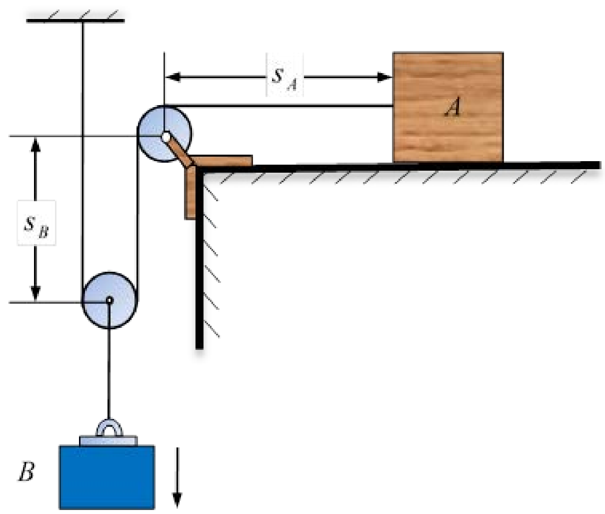
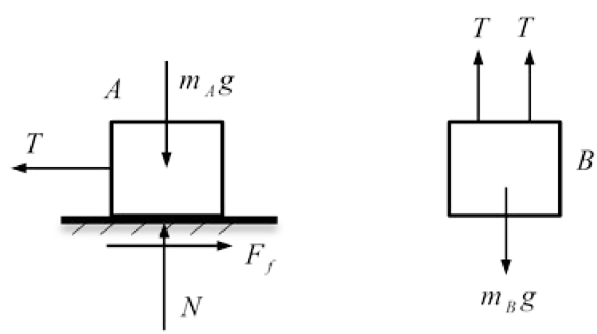
2-36. The 10-kg block *B* has an initial downward velocity $(v_B)_1 \sim N(1, 0.1^2)$ m/s. Block *A* is 8-kg and the mass of the pulleys and cords is negligible. If the coefficient of kinetic friction between the horizontal plane and block *A* is $\mu_k \sim N(0.5, 0.05^2)$, determine the velocity of *A* when $t = 2$ s. Assume $(v_B)_1$ and μ_k are independent.



Solution:



$$s_A + 2s_B = Constant$$

$$v_A = 2v_B$$

Block *A* $(+\leftarrow)$

$$F_f = \mu_k N = \mu_k m_A g$$

$$m_A(v_A)_1 + Tt - F_f t = m_A(v_A)_2$$

$$m_A(v_A)_1 + Tt - \mu_k m_A g t = m_A(v_A)_2$$

Block *B* $(+\downarrow)$

$$m_B(v_B)_1 + m_B gt - 2Tt = m_B(v_B)_2$$

Since $(v_A)_1 = 2(v_B)_1$ and $(v_B)_2 = 0.5(v_A)_2$,

$$2m_A(v_B)_1 + Tt - \mu_k m_A gt = m_A(v_A)_2$$

$$m_B(v_B)_1 + m_B gt - 2Tt = 0.5m_B(v_A)_2$$

Solving above equations, we have

$$(v_A)_2 = \frac{(4m_A + m_B)(v_B)_1 + m_B gt - 2\mu_k m_A gt}{2m_A + 0.5m_B}$$

$$\mu_{(v_A)_2} = \frac{(4m_A + m_B)\mu_{(v_B)_1} + m_B gt - 2\mu_{\mu_k} m_A gt}{2m_A + 0.5m_B} = 3.87 \text{ m/s}$$

$$\sigma_{(v_A)_2} = \frac{1}{2m_A + 0.5m_B}\sqrt{\left(-2\sigma_{\mu_k} m_A gt\right)^2 + \left((4m_A + m_B)\sigma_{(v_B)_1}\right)^2} = 0.77 \text{ m/s}$$

Therefore, $(v_A)_2 \sim N(3.87, 0.77^2)$ m/s $\leftarrow$. **Ans.**