Momentum and Impulse

$$\vec{F} = ma = m\frac{\Delta \vec{v}}{\Delta t},$$

$$\Delta \vec{p} = \vec{F} \Delta t$$

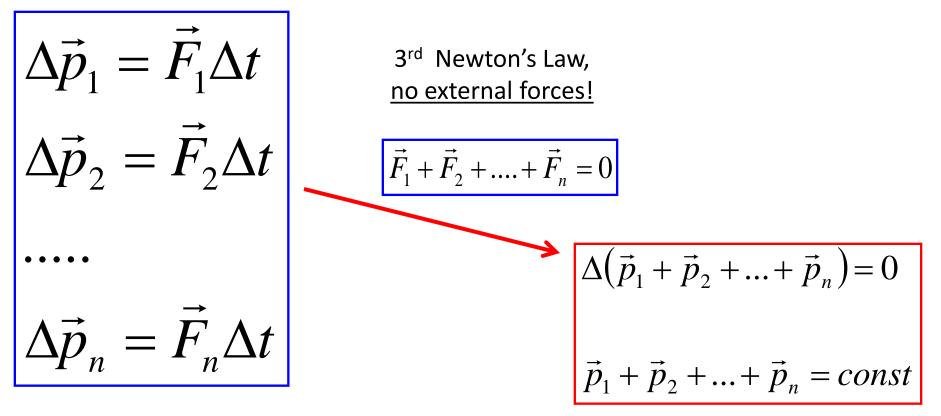
$$\vec{p} = m\vec{v}$$
 called Momentum
 $\vec{F}\Delta t$ called Impulse

If **F** changes with time, Impulse is time integral of Force:

$$\Delta \vec{p} = \int_{t_1}^{t_2} \vec{F} dt$$

Conservation of Momentum

2nd Newton's Law for *n* objects:



Total Momentum of Isolated System is Conserved

Homework

Problem 1

A tennis ball of mass *m=57 g* with initial velocity *v=30 m/s*, directed towards the wall bounces off it elastically. Using high-speed camera, it was determined that the collision time was about *t=1ms* (1 millisecond). Estimate the maximum force between the wall and the ball.

Problem 2

A block of mass **M=100g** moves with speed of **v=10m/s** on a frictionless flat surface. A bullet of mass m=8g that moves with speed **u=700 m/s** in the opposite direction, hits the block and gets stuck in it. What will be the velocity of the block after this collision (include direction in your response)?