2.3 Gravitational Force

Weight is a force of gravity acting on an object with mass.
Weight = mass x acceleration due to gravity
W = m g

Acceleration due to gravity (g): Gravitational force causes objects to accelerate towards the center of Earth. It is approximately 9.8m/s².

The gravitational constant (G) is a fundamental constant in physics. It is approximately equal to

$6.674 \times 10^{-11}\ Nm^2/kg^2$

→ It is used to determine the Strength of the gravitational force.

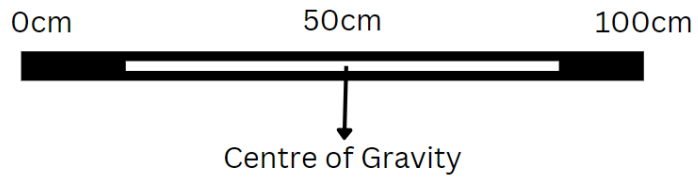
- The Larger the mass of an object, the stronger the gravitational pull.

Gravitational force is the cause of the Orbital motion of celestial bodies such as the gravitational force of the sun keeps the planets In orbit.

CENTER OF GRAVITY

The Centre of Gravity is the point through which all of an object's weight can be considered to act.

For example:



This is a 100cm ruler. Its Centre of Gravity is at the point where the symmetrical lines meet.

How to find the center of gravity of an irregularly shaped Lamina:

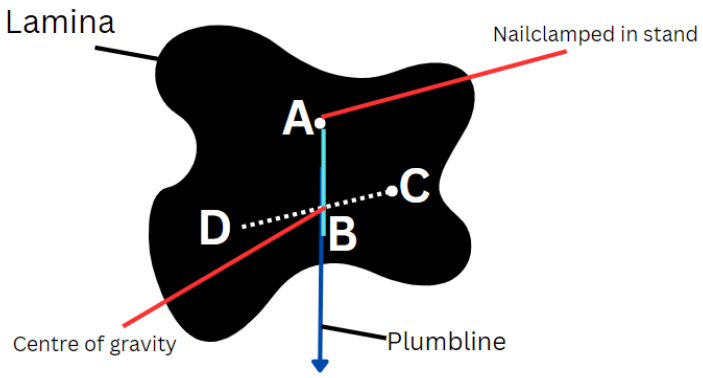
Lamina: Thin sheet of cardboard.

1) Make a hole A in the Lamina and hang it on a nail clamp in a stand so that it can swing freely

2) Tie a plumbline to the nail and mark its position AB on the Lanina

3) Create another hole C and use that point to hold the lamina and mark the plumbline position CD

4) The Point AB intersects with the CD. That intersection point is the Centre of gravity



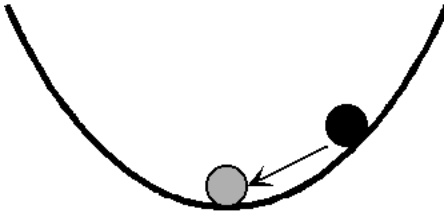
Plumbline: A thread tied with weight.

STABILITY

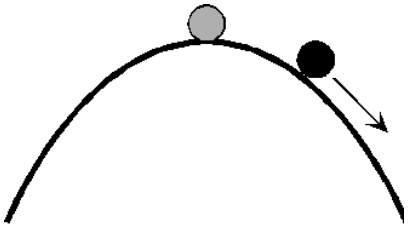
Stability is the ability of an object to maintain a balanced position / steady state.

There are three types of stability:

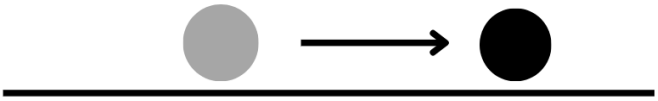
Stable stability: This is when an object is slightly displaced and will return to its original position. This is caused when its gravitational Potential energy increases as its Position moves away from the equilibrium The returns back object naturally to the equilibrium Position when it loses gravitational Potential energy.
The ball will roll up and down and will settle over time in the Position of its equilibrium.



Unstable Stability: This is when an object is displaced and will not naturally return to its original position and it will move away instead This happens because the gravitational Potential energy decreases as its position moves away from the equilibrium position. The object naturally moves away from the equilibrium position when it loses gravitational Potential energy.
The ball will be displaced in either of the directions and will not return to its original position.



Neutral stability: An object is in neutral equilibrium if it Stays in its new position when displaced. This is because when an object is in neutral equilibrium, the gravitational potential energy of the object remains constant regardless of its position.
The ball is displaced to its right and stays in its new Position



Factors that increase stability:

1) **Lowering its Centre of gravity:** This means bringing the mass of the object closer to the ground.

2) **Increasing the area of the base**: the object becomes more resistant to tipping over. It allows Providing more points of contact with the supporting surface.

For example: Racing cars have a low center of gravity and a wider base area to maximize Stability.