FORCE

Definition:

A force is either push or pull. A Force is a vector quantity that means it has magnitude and direction. Force is measured in a unit called Newtons (N).

Some examples of forces are:

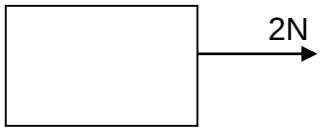
a) Weight- downward pull of gravity on a body.
b) Tension- the force in a stretched rope or string.
c) Friction- a force which stops objects.
d) Air/Water Resistance- examples of friction.

Combining Forces (Resultant Force)

On Earth, very few objects have just one force acting on them. Usually there at least two forces acting though the same point. When this occurs we can combine the forces to form the Resultant Force.

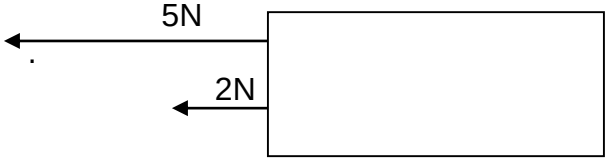
Examples:

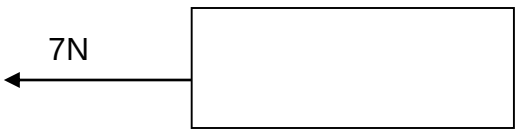
a.



Resultant Force
(5-3) = 2N to the right

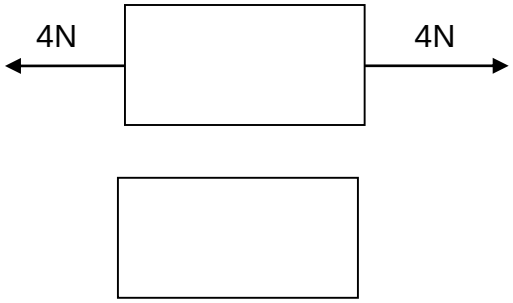
b.





Resultant Force
(2+5) = 7N to the left

c.



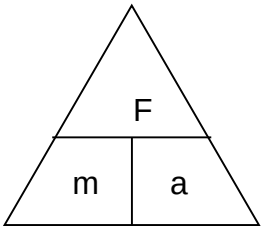
Resultant Force
Zero (0N)

Forces, Mass and Acceleration

We can state a relationship which links force, mass and acceleration together. This relationship is known as Newton's second law in motion.

Force = mass × acceleration

F = ma



Definitions

The mass of an object is the amount of matter it contains. The mass is unchanged no matter where you are in the universe. (mass is measured in ***kg***).

Acceleration is the change of speed with time and it is measured ***m/s²*** *or* ***ms⁻²***

$$\text{acceleration} = \frac{\text{force}}{\text{mass}}$$

$$a = F/m$$

Weight

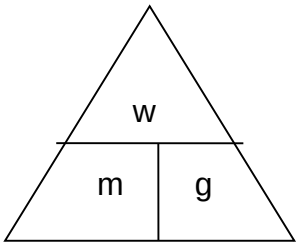
Weight is the pull of a body caused by gravity. The weight of an object depends on where the object is in the universe.

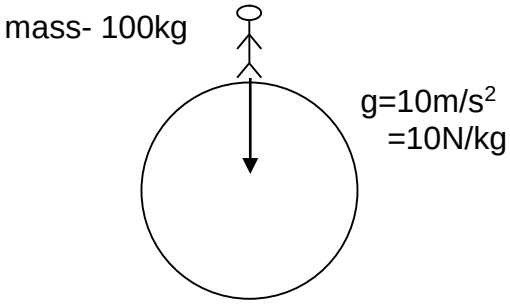
Gravity

Gravity is the pull of a large body on a much smaller body. The earth exerts a gravitational pull on objects which causes an acceleration of g or 9.8 m/s^2. Gravity is a force and the weight of a body is determined by the gravitational pull on that body.

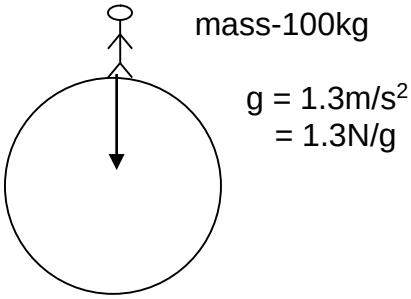
We can determine the weight by using the formula

weight = mass x acceleration due to gravity
(since weight is a force its units is Newton)





Earth
W = mg
= 100 × 10
= 1000N
Weight on earth = 1000N



Moon
W = mg
= 100 × 1.3
= 130N
Weight on moon = 130N

On Earth a man of mass 100kg weighs 1000N. Since gravity on Earth is 10m/s^2 or 10 N/kg.

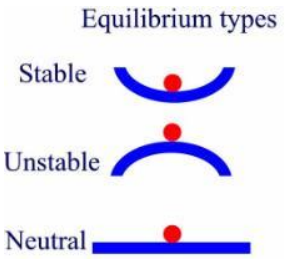
On the moon the same man of mass 100kg weighs 130 N/kg. Since gravity on the moon is 1.3m/s^2 or 1.3N/kg.

The Centre of Gravity, Stability and Equilibrium

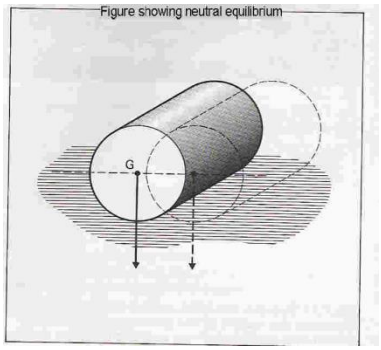
The centre of gravity is the point at which the whole weight of a body is acting. The centre of gravity is the centre of mass. The centre of gravity can be found experimentally.

Stable equilibrium

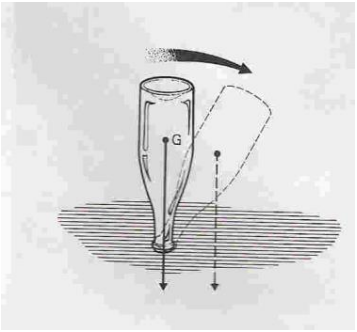
When a body is in stable equilibrium, it returns to its original position after being given a small displacement. The lower the centre of gravity, the less chance there is that the object will overbalance and fall over sideways – think about the shape of a racing car.



A body in neutral equilibrium has no tendency to return to its original position or move further away from it when given a displacement e.g. a can on its side. This is because the vertical from the centre of gravity always passes through the point of contact with the surface



An object in unstable equilibrium will move further away from its original position e.g. the bottle in the figure above.



Balanced Forces

Sir Isaac Newton was the first to describe how objects would move if no forces were acting on them. ***Newton's first law of motion*** states:

If an object has no force on it, it will remain stationary, if was still. OR If it was moving, it will continue moving at a steady speed in a straight line.

Friction

On Earth vehicles quickly come to rest because they are slowed by the force of friction. Friction is the resistance which must be overcome when one surface moves over the other. Friction always acts in the opposite direction to the movement and always opposes you when you try to do work.

Although, surfaces may appear to be smooth they are in fact very rough. When an attempt is made to move two surfaces the hills and valleys interlock with each other. These interlocking forces cause friction between the two surfaces. When objects slide across each other like this the friction heats them up. It also causes the surfaces to wear away.