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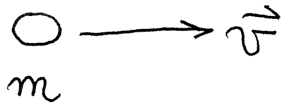
IMPULSE AND MOMENTUM



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

NEWTON'S SECOND LAW:

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

IF m IS CONSTANT $\Rightarrow$

$$\vec{F} = \frac{\vec{p}_f - \vec{p}_i}{\Delta t} = \frac{m\vec{v}_f - m\vec{v}_i}{\Delta t} = m\frac{(\vec{v}_f - \vec{v}_i)}{\Delta t} = m\vec{a}$$

$\vec{F} = m\vec{a}$ IS A SPECIAL CASE OF NEWTON'S SECOND LAW, TRUE ONLY IF m IS CONSTANT.

IF m IS NOT CONSTANT:

$$\vec{F} = \frac{\Delta \vec{p}}{\Delta t} = \frac{\Delta(m\vec{v})}{\Delta t} = m\frac{\Delta \vec{v}}{\Delta t} + \vec{v}\frac{\Delta m}{\Delta t}$$

$$\vec{F} = m\vec{a} + \vec{v}\frac{\Delta m}{\Delta t}$$

IF NO EXTERNAL FORCES ACT TO ADD IMPULSE TO THE SYSTEM, $\vec{p}$ IS CONSERVED

$$\left[\sum_i \vec{p}_i\right]_{initial} = \left[\sum_i \vec{p}_i\right]_{final}$$

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IMPULSE

NEWTON'S SECOND LAW: $\vec{F} = \frac{\Delta \vec{p}}{\Delta t}$

$\Delta \vec{p} = \vec{F} \Delta t$ "IMPULSE-Momentum Theorem"

$\vec{F} \Delta t \equiv \vec{J} \equiv$ "IMPULSE" $=$ FORCE X TIME

"A Force ACTING over Time Changes An object's momentum"

Units $\vec{p} = m\vec{v} = kg\text{-}m/s$

IMPULSE => $\vec{J} = \vec{F} \Delta t = N\text{-}s$

NB: $1N = 1\ kg\ m/s^2$

=> $N\text{-}s = (kg\text{-}m/s^2)s = kg\text{-}m/s$

IMPULSE AND MOMENTUM HAVE THE SAME UNITS! $\{1\ kg\text{-}m/s = 1\ N\text{-}s\}$