Example Problem - Le 16
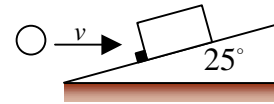
Ex.   A 1 kg ball moving horizontally at 12 m/s strikes a 10 kg block. The coefficient of restitution of the impact is e=0.6., and the coefficient of kinetic friction between the block and the inclined surface is 0.4. What distance does the block slide before stopping?
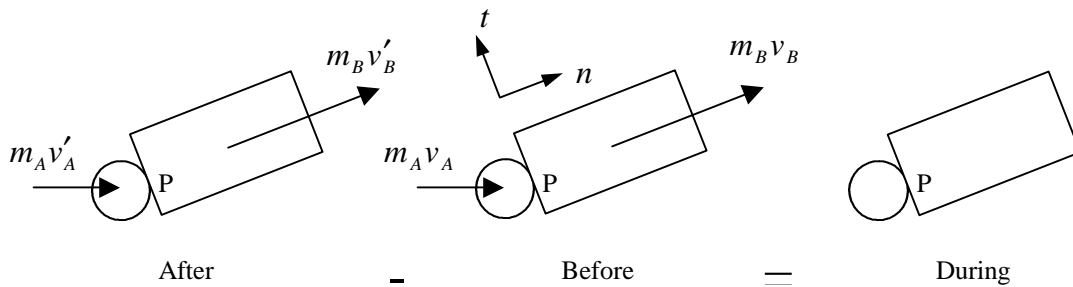

Known: $m_A = 1\,kg$, $m_B = 10\,kg$, $v_A = 12\,m/s$, $e = 0.6$, $m_k = 0.4$

unk	eqs
d	1
v'_{PA_n}	2
v'_{PB_n}	3

Strategy: COLM(FT) process 1→2

               COE(FT) process 2→3

Process 1→2

          After   —   Before   ═   During

Kinetics:

         COLM(FT) n-direction

$$\left(m_A v'_{PA_n} + m_B v'_{PB_n}\right) - \left(m_A v_{PA_n} + m_B v_{PB_n}\right) = 0 \tag{1}$$

Constitutive Models:

         Coefficient of Restitution

$$e = -\left(\frac{v'_{PB_n} - v'_{PA_n}}{v_{PB_n} - v_{PA_n}}\right) \tag{2}$$

Solving:

         Note: $v_{PB_n} = 0$, $v_{PA_n} = v_A \cos 25°$, $v'_{PB} = v'_{PB_n}$

$$\boxed{\begin{array}{l} v'_{PB_n} = 1.58\,m/s \\ v'_{PA_n} = -4.95\,m/s \end{array}}$$

Process 2→3

Kinetics:

         COE(FT)

$$\Delta E_{sys} = W = Fd \tag{3}$$

Solving:

$$\boxed{d = 0.162\,m}$$