Conservation Principles

1. ***The Principle of Conservation of Total Mechanical Energy*:**
   If the total work done on a system by *nonconservative* forces is zero, then the total mechanical energy of the system remains constant.

2. ***The Principle of Conservation of Total Linear Momentum:***
   If the total work done on a system by *external* forces (conservative and/or nonconservative) is zero, then the total linear momentum of the system remains constant.

$$\vec{P} = m\vec{v} \quad (kg\cdot m/s)$$

$$\frac{\Delta\vec{P}}{\Delta t} = m\frac{\Delta\vec{v}}{\Delta t} = m\vec{a} = \vec{F}$$

elastic – kinetic energy conserved
in – not □□ sticks together

△ momentum conserved in a closed system.

$\vec{P} = m\vec{v}$

$\Delta\vec{P} = \vec{F}_{net}\,\Delta t$

Balistic Pendulum

Scene A & B

$\mathcal{E}_A \neq \mathcal{E}_B$ non-consorvative force work is not zero (friction)

$W_{net} = 0 \quad \vec{P}_{totA} = \vec{P}_{totB} =$

$m_b\vec{v}_{b0} + M\vec{v}_{B0} = m_b\vec{v}_{bf} + M\vec{v}_{Bf}$

$M\vec{v}_{B0}$: 0, initial velocity $\quad \vec{v}_{bf} = \vec{v}_{Bf} = \vec{V}$

$m_b\vec{v}_{b0} = (m_b + M)\vec{V}$

Scene B & C

$W_{nc} = W_T + W_f = 0$

between B / C $\to$ no work done

▲ Total mechanical energy conserved

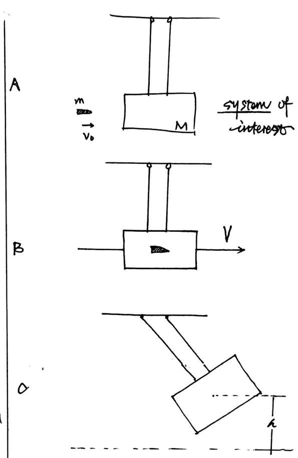
$\mathcal{E}_B = \mathcal{E}_C$

$K_B + \underbrace{PE_B}_{0} = \underbrace{K_C}_{0} + PE_C$

$\frac{1}{2}(m_b + M)V^2 = (m_b + M)gh$

$V = \sqrt{2gh}$

$v_{b0} = \left(1 + \frac{M}{m_b}\right)\sqrt{2gh}$



P (momentum) = mv $\quad kg\,m/s$

$F = \frac{\Delta P}{\Delta t}$

7.42

Scene A & B

$W_{nc} = W_f \neq 0, \quad \mathcal{E}_A \neq \mathcal{E}_B$

external force, gravity & normal force

$W_{ext} = W_g + W_{FN} = 0, \quad \vec{P}_{totA} = \vec{P}_{totB}$

$m\vec{v}_A = m_1\vec{v}_{BB} + m\vec{v}_B$

Scene C & D

$m\vec{v}_C = (m + m_2)\vec{V}$

$v_B = v_C$

$V = 0.513\,m/s$