Lecture 16

$$\vec{I} = \Delta\vec{p} = \vec{F}_{av}\,\Delta t$$

In 2-D,

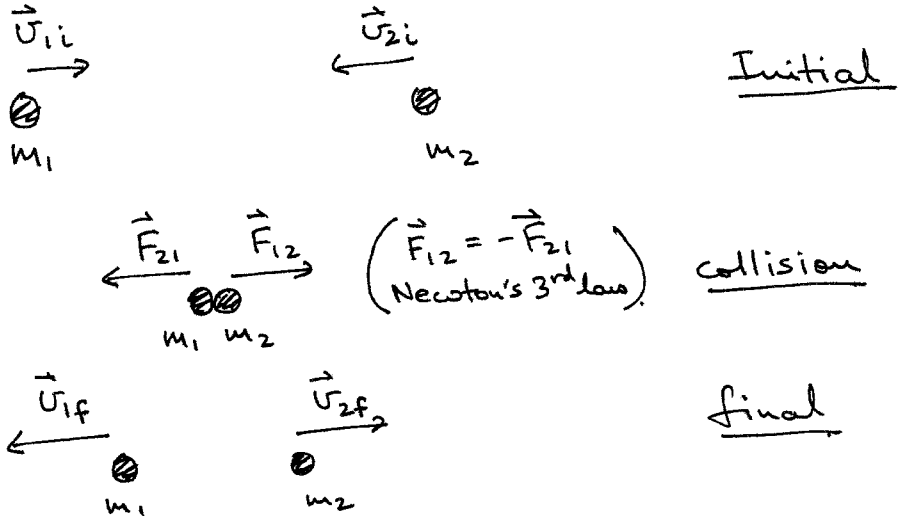
$$I_x = (\Delta p)_x = (F_{av})_x\,\Delta t$$
$$I_y = (\Delta p)_y = (F_{av})_y\,\Delta t$$

Conservation of momentum

$\Delta\vec{p} = \vec{F}_{av}\Delta t$, if $\vec{F}_{av} = 0 \Rightarrow \Delta\vec{p} = 0 \Rightarrow \vec{p}_f = \vec{p}_i$

this is just Newton's 2nd law → No force ⇒ no change in velocity.

If there are two masses which collide:



$$\Rightarrow \Delta\vec{p}_1 = m_1\vec{v}_{1f} - m_1\vec{v}_{1i} = \vec{F}_{21}\Delta t \longrightarrow (1)$$
$$\Delta\vec{p}_2 = m_2\vec{v}_{2f} - m_2\vec{v}_{2i} = \vec{F}_{12}\Delta t = -\vec{F}_{21}\Delta t \longrightarrow (2)$$

Adding (1) & (2)

$$\Delta\vec{p}_1 + \Delta\vec{p}_2 = m_1\vec{v}_{1f} - m_1\vec{v}_{1i} + m_2\vec{v}_{2f} - m_2\vec{v}_{2i} = 0 \longrightarrow (3)$$

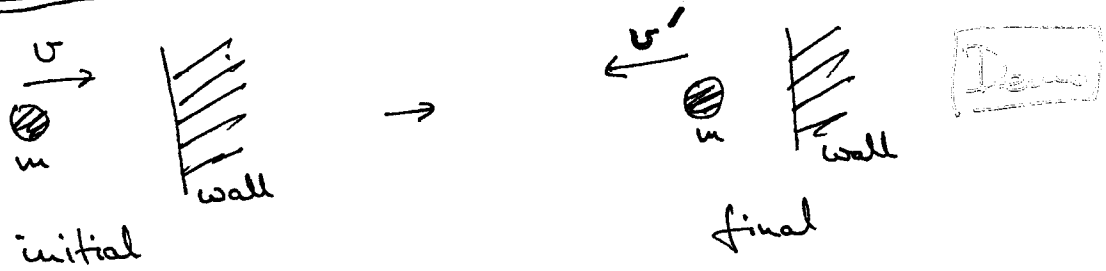
⇒ Change in total momentum of system consisting of m_1 & m_2 is zero

in other words:

Change in the total momentum of the ~~isolated~~ isolated (no external forces) system of m_1 & m_2 is zero (the total momentum is conserved)

equation (3) $\Rightarrow$ $\boxed{m_1\vec{v}_{1i} + m_2\vec{v}_{2i} = m_1\vec{v}_{1f} + m_2\vec{v}_{2f}}$ $\rightarrow$ (4)

How is momentum conserved When a ball bounces off a wall: ??



equation (4) $\Rightarrow$ $mv + M.0 = -mv' + MV$

where m = mass of ball, M = " " wall

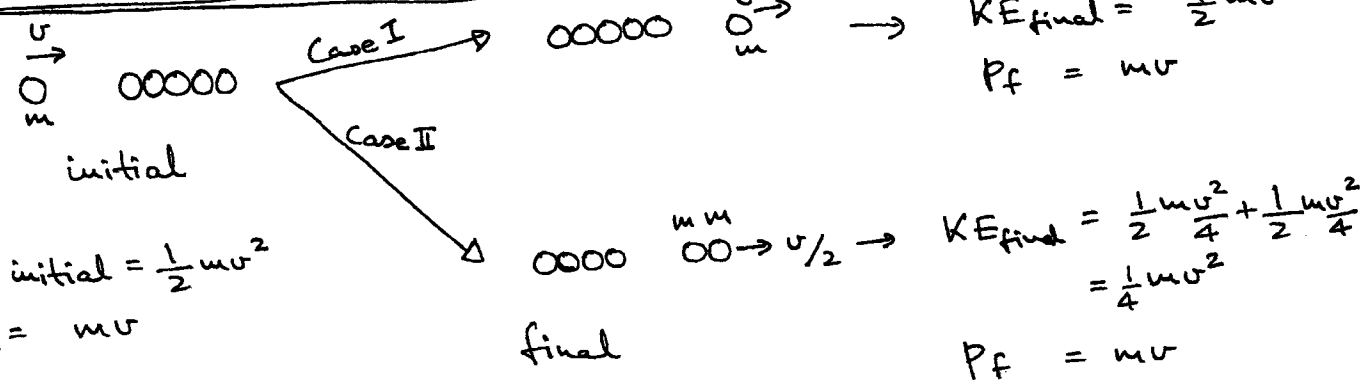
$V = \frac{m(v+v')}{M}$ $\qquad v' = \frac{MV - mv}{M}$

since $m << M$, $V \approx 0$

thats why the wall does not appear to move even though momentum is conserved.

Momentum balls experiment

Demo



Both case I and case II conserve momentum but only case I conserves KE. Case I is an elastic collision and is observed in the experiment.
⇒ the collisions in the experiment are nearly elastic.

Elastic collisions & Inelastic collisions

See definitions in lecture slides

Basketball cannon experiment.

The styrofoam ball (SB) reaches a greater height than its initial height. Problem to be completed in the next class.