

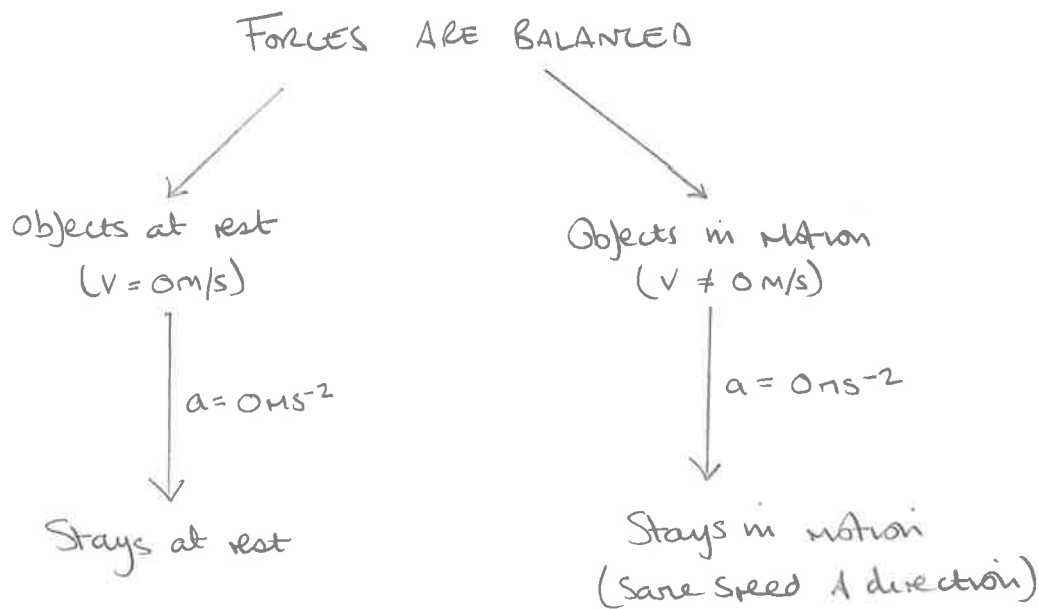
Newton's Law's

Newton's 1st Law

often stated as:

"An object at rest stays at rest, and an object in motion stays in motion with the same speed and in the same direction, unless acted upon by an unbalanced force

This can be summarised by:



Newton's 2nd Law:

The Second law states that the acceleration of an object is dependent on two variables: the net (unbalanced) force acting on it and the mass of the object.

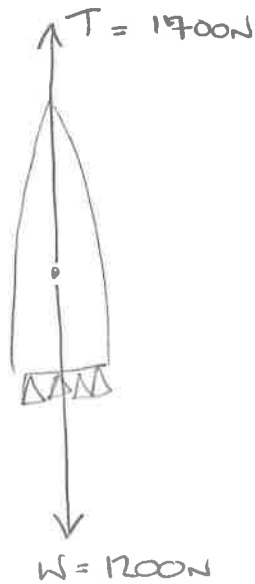
Unbalanced Force = mass \times acceleration

$$F_k = m a$$

$$(N) = (kg)(m/s^2)$$

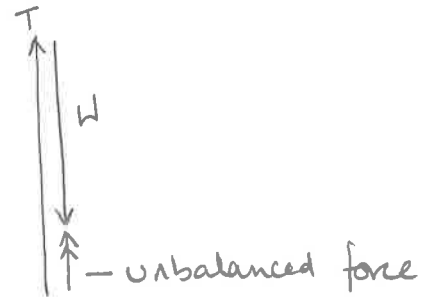
There a force of 1N will cause a mass of 1kg to accelerate at $1 m/s^2$

Application of Newton 2nd Law.



A model rocket has a thrust of 1700N and a weight of 1200N . What will be its acceleration on launch.

Unbalanced force :
(resultant)



Unbalanced/net/resultant force

$$\rightarrow F_R = m a$$

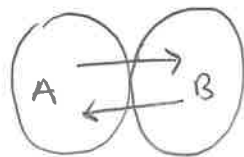
$$a = \frac{F_R}{m} = \frac{500\text{N}}{120\text{kg}}$$

$$\underline{\underline{a = 4.17 \text{ m s}^{-2}}}$$

$$\begin{aligned} \therefore F_R &= T - W \\ &= 1700\text{N} - 1200\text{N} \\ &= \underline{500\text{N}} \end{aligned}$$

$$\left[m = \frac{W}{g} = \frac{1200\text{N}}{10 \text{ N/kg}} = 120\text{kg} \right]$$

Newton's 3rd Law



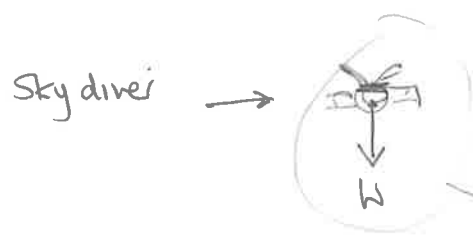
If object A exerts a force on object B, Object B exerts a force on object A that is

- equal in magnitude
- opposite in direction
- the same type of force (eg. contact, gravitational)

• The 'same type of force' is critical and where most errors are made with the application of N^{III}rd Law. e.g. in a falling object, weight is not balanced by drag (weight = gravitational force; drag = contact force).

Newton's 3rd Law in Action:

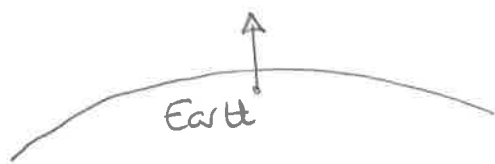
Example:



3rd Law pair:

Earth pulls on man
Man pulls on Earth

[GRAVITATIONAL FORCE PAIR]



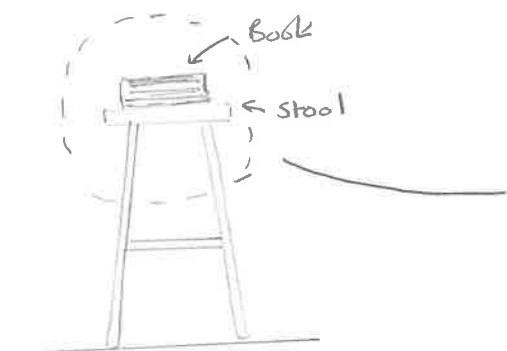
3rd Law pair:

Man exerts force on air molecule
Air molecule exerts force on man

[CONTACT FORCE PAIR]

Important note: the pair of forces each act on a different body, meaning that weight & normal reaction, or weight and drag, cannot be an NIII pair as they act on the same body.

Example:



3rd Law pairs

- Earth pulls down on book
- book pulls up on Earth
(think: if stool removed, book falls to ground).
- Book exerts force downwards on stool.
- Stool exerts force upwards on book.

Once again, we have a gravitational paired force & a contact paired force.

Note: the system is in equilibrium,
∴ no resultant force acting.