Class Notes: Lecture 16 (Biswas) 15 October 2009

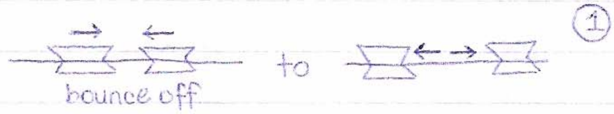
Collisions

$A + B \rightarrow C$

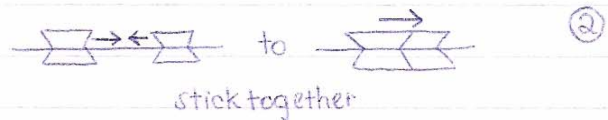
$r = k(T)\,[A]^m\,[B]^n$

rate constant temp

DEMO: Regular collision



Versus inelastic



For example: Regular H_2O captures neutrons ②; heavy water slows it down, but it bounces off ①

Conservation of Momentum

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

$\left.\begin{array}{l} I_x = \Delta p_x = (F_{avg})_x \Delta t \\ I_y = \Delta p_y = (F_{avg})_y \Delta t \end{array}\right\}$ components

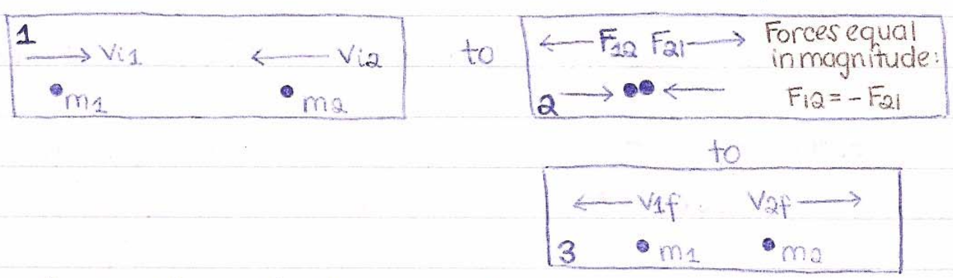
proven with next example

$\Delta\vec{p} = \vec{F}_{avg}\Delta t$, $\vec{F}_{avg} = 0$ w/ no external forces

$\therefore \Delta\vec{p} = 0$ **OR** $p_i = p_f$

for now, head on collisions:

Example:



$\Delta\vec{p}_1 = m_1\vec{v}_{1f} - m_1\vec{v}_{1i} = F_{12}\Delta t$ Equation #1

$\Delta\vec{p}_2 = m_2\vec{v}_{2f} - m_2\vec{v}_{2i} = F_{21}\Delta t = -F_{12}\Delta t$ Equation #2

Newton's 3rd Law

$\Delta\vec{p} = \Delta\vec{p}_1 + \Delta\vec{p}_2 = m_1\vec{v}_{1f} - m_1\vec{v}_{1i} + m_2\vec{v}_{2f} - m_2\vec{v}_{2i} = 0$ Sum Equation

So, $m_1\vec{v}_{1i} + m_2\vec{v}_{2i} = m_1\vec{v}_{1f} + m_2\vec{v}_{2f}$ Momentum Conserved!

Can be expanded to any number of objects

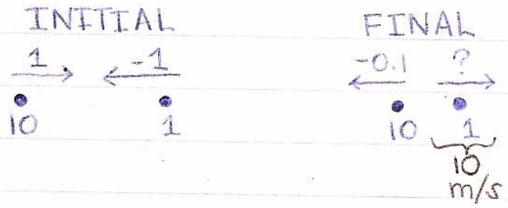
Must be isolated

Note:

Conservation of $\vec{p}$ applies to the SYSTEM

Not conserving velocity, but conserving mv

Example:

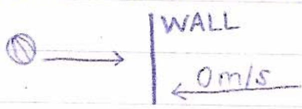


$m_1\vec{v}_{1i} + m_2\vec{v}_{2i} = m_1\vec{v}_{1f} + m_2\vec{v}_{2f}$

$10(1) + 1(-1) = 10(-.1) + 1\vec{v}_{2f}$

$\vec{v}_{2f} = +10$

Problems with Understanding?



Seems like $\vec{p}$ won't be conserved...

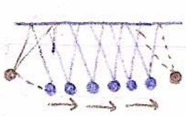
$-mv + 0 = mv' + MV$

$V = \dfrac{-m(v+v')}{M}$ the bigger the M, the smaller the V

$M \to \infty,\ V \to 0$

wall becomes part of system as a really heavy object

DEMO



balls lifted = balls moving on other side

due to: conservation of energy

conservation of p

Example $\overrightarrow{\text{①}}$ ②③④ to ①② ③④

mv $\quad \frac{mv}{2} + \frac{mv}{2} = mv$

$\frac{1}{2}mv^2 = 2\,\frac{1}{2}m\left(\frac{v}{2}\right)^2$

$= \frac{1}{4}mv^2$ KE not conserved!