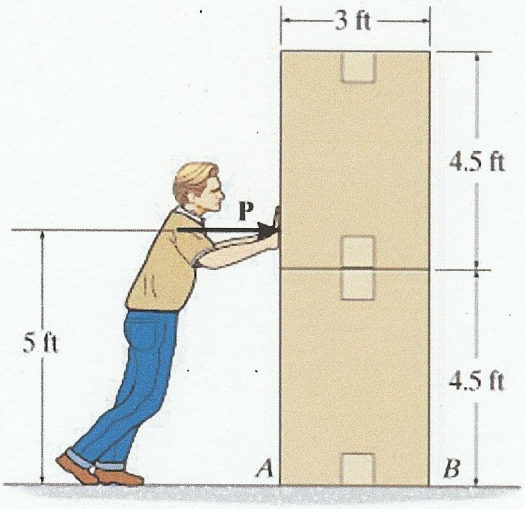
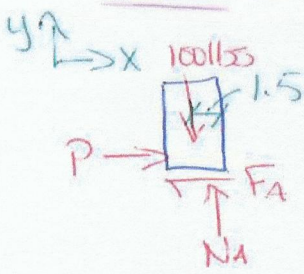
Problem 3: Friction II

In an effort to move two stacked boxes, each weighing 100 lb, the man pushes horizontally on them at the base of the top box as shown. Determine the smallest force **P** that must be applied in order to cause impending motion. The coefficient of static friction between the boxes is $\mu_s = 0.7$ and between the box and the floor is $\mu'_s = 0.4$.



Assume Top Crate Slips



$F_A = 0.7N_A$

$+\uparrow \sum F_y = 0 = N_A - 100$

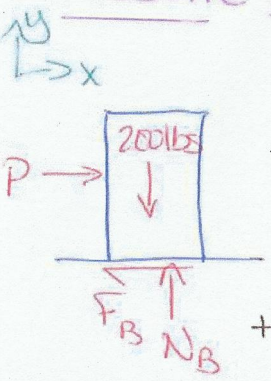
$N_A = 100\text{lbs}$

$+\rightarrow \sum F_x = 0 = P - F_A$

$P = 0.7N_A = 0.7(100)$

$P = 70\text{ lbs}$

Assume Bottom Crate Slips



$F_B = 0.4N_B$

$+\uparrow \sum F_y = 0 = N_B - 200$

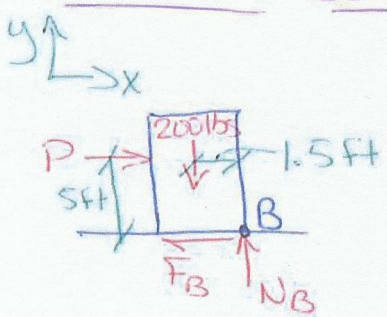
$N_B = 200\text{lbs}$

$+\rightarrow \sum F_x = 0 = P - F_B$

$P = 0.4N_B = 0.4(200)$

$P = 80\text{ lbs}$

Assume Both Tip



$\circlearrowleft \sum M_B = 0 = 200(1.5) - P(5)$

$P = 60\text{ lbs}$

$P_{min} = 60.0\text{ lbs}$
both crates tip