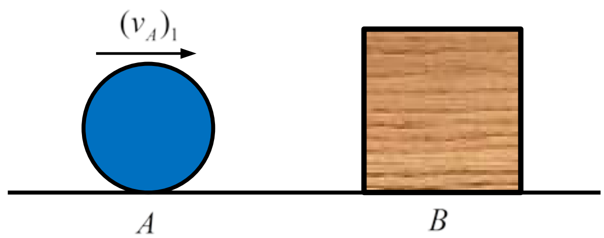
2-37. A 4-kg ball *A* strikes a 6-kg block *B* that is at rest. The coefficient of restitution between *A* and *B* is $e = 0.8$, and the coefficient of kinetic friction between the floor and the block is $\mu_k = 0.6$. If the velocity of the ball just before the strike is normally distributed $(v_A)_1 \sim N(25, 2.5^2)$ m/s, determine the probability that the block stops sliding in 3 seconds.



$$(+\rightarrow)\ \Sigma m_1 v_1 = \Sigma m_2 v_2$$

$$m_A (v_A)_1 + 0 = m_A (v_A)_2 + m_B (v_B)_2$$

$$(+\rightarrow)\ e = \frac{(v_B)_2 - (v_A)_2}{(v_A)_1 - (v_B)_1} = \frac{(v_B)_2 - (v_A)_2}{(v_A)_1 - 0}$$

Solving the above equations,

$$(v_B)_2 = \frac{m_A (1+e)(v_A)_1}{m_A + m_B}$$

For block *B*

$$(+\rightarrow)\ mv_1 + \Sigma \int F dt = mv_2$$

$$m_B (v_B)_2 - \mu_k m_B g t = 0$$

$$t = \frac{m_B (v_B)_2}{\mu_k m_B g} = \frac{m_A (1+e)(v_A)_1}{(m_A + m_B)\mu_k g}$$

$$\mu_t = \frac{m_A (1+e)\mu_{(v_A)_1}}{(m_A + m_B)\mu_k g} = \frac{4(1+0.8)(25)}{(4+6)(0.6)(9.81)} = 3.06\ \text{s}$$

$$\sigma_t = \frac{m_A (1+e)\sigma_{(v_A)_1}}{(m_A + m_B)\mu_k g} = \frac{4(1+0.8)(2.5)}{(4+6)(0.6)(9.81)} = 0.31\ \text{s}$$

$$\Pr\{t < 3\} = \Phi\left(\frac{3 - \mu_t}{\sigma_t}\right) = \Phi\left(\frac{3 - 3.06}{0.31}\right) = 0.42$$