

Momentum Notes/Problems

Momentum **Momentum:**
: Measure of the motion of an object equal to its mass x velocity. (How hard it is to stop something)

$$p = mv$$

$$m = \frac{\text{mass}}{\text{velocity}} \quad \begin{matrix} \text{in kg} \\ \text{in m/s} \end{matrix}$$

Momentum is abbreviated with the letter p Units = kg · m/s
(In latin, momentum is impetus...m and I were already taken)

Which has more momentum:
you walking down the hall or semi-truck parked outside

Ex: Calculate your momentum if you are driving down the freeway at 36 m/s and you and your car have a mass of 945.5 kg.

$$p = (945.5 \text{ kg}) (36 \text{ m/s}) = 34038 \text{ kg} \cdot \frac{\text{m}}{\text{s}}$$

Force and Impulse:

In order to change an object's momentum, we need to apply a force over a time period

Newton's 2nd law can be used to calculate the force:

$$F = m \cdot a \quad a = \frac{v_f - v_i}{\Delta t}$$

$$F = m \left(\frac{v_f - v_i}{\Delta t} \right)$$

$$F \Delta t = m (v_f - v_i) = F \Delta t = m \Delta v$$

So:

$$F \Delta t = m \Delta v$$

or

$$I = m \Delta v$$

or

$$F \Delta t = I$$

F = Force (N)

Δt = time (sec)

M = mass (kg)

Δv = velocity (m/s)

$F \Delta t$ = impulse (I) $\text{kg} \cdot \frac{\text{m}}{\text{s}} = \text{N} \cdot \text{sec}$

$m \Delta v$ = change in momentum

When something hits with a force, we can change the time by cradling it to lessen the impact. (Ex. Air bag, catching someone falling with a blanket)

Ex: Calculate the **impulse** needed to stop a 1.7 kg water balloon if it is initially traveling at 8 m/s.
(-13.6 kg m/s)

$$\Delta v = v_f - v_i$$

$$\Delta v = 0 - 8 = -8 \text{ m/s}$$

$$I = m \Delta v$$

$$(1.7)(-8)$$

$$= -13.6 \text{ kg} \cdot \frac{\text{m}}{\text{s}}$$