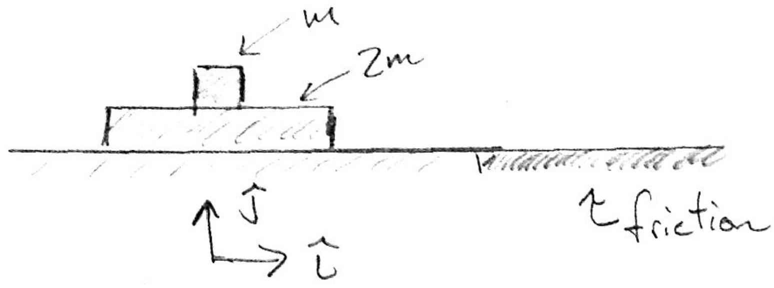
Given: m, v_0, μ_s, μ_k ← initial speed

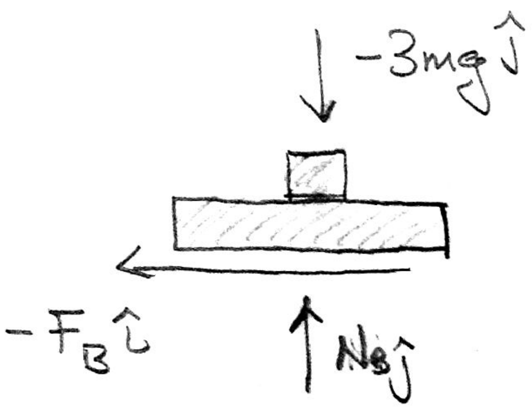
$\mu_k = 0.9\,\mu_s$



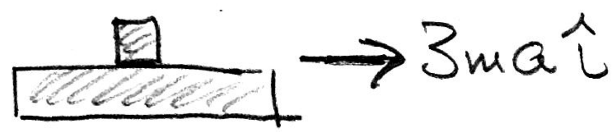
Find (Q1): Does the top block slide relative to bottom block?

Assume: Top block does not slide relative to bottom. Then check assumption

FBD (total)



MAD (total)



<expect $a<0$>

Newton $\Sigma \underset{\sim}{F} = m\underset{\sim}{a}$

$\hat{i}: \; -F_B = 3ma \quad (1)$

$\hat{j}: \; N_B - 3mg = 0 \;\Rightarrow\; N_B = 3mg,$

Since F_B is kinetic friction (sliding)

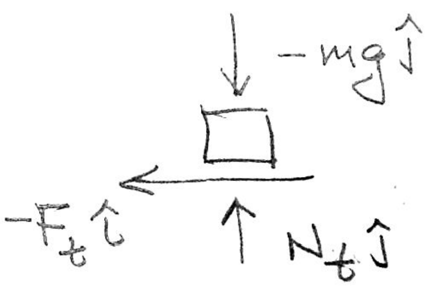
$F_B = \mu_k N_B = 3\mu_k mg$

Subst into (1)

$$-3\mu_K mg = 3ma \Rightarrow \underline{a = -\mu_K g} \quad (2)$$

To check our assumption, let's look at friction force between blocks

<u>FBD</u> (top)



<u>MAD</u> (top)

<u>Newton</u> $\sum \underset{\sim}{F} = m\underset{\sim}{a}$

$$\hat{\imath}: -F_t = -\mu_K mg \Rightarrow F_t = \mu_K mg$$

$$\hat{j}: N_t - mg = 0 \Rightarrow N_t = mg$$

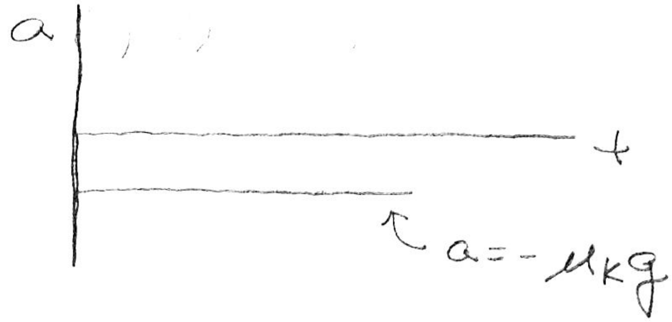
Check assumption: No sliding if

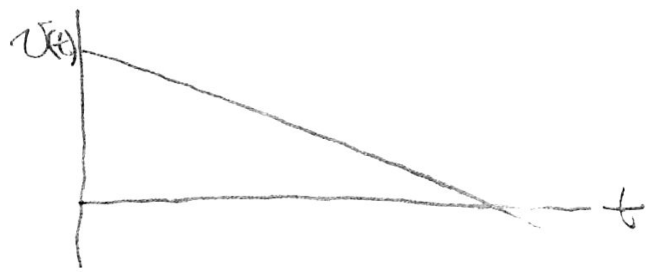
$$F_t \leq \mu_s N_t; \quad \mu_K mg \leq \mu_s mg$$

$$\mu_K \leq \mu_s \quad \checkmark \text{ verified}$$

since $\mu_K = 0.9\mu_s$

Q2: Final time to come to a stop





Speed as function of time

$$v(t) = \int a(t)\,dt = -\mu_K g t + C$$

I.C. $v(0) = v_0$

$$\Rightarrow v(t) = -\mu_K g t + v_0$$

Let t_s be stop time:

$$v(t_s) = 0 = -\mu_K g t_s + v_0$$

$$\Rightarrow \boxed{t_s = \frac{v_0}{\mu_K g}}$$

units $\frac{L/T}{L/T^2} = T$ ✓