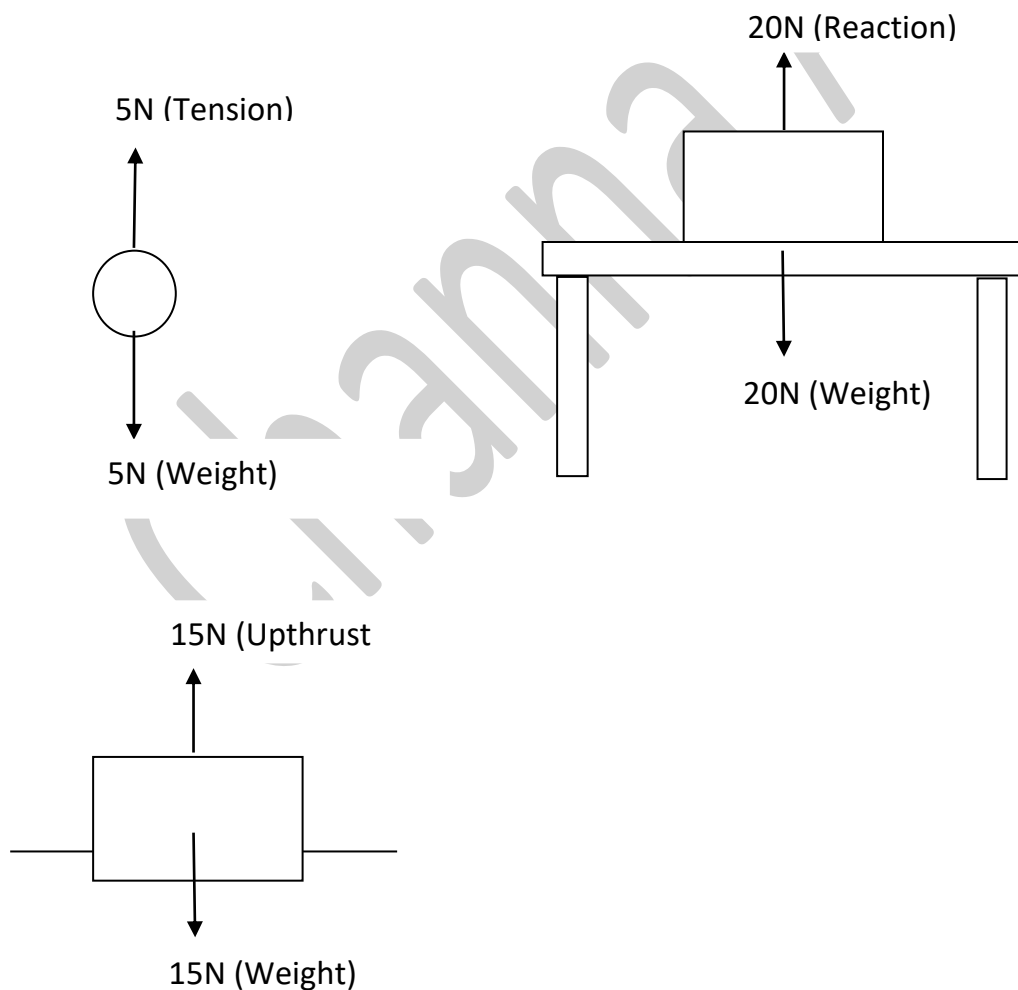


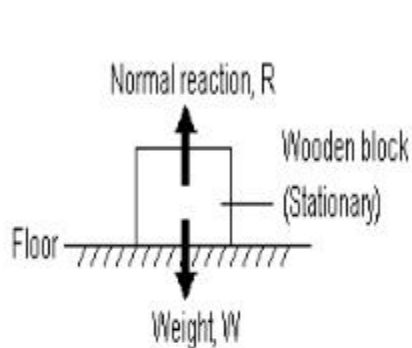
## Chapter 12 – Equilibrium of forces

- 1) When many forces are acting on an object, if the resultant force is zero ( $R=0$ ), then the object is said to be in equilibrium.
- 2) When an object is in equilibrium,
  - (i) The objects which are moving will move in uniform velocity.
  - (ii) The objects which are at rest will remain in rest.
- 3) Therefore the objects which are at rest are in equilibrium.
- 4) Therefore the resultant force of objects that are at rest will be zero.

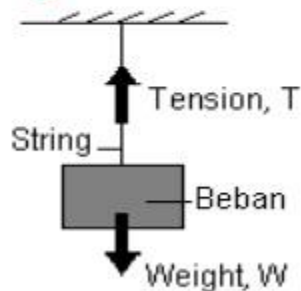
### Equilibrium of an object under two forces



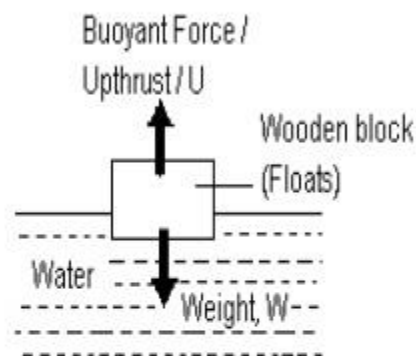
## Examples Forces in Equilibrium



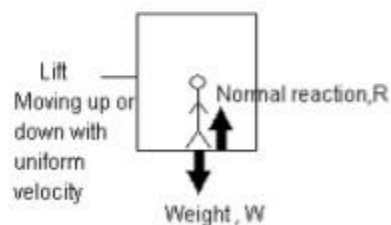
**Weight = Normal reaction**



**Weight = Tension**



**Buoyant force = Weight**



**Weight = Normal reaction**

### Question 1

An object having a mass of 250g was hung by a wire. Find the tension exerted by the wire on the object.

Tension exerted by the wire = weight of the object

$T = \text{mass in kilograms} \times \text{gravitational acceleration}$

$T = 250/1000\text{kg} \times 10\text{ms}^{-2}$

$T = 2.5\text{N}$

**Question 2**

An object having a mass of 15kg was kept on a table. Find the reaction exerted by the table on the object.

Reaction exerted by the table = weight of the object

$$R = \text{mass in kilograms} \times \text{gravitational acceleration}$$

$$R = 15\text{kg} \times 10\text{ms}^{-2}$$

$$R = 150\text{N}$$

**Question 3**

An object having a mass of 500g was floating on water. Find the upthrust force exerted by water on the object.

Upthrust exerted by water = weight of the object

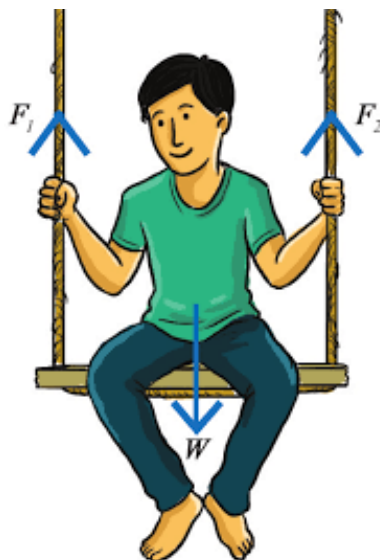
$$U = \text{mass in kilograms} \times \text{gravitational acceleration}$$

$$U = 500/1000\text{kg} \times 10\text{ms}^{-2}$$

$$U = 5\text{N}$$

\* When an object is in equilibrium under two forces

- 1) the magnitude of the two forces should be equal
- 2) the two forces should be in opposite directions
- 3) the two forces should lie on the same line (collinear forces)

**Equilibrium of an object under three coplanar parallel forces.****Question 4**

An boy having ma mass of 25kg was sitting on a swing. Find the tension of one rope.

Tension of two ropes = Weight of the boy

$T + T = \text{Mass of the boy in kilograms} \times \text{gravitational acceleration.}$

$2T = 25\text{kg} \times 10\text{ms}^{-2}$

$2T = 250\text{N}$

$T = 125\text{N}$

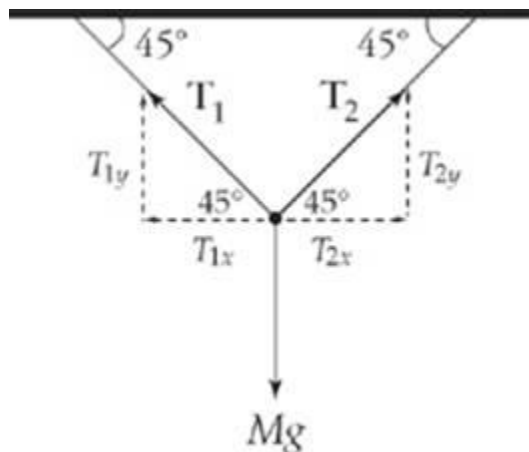
\* When an object is in equilibrium under 3 coplanar parallel force.

1) the three forces should be on the same plane (coplanar)

2) one force should be opposite to the direction of other two forces.

3) the resultant of any two forces should be equal in magnitude and opposite to the direction of the third force.

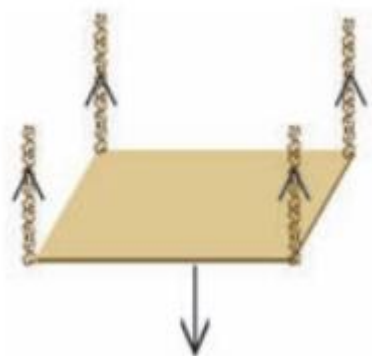
### Equilibrium of an object under three non parallel forces



\* When an object is in equilibrium under 3 non parallel force.

- 1) the three forces should be on the same plane (coplanar)
- 2) the resultant of any two forces should be equal in magnitude and opposite to the direction of the third force.
- 3) the lines of action of three forces should meet at a common point.

## Question 4



5kg wooden plank was hung with 4 wires. Find the tension of one wire.

Tension of 4 wires = weight of the wooden plank

$T + T + T + T + T$  = mass of the plank in kilograms  $\times$  gravitational acceleration

$4T$  =  $5\text{kg} \times 10\text{ms}^{-2}$

$4T$  = 50N

$T$  = 12.5N