Physics 11 - Unit 5
Momentum
5.1 - Introduction

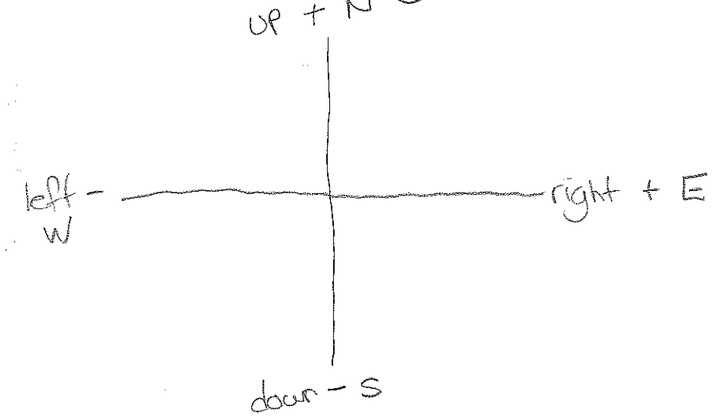
Review

Mechanics

- **Kinematics** [motion only]
- **Statics** [Force only]
- **Dynamics** [motion & force]

Scalars: magnitude only - no direction: speed/mass

Vectors: magnitude & direction: acceleration/velocity



New

Momentum: the mass of an object multiplied by its velocity

: if an unbalanced force is applied over a period of time there is a change (Δ) momentum.

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

$\vec{p}$ = momentum

m = mass

$\vec{v}$ = velocity

Momentum Units

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

$\vec{p} = kg \cdot m/s$

Derivation: from Newtons 2nd Law $\vec{F} = m\vec{a}$

$\vec{F} = m\vec{a}$ $\quad \vec{a} = \Delta v / t$

$t \cdot \vec{F} = m\Delta v / t \cdot t$

$\boxed{\vec{F} \cdot t = m\Delta v}$

Therefore: $\Delta\vec{p} = \vec{F}\Delta t = m\Delta\vec{v}$

an unbalanced force applied over a given time = Δ momentum

Theory

Would u rather B hit by a piece of chalk or a linebacker?

You need 2 consider ∓ momentum ($\vec{p}$) 1st

→ the impact is not only a f(x) of ∓ mass but also ∓ velocity! function

(*) The greater (>) ∓ momentum 'harder' it is to stop!

The Math

$\boxed{\vec{p} = m\vec{v}}$

Calculate ∓ following momenta (plural)

a) 100 kg football player running @ 12 km/hr*

$m = 100\,kg$

$\vec{v} = 12\,km/hr \rightarrow 12\,\frac{km}{hr} \times \frac{1000\,m}{1\,km} \times \frac{1\,hr}{3600\,s}$

$\boxed{\vec{v} = 3.3\,m/s}$

$\vec{p} = (100\,kg)(3.3\,m/s)$

$\vec{p} = 330\,kg \cdot m/s$

b) Blue whale = 150 metric tonnes moving @ 30 km/hr

$m = 150\,tonnes \times \frac{1000\,kg}{1\,tonnes} = 150\,000\,kg$

$\boxed{1.5 \times 10^5\,kg = m}$

$\vec{v} = 30\,\frac{km}{hr} \times \frac{1000\,m}{1\,km} \times \frac{1\,hr}{3600\,s} = 8.3\,m/s$

$\vec{p} = (1.5 \times 10^5\,kg)(8.3\,m/s)$

$\boxed{\vec{p} = 1.2 \times 10^6\,kg \cdot m/s}$