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

Conservation of Momentum

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

$$\Delta\vec{p}_1 = \vec{F}_1\Delta t$$

$$\Delta\vec{p}_2 = \vec{F}_2\Delta t$$

.....

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

3rd Newton's Law,
<u>no external forces!</u>

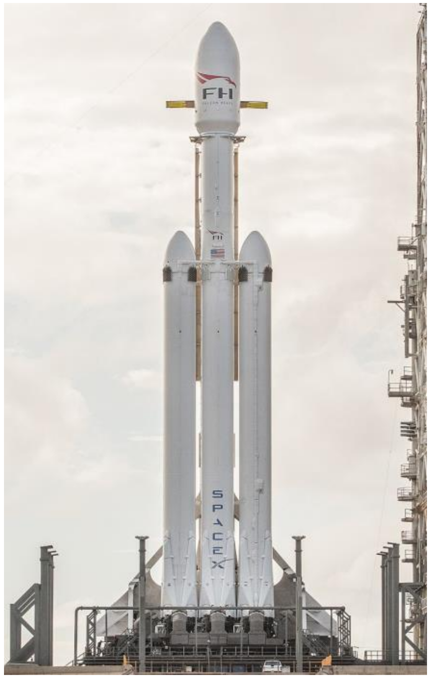
$$\vec{F}_1 + \vec{F}_2 + ... + \vec{F}_n = 0$$

$$\Delta\left(\vec{p}_1 + \vec{p}_2 + ... + \vec{p}_n\right) = 0$$

$$\vec{p}_1 + \vec{p}_2 + ... + \vec{p}_n = const$$

<u>Total Momentum of Isolated System is Conserved</u>

Homework



In February of 2018, Space X company has launched its most powerful rocket, Falcon Heavy, for the first time. Its payload was Tesla Roadster car that now orbits our Sun. One of the most impressive parts of the launch was a return of the boosters back to Earth (you can easyily find the video online).

Let us understand how this last part worked. The two boosters were coming to Earth at rather high speed, at least the speed of sound $v=300m/s$. They dramatically slowed down by using their engines. Estimate how much fuel was used for this maneuver, if the mass of a booster is $M= 22000$ kg, and the burned fuel gets out of the engine at speed $u=3000m/s$