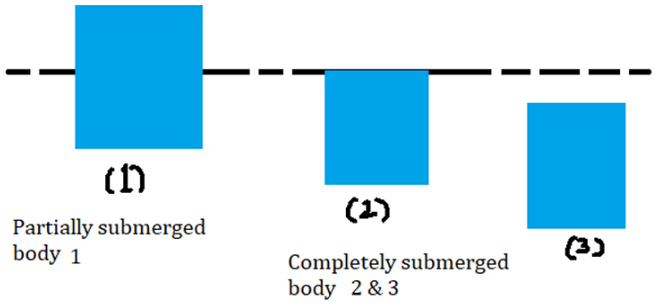
FLOATATION

1. INTRODUCTION

Anyone who has ever tried to swim to the bottom of a pool to retrieve their goggles will have noticed how difficult it is. In fact, a force tends to oppose the body that is descending towards the bottom and push it towards the surface. This vertical thrust force that applies to any object immersed in a fluid is called Archimedes' buoyancy.

Floatation- when body making no vertical movement when present inside liquid

- Partially submerged body
- Completely submerged body



2. ARCHIMEDES' PRINCIPLE

Archimedes' principle, physical law of buoyancy, discovered by the ancient Greek mathematician and inventor Archimedes, stating that any body completely or partially submerged in a fluid (gas or liquid) at rest is acted upon by an upward, or buoyant, force, the magnitude of which is equal to the weight of the fluid displaced by the body. The volume of displaced fluid is equivalent to the volume of an object fully immersed in a fluid or to that fraction of the volume below the surface for an object partially submerged in a liquid. The weight of the displaced portion of the fluid is equivalent to the magnitude of the buoyant force. The buoyant force on a body floating in a liquid or gas is also equivalent in magnitude to the weight of the floating object and is opposite in direction; the object neither rises nor sinks. For example, a ship that is launched sinks into the ocean until the weight of the water it displaces is just equal to its own weight. As the ship is loaded, it sinks deeper, displacing more water, and so the magnitude of the buoyant force continuously matches the weight of the ship and its cargo.

2.1 Archimedes' principle states that:

"The upward buoyant force that is exerted on a body immersed in a fluid, whether partially or fully submerged, is equal to the weight of the fluid that the body displaces and acts in the upward direction at the center of mass of the displaced fluid".

2.2 Archimedes' Principle Formula

In simple form, the Archimedes law states that the buoyant force on an object is equal to the weight of the fluid displaced by the object. Mathematically written as:

Where F_b is the buoyant force, ρ is the density of the fluid, V is the submerged volume, and g is the acceleration due to gravity.

$F_b = \rho \times g \times V$

2.3 Thrust force

Thrust force =ρ.V.g

Where ρ is the density of the liquid,

V is the volume of liquid displaced and g is the acceleration due to gravity.
The thrust force is also called the buoyant force because it is responsible for objects floating. Thus, this equation is also called the law of buoyancy.

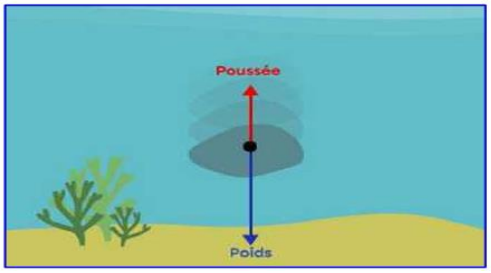
2.3.1 Forces on a flowing object

The downward force is therefore greater than the upward force. The resulting force is directed downward and the object sinks to the bottom: Pf > FA

For the object to be completely submerged and touch the bottom,

it is necessary that:

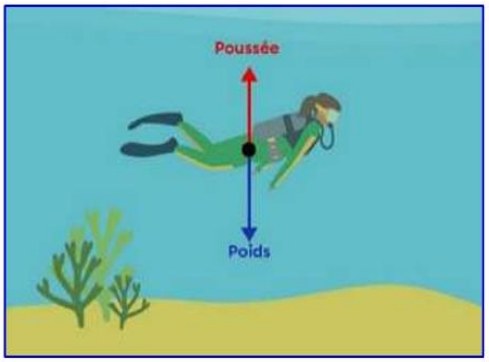
$\rho_{object} > \rho_{fluid}$



2.3.2 The distribution of forces on an object that remains at the same depth

The downward force and the upward force are of the same magnitude. They cancel each other out and the object remains at thedepth where it is: $P_f = F_A$

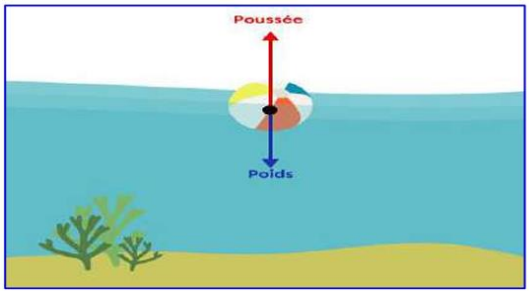
For the object to remain at the samedepth, it is necessary that: $\rho_{object} = \rho_{fluid}$



2.3.3 The distribution of forces on a floating object

The downward force is smaller than the upward force. The resulting force is directed upward and the object rises to the surface.$P_f < F_A$. For the object to float, it is necessary that:

$$\rho_{object} < \rho_{fluid}$$



3. ARCHIMEDES' THRUST THEOREM

Any solid body completely immersed in a liquid at rest undergoes a force called Archimedes' thrust from this liquid,

the characteristics of which are as follows:

– Point of application: the center of thrust located on the vertical containing the center of gravity of the displaced liquid;

– Direction: vertical;

– sense: ascending or from bottom to top;

– Intensity: equal to that of the displaced liquid**.**

4. NOTE

- ❑ It should be remembered that the density ρ in the Archimedes' buoyancy formula,

  $F_{Archimède} = \rho_{fluide} . g. V_{fluide\ déplacé}$

  refers to the density of the displaced fluid, not that of the submerged

  object.

- ❑ It should be kept in mind that the volume in the Archimedes buoyancy formula is that of the displaced fluid (in other words, the volume of the submerged part of the object), and that this volume is not necessarily that of the entire object.

- ❑ It is often thought that the intensity of Archimedes buoyancy increases as the object on which it is applied sinks deeper into the fluid. But Archimedes buoyancy does not depend on depth. It only depends on the volume of fluid displaced$Vfluide\ déplacé$, the density of the fluid $\rho fluide$ and the acceleration g.