Impulse & Momentum

Impulse (J)

The effect of a net force acting on an object.

Equation

$J = F\,t$ (F → Force; t → time)

Units

(N · s)

Momentum (p)

Mass in motion.

Equation

$$p = mv$$

Units

($kg \cdot m/s$) ($\overbrace{kg \cdot m/s^2}^{N} \cdot s$)

($N \cdot s$)

Newton's 2nd Law

$$F = ma \qquad a = \frac{\Delta v}{t}$$

$$F = \frac{m\Delta v}{t}$$

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

How are Impulse and Momentum related?

$$Ft = J = \Delta p$$

$$\boxed{Ft = m\Delta v}$$

- A large change in momentum requires a large force, or a long time.

Example Problem

According to Newton's Third Law of Motion, small thruster rockets can be used to make fine adjustments in satellite orbits. One such rocket has a thrust of 35 N. If it is fired to change the velocity of a 72,000 kg satellite by 63 cm/s, how long should it be fired?

$F = 35\ N$

$m = 72{,}000\ kg$

$\Delta v = 63\ cm/s$

$= .63\ m/s$

$t = ?$

$$Ft = m\Delta v$$

$$t = \frac{m\Delta v}{F}$$

$$t = \frac{(72{,}000\ kg)(.63\ m/s)}{35\ N}$$

$$t = 1{,}296\ s$$