Lecture 31

Mon: HW

Ex 260, 262, 264, 265, 266, 268, 272, 273

Tues: Warm Up 12 D2L

Thurs: Review

Fri: Exam 3

Covers: work, energy, momentum

Ch 7, 8, 9

Lecture 23-31

Conservation of momentum

Consider a system of objects.

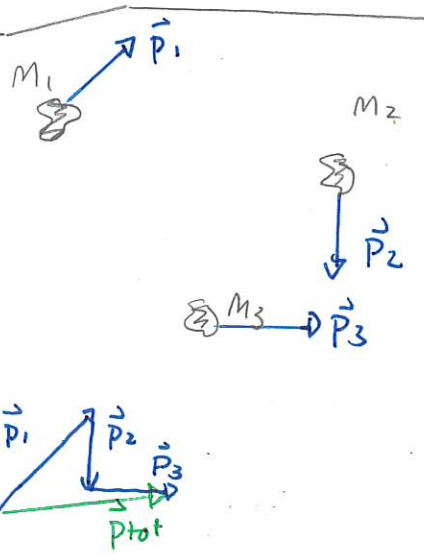
If the net external force on the system is zero then the total momentum

$$\vec{p}_{tot} = \vec{p}_1 + \vec{p}_2 + \dots$$

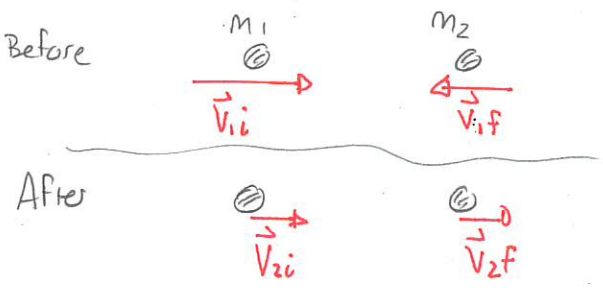
is constant. Here

$$\vec{p}_i = m_i \vec{v}_i$$

where $\vec{v}_i$ is the velocity of particle i



In one dimension



$p_{tot\,i} = m_1 v_{1i} + m_2 v_{2i}$ (can be + or −)

$p_{tot\,f} = m_1 v_{1f} + m_2 v_{2f}$

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

Note signs of velocities

Quiz1 : ~~KE~~ 30% } 30%

Demo: Happy / Sad . Ball

Explosions

An explosion is where two objects that initially move together with the same velocity separate and move apart.

Quiz2 20% - 40% } 20% →

Example: A crowd of 100000 people, each 80kg, are at rest on Earth. They jump up simultaneously, leaving Earth with speed 3.0m/s (relative to background). Determine Earths recoil speed.

Answer:

Treat entire crowd as one object.

$$p_{tot\,f} = p_{tot\,i}$$

$$\Rightarrow m_p v_{pf} + m_E v_{Ef} = \cancel{m_p v_{pi}}^{\,0} + \cancel{m_E v_{Ei}}^{\,0} = 0\ kg\ m/s$$

$$m_E v_{Ef} = -m_p v_{pf}$$

$$\Rightarrow v_{Ef} = -\frac{m_p}{m_E} v_{pf} = -\frac{80kg \times 10^5}{5.98 \times 10^{24} kg}\, 3.0 m/s = -4.0 \times 10^{-18} m/s$$

Demo: Barcelona Stadium (requires registration)

Momentum and energy in collisions.

We can use either or both momentum and energy in collisions