CHAPTER THREE
FORCES.

Force is a push or a pull. Force is therefore that which changes a body's state of motion or shape. The SI unit for force is Newton (N). It is a vector quantity. It is represented by the following symbol.

Types of forces

1. Gravitational force –*this is the force of attraction between two bodies of given masses.*
   - *Earth's gravitational force is the force which pulls a body towards its center. This pull of gravity is called weight.*
2. Force of friction – *this is a force which opposes the relative motion of two surfaces in contact with each other. Friction in fluids is known as viscosity*.
3. Tension force – *this is the pull or compression of a string or spring at both its ends*.
4. Upthrust force – *this is the upward force acting on an object immersed in a fluid.*
5. Cohesive and adhesive forces – *cohesive is the force of attraction of molecules of the same kind while adhesive is the force of attraction of molecules of different kinds*.
6. Magnetic force – *this is a force which causes attraction or repulsion in a magnet.*
7. Electrostatic force – *this is the force of attraction or repulsion of static charges.*
8. Centripetal force – *this is a force which constrains a body to move in a circular orbit or path.*
9. Surface tension – *this is the force which causes the surface of a liquid to behave like a stretched skin. This force is cohesive.*

Factors affecting surface tension

a) Impurities – they reduce the surface tension of a liquid i.e. addition of detergent
b) Temperature – rise in temperature reduces tension by weakening inter-molecular forces.

Mass and weight.

Mass is the amount of matter contained in a substance while weight is the pull of gravity on an object. The SI unit for mass is the **Kg** while weight is the **newton (N).** Mass is constant regardless of place while weight changes with place. The relationship between mass and weight is given by the following formula, **W = mg** where g = gravitational force.

Differences between mass and weight

Mass	**Weight**
It is the quantity of matter in a body	*It is the pull of gravity on a body*
It is measured in kilograms	*It is measured in newton's*
It is the same everywhere	*It changes from place to place*
It is measured using a beam balance	*Measured using a spring balance*
Has magnitude only	*Has both magnitude and direction*

Example

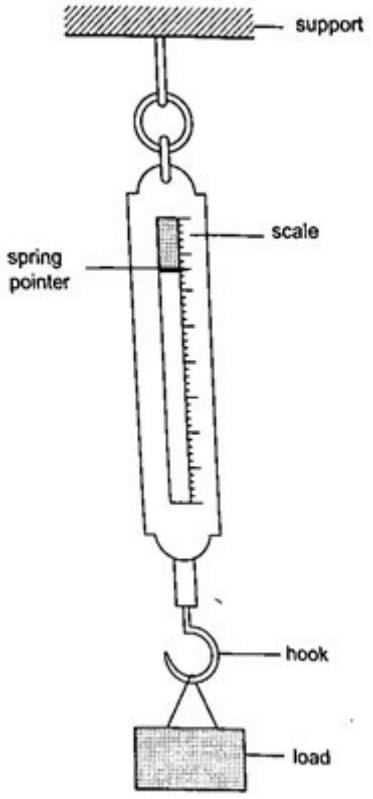
An astronaut weighs 900 N on earth. On the moon he weighs 150 N. Calculate the moons' gravitational strength. (Take g = 10 N/kg). Solution

Moons' gravitational strength = weight of astronaut on the moon / mass of astronaut.

= 150 / 90 = 1.67 Nkg^{-1}.

Measuring force

We use a spring balance to measure force. A spring balance is an instrument that uses the extension of a spring to measure forces.



Example

The length of a spring is 16.0 cm. its length becomes 20.0 cm when supporting a weight of 5.0 N. calculate the length of the spring when supporting a weight of:

a) 2.5 N b) 6.0 N c) 200 N

Solution

5N causes an extension of 4.0 cm, therefore 1.0 cm causes an extension of 4 /5 = 0.8 cm. a) 2.5 N => 2.5 × 0.8 = 2.0 cm therefore length becomes = 16.0 + 2.0 = 18.0 cm.

b) 6.0 N => 6.0 × 0.8 = 4.8 cm therefore length becomes = 16.0 + 4.8 = 20.8 cm.

c) 200 N => 200 × 0.8 = 160.0 cm therefore length becomes = 16.0 + 160.0 = 176.0 cm.

Vector and scalar quantities

A scalar quantity is a quantity which has magnitude (size) only. Examples are distance, mass, speed

A vector quantity is a quantity which has both magnitude and direction. Examples are displacement, weight, velocity.