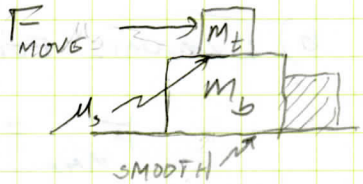
HR2 5-17

A SMALL BLOCK RESTS ON A LARGE ON A LARGE ONE ON A FRICTIONLESS TABLE. WHEN THE BOTTOM ONE IS HELD, IT TAKES F_{MOVE} TO MAKE THE TOP ONE SLIP.

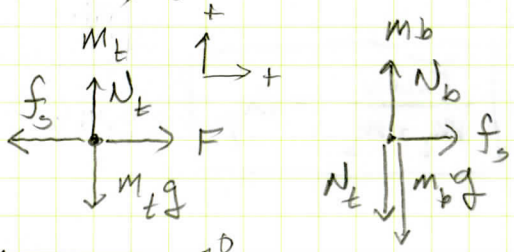


a) WHAT'S F_{MAX} ON THE LOWER BLOCK THAT ALLOWS THEM TO MOVE TOGETHER

b) EVALUATE THIS FOR $m_t = 4.0\,kg$, $m_b = 5.0\,kg$ & $F_{MOVE} = 12N$.

c) WHAT'S a_{BLOCKS}?

FIND μ_s IN TERMS OF F_{MOVE}



$\Sigma F_V = m_t \not{a}_V^{\,0}$

m_t: $\Sigma F_{HORIZ} = m_t \not{a}_{HORIZ}$ (JUST SLIPS = 0)

$F_M - f_s = 0 \Rightarrow F_M = f_s$

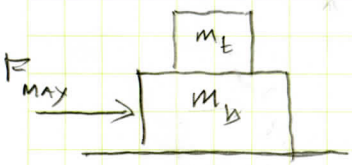
$\Sigma F_{VERT} = m_t \not{a}_{VERT}^{\,0}$

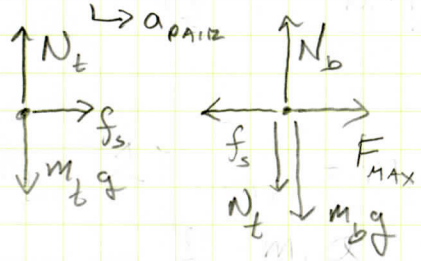
$N_t - m_t g = 0 \Rightarrow N_t = m_t g$

$F_{MOVE} = f_s = \mu_s N_t$

$$\boxed{F_{MOVE} = \mu_s m_t g} \Rightarrow \boxed{\mu_s = \frac{F_{MOVE}}{m_t g}}$$

a) FIND F_{MAX} FOR m_t TO ACCELERATE WITH m_b





m_t: $\Sigma F_H = m_t a_P$

$f_s = m_t a_P$

$\Sigma F_V = m_t \not{a}_V^{\,0}$

$N_t - m_t g = 0$

$\mu_s N_t = m_t a_P$

$\mu_s m_t g = m_t a_P$

$$\boxed{a_P = \mu_s g}$$

m_b: $\Sigma F_H = m_b a_P$

$F_{MAX} - f_s = m_b a_P$

$F_{MAX} = m_b a_P + f_s = m_b(\mu_s g) + \mu_s m_t g$

$F_{MAX} = (m_b + m_t)\mu_s g$

FROM ABOVE:

$$F_{MAX} = \frac{(m_b + m_t)}{m_t} F_{MOVE}$$

b) EVALUATE FOR $m_t = 4\,kg$, $m_b = 5.0\,kg$, $F_{MOVE} = 12\,N$

$$F_{MAX} = \frac{m_t + m_b}{m_b} F_{MOVE}$$

$$= \frac{4+5}{4}(12) = \frac{9}{\cancel{4}}(\cancel{12}^{3}) = \boxed{27\,N = F_{MAX}}$$

c) USE THIS TO FIND a_p

$$a_p = \mu_s g = \left(\frac{F_{MOVE}}{m_t g}\right) g = \frac{F_{MOVE}}{m_t}$$

FROM b

$$a_p = \frac{1}{\cancel{m_t}}\left(\frac{\cancel{m_t}}{m_t + m_b}\right) F_{MAX} = \boxed{\frac{F_{MAX}}{m_t + m_b} = a_p}$$

$$a_p = \frac{27}{4+5} = \boxed{3\,\frac{m}{s^2} = a_p}$$