**Balanced** forces cancel each other out.

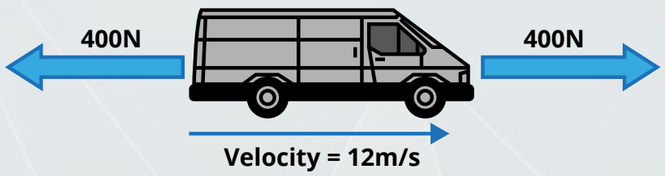

Unbalanced forces cause a **resultant** force to act on an object.


## Newton's first law

Newton's first law states '*an object will remain at rest or at a constant velocity unless it is acted upon by an external resultant force.*'

This means that this object will remain stationary


and this object will continue moving at 12m/s in a straight line.

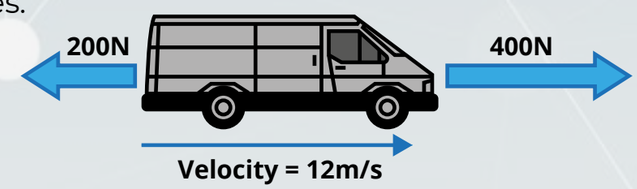



It is important to know the difference between weight and mass.
**Weight** is the force of gravity acting on an object.
**Mass** is the amount of matter in an object.
*(Mass does not change when you go into space but your weight will.)*
You can calculate weight using this equation:

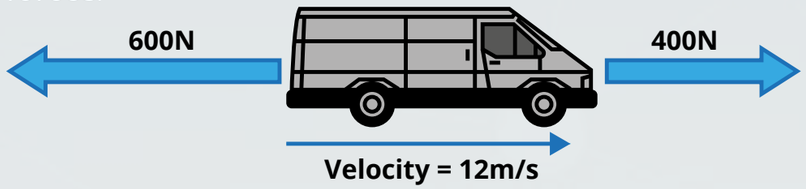
*Weight = mass × gravitational field strength*

**On Earth** the gravitational field strength is **10N/kg** but this is different on different planets.

If the forces are not balanced then the motion of the object will change.
This van will accelerate due to the unbalanced forces.




Whereas this van will slow due to the unbalanced forces.



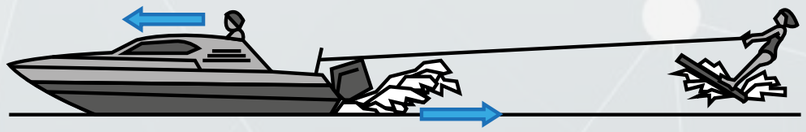

**Newton's second law** can be used to calculate the acceleration or deceleration.

*Resultant force = mass × acceleration*

## Newton's third law

Newton's third law states that '*if a body A exerts a force on body B, then body B exerts an equal and opposite force on body A.*'

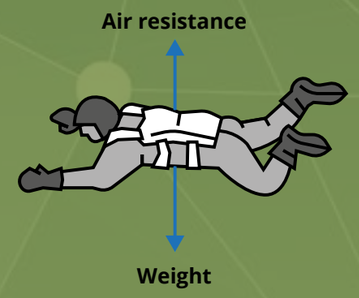
For example:
A **rocket pushes down** on the Earth at take-off, so the **Earth pushes the rocket up** with the same force but opposite direction.

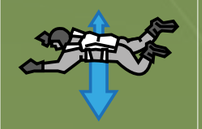
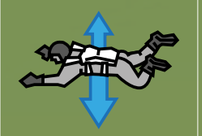
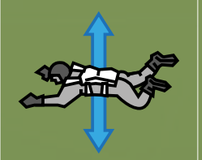


The propeller of this boat pushes the water backwards, so the water pushes the boat forwards with a force the **same size but opposite direction**.

## Terminal speed

The forces acting on a sky diver as they fall are **air resistance** upwards and **weight** downwards. The sky divers weight **remains the same** throughout but the air resistance **changes** due to changes in speed.




| | |
|---|---|
| **1.** Initially the air resistance is **smaller** than the weight, this causes the sky diver to accelerate. |  |
| **2.** As they accelerate, the air resistance **increases**. |  |
| **3.** This continues until the air resistance is **equal and opposite** to the weight. The forces are balanced so the sky diver continues to fall at a **constant** speed. This is known as their **terminal speed**. |  |
| **4.** When the sky diver opens their parachute, the forces become unbalanced. The air resistance **increases** to be larger than the weight, this slows the sky diver. |  |
| **5.** As the sky diver slows, the air resistance decreases to become **equal** to the weight again. The forces balance and a **new lower** terminal speed is reached. |  |

Terminal speeds can also be achieved with vehicles travelling horizontally, where air resistance and friction backwards increase to be equal to the engine's force forward.