$

Quantitative Analysis

PART B: In the blanks above, write an equation stating Newton's second law in the horizontal direction for the bulldozer, the cube, and the bulldozer-cube system.

PART C: Use the equation created for the external forces on the bulldozer-cube system to determine the acceleration of the bulldozer-cube system if the mass of the bulldozer is 1,000 kg, the mass of the rock is 500 kg, the force of friction on the bulldozer is 5,000 N, and the force of friction on the cube is 2,000 N.

$F_{\text{ground on bulldozer}} - F_{\text{friction}} = (M + m)a_x$

$5{,}000\ \text{N} - 2{,}000\ \text{N} = (1{,}000\ \text{kg} + 500\ \text{kg})a_x$

$3{,}000\ \text{N} = (1{,}500\ \text{kg})a_x$

$a_x = 2\ \frac{\text{m}}{\text{s}^2}$