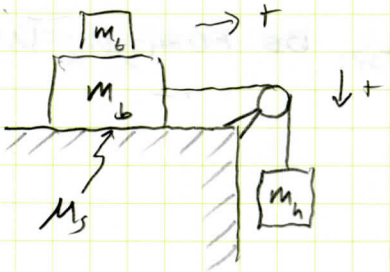
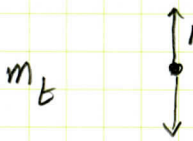
HRW 5-20



a) FOR THE SYSTEM SHOWN, WHAT m_t WILL KEEP IT FROM MOVING?

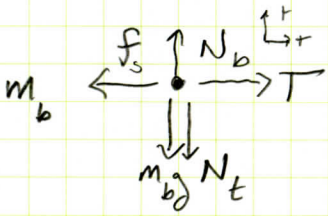
m_b: $\Sigma F_{VERT} = m_b a^{\nearrow 0}_{VERT}$

$N_b - N_t - m_b g = 0 \Rightarrow N_b = N_t + m_b g$



m_t: $\Sigma F_{VERT} = m_t a^{\nearrow 0}_{VERT}$

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



$N_b = (m_t + m_b) g$

m_h: $\Sigma F_{VERT} = m_h a^{\nearrow 0}_{VERT}$

$m_h g - T = 0 \Rightarrow T = m_h g$

BACK TO m_b:

$\Sigma F_H = m_b a^{\nearrow 0}_H$

$T - f_s = 0$

$f_s = T = m_h g$

$\mu_s N_b = m_h g$

$\mu_s (m_t + m_b) g = m_h g$

$$\boxed{m_t = \frac{m_h - \mu_s m_b}{\mu_s}}$$

$m_b = 6$ kg

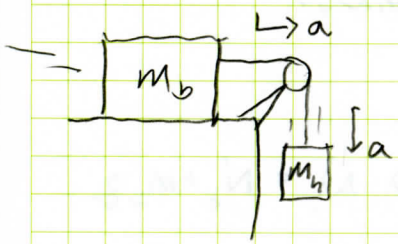
$m_h = 3$ kg

$\mu_s = 0.4$

EVALUATING

$$m_t = \frac{3 - (0.4)6}{0.4} = \boxed{1.5 \text{ kg} = m_t}$$

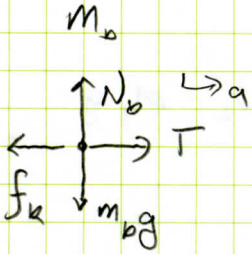
b) WHEN m_b IS LIFTED OFF, WHAT WILL a_{sys} BE FOR $\mu_k = 0.2$?



m_h: $\sum F_{VERT} = m_h a_{VERT}$

$m_h g - T = m_h a_{sys}$

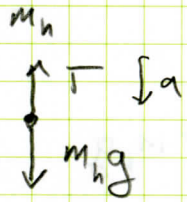
$T = m_h (g - a_{sys})$



m_b: $\sum F_{VERT} = m_b \cancel{a^{0}_{VERT}}$

$N_b - m_b g = 0$

$N_b = m_b g$



$\sum F_{HORIZ} = m_b a_{HORIZ}$

$T - f_k = m_b a_{sys}$

$m_h (g - a_{sys}) - \mu_k N_b = m_b a_{sys}$

$m_h g - \mu_k (m_b g) = (m_b + m_h) a_{sys}$

$$\boxed{a_{sys} = \frac{m_h - \mu_k m_b}{m_b + m_h} g}$$

$m_b = 6\ kg$

$m_h = 3\ kg$

$\mu_k = 0.2$

$$a_{sys} = \frac{3 - (0.2)(6)}{3 + 6} (9.8)$$

$$\boxed{a_{sys} = 1.96 \frac{m}{s^2}}$$