Physics 200 Day 14

momentum and collisions

one of the days I have to run, at endo' class.

This Friday: Exam 2 Review!

Next Fri, Exam 2

we have had 2 labs since exam 1.

Sometime: Quiz 2.0

$\boxed{\cancel{\text{Force}}\ 15}$

Work 7

Energy $\emptyset$

Q.2.0

Dates:

Wed 2

$\boxed{\text{next Mon}\ (9)}$

next Wed

this Fri 2

momentum $\vec{p} = m\vec{v}$

and: $\sum \vec{F} = \frac{d\vec{p}}{dt} = m\left(\frac{d\vec{v}}{dt}\right) + \left(\frac{dm}{dt}\right)\vec{v}$

$$\sum \vec{F} = m\vec{a} + \frac{dm}{dt}\cdot\vec{v}$$

momentum is Conserved.

$\sum \vec{p_o} = \sum \vec{p_f}$ equivalent to Newton's 3^{rd} Law

$$\Delta\vec{P} = \int \vec{F}(t)\,dt = \vec{J}$$

the Impulse

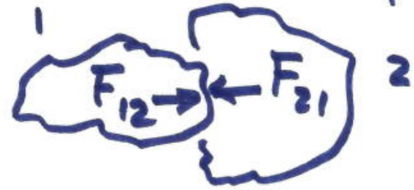
Note: Typo on Eq. 5.1

$\cancel{W \overset{?}{=} \int \vec{F}(t)\,dt}$

$W = \int \vec{F}(x) \cdot d\vec{x}$

* Should Be *

$$\Delta\vec{P}_1 + \Delta\vec{P}_2 = 0$$

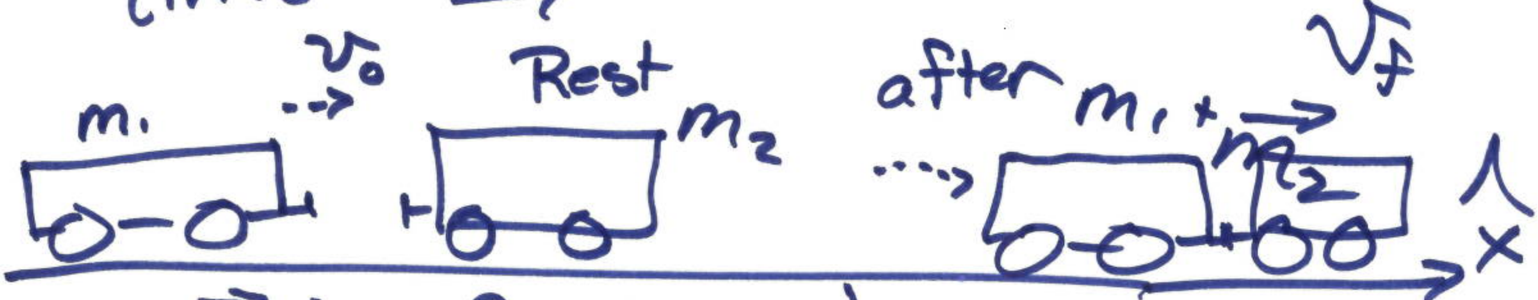


because

$$\vec{F}_{12} = -\vec{F}_{21}$$

What useful for?

Often, 1 force is really big, for short time $\Rightarrow$ collision.



$\vec{p}$ is Conserved:

$$\sum \vec{P_0} = \sum \vec{P_f} \quad \hat{x} \text{ direction}$$

$$m_1 v_0 + m_2 \cdot 0 = (m_1 + m_2) v_f$$

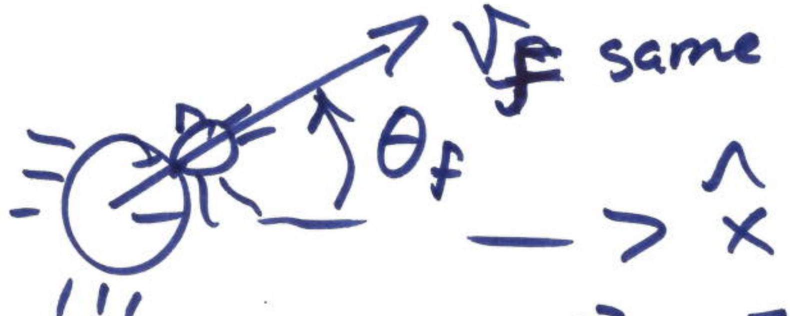
$$\boxed{\frac{m_1 v_0}{m_1 + m_2} = v_f}$$

$\rightarrow$ "totally inelastic" when 2 object move together at end.

max. Kinetic energy "lost" to thermal (heat).

Simple 2-d $\uparrow^{g}$ Collision

Given all that $\uparrow$ Can find $\vec{v}_f$ ~~v_F~~ of bird + fish (moving together)



$$\cos\theta = \frac{adj}{hyp} = \frac{v_{fx}}{v_f}$$

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

$$\sum \vec{P_o} = \sum \vec{P_f}$$

$$\sum P_{ox} = \sum P_{fx}$$

$$m_B v_B + m_E \cdot 0 = (m_B + m_E) v_f \cos\theta_f$$

$$\sum P_{oy} = \sum P_{fy}$$

$$m_B \cdot 0 + m_E \underline{v_E} = (m_B + m_E) v_f \sin\theta_f$$

<u>want</u>: v_f θ_f.

divide 2 equ'n's:

$$\frac{m_E v_E}{m_B v_B} = \frac{\cancel{(m_B + m_E)}\cancel{v_f}\sin\theta_f}{\cancel{(m_B + m_E)}\cancel{v_f}\cos\theta_f}$$

$$\frac{m_E v_E}{m_B v_B} = \tan\theta_f$$

solve θ_f, plug in above to find v_f.

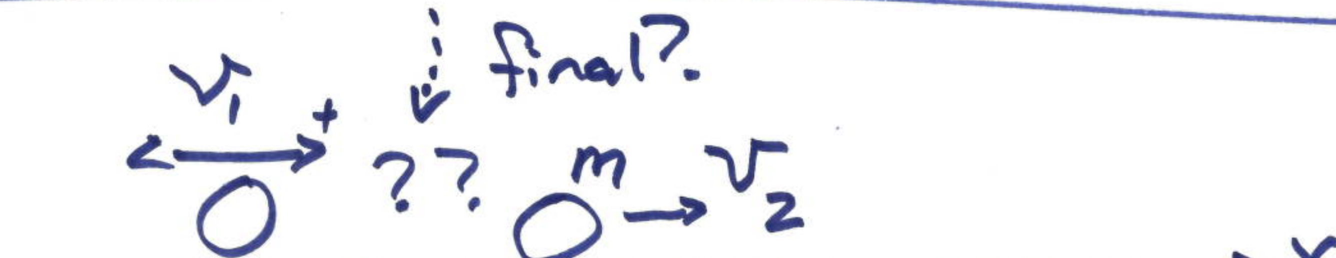
Perfectly Elastic Collisions:

aka: Perfect or Elastic

→ Macroscopic (or mechanical) energy is also conserved.

(No thermal generated)

1-D 2 Pool Balls equal mass



P_x is conserved:

$$m v_0 + m \cdot 0 = m v_1 + m v_2$$

E_K is conserved:

$$\frac{1}{2} m v_0^2 + \frac{1}{2} m 0^2 = \frac{1}{2} m v_1^2 + \frac{1}{2} m v_2^2$$

$$v_0 = v_1 + v_2 \longrightarrow \cancel{v_1 = (v_0 - v_2)}$$

$$v_0^2 = v_1^2 + v_2^2 \qquad \cancel{v_1^2 = ((}$$

$$v_2 = (v_0 - v_1)$$

$$v_2^2 = (v_0^2 - 2v_1v_0 + v_1^2)$$

$$v_0^2 = v_1^2 + v_0^2 - 2v_1v_0 + v_1^2$$

$$0 = 2v_1^2 - 2v_1v_0$$

$$\underbrace{0 = v_1(2v_1 - 2v_0)}_{\text{2 solutions:}}$$

$v_1 = 0 \longrightarrow v_2 = v_0$ all $E, \vec{p}$ transfered

$v_1 = v_0 \longrightarrow v_2 = 0$

They MISS !!