Archimedes' Principle

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".**

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:

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

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

Archimedes' Principle Derivation

We know that the density is defined as

ρ = mass/volume

Therefore, the mass of the displaced liquid can be written as follows:

Mass(M) = Density(ρ) x Volume #(V)

Now, the weight of the displaced liquid can be calculated as follows:

$w = m \times a$

$w = m \times g = \rho \times V \times g$

From Archimedes' principle, we know that the apparent loss of weight is equal to the weight of the water displaced therefore the thrust force is given by the following equation:

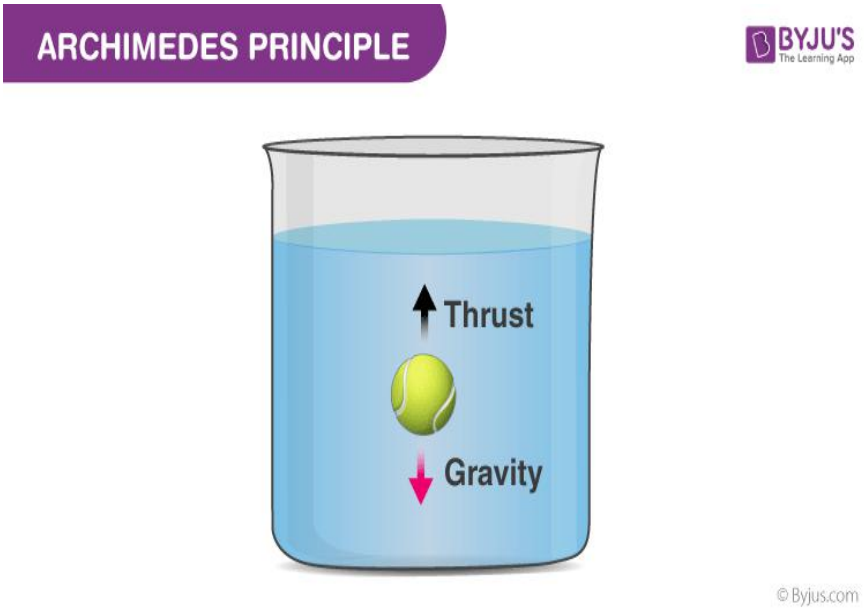
Thrust Force = $\rho \times V \times g$

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.

PROCEDURES

Archimedes' Principle, often known as hydrostatic weighing, is a method for determining an object's volume and density by measuring the buoyant force it experiences when immersed in a fluid. This is how the procedure is carried out:



1. Preparation
   i. As the immersion medium, select a fluid with a specified density, often water.
   ii. To ensure precise measurements, calibrate the equipment used, such as the weighing scale, container, and water displacement apparatus.

2. Weighing in Air:
   i. Using a calibrated weighing scale, weigh the object in the air. This measurement yields the mass (m) of the object.

3. Immersion in Fluid:

   i. Place the object completely submerged in a container of the immersion fluid (typically water). Make sure there are no air bubbles on the object's surface.

4. Buoyant Force Measurment:
   i. When an object is immersed in a fluid, it displaces an equal volume of fluid. This fluid displacement produces an upward force known as the buoyant force (F_b), which counteracts the weight of the object in the fluid.

ii. Using the same calibrated weighing scale, weigh the object while it is immersed in the fluid. This measurement takes into consideration the object's reduced effective weight as a result of buoyancy.

5. Calculation of Volume and Density:

i. The weight of the fluid displaced by the submerged object equals the buoyant force (F_b). The equation for this force is F_b = _fluid * V * g, where _fluid is the density of the fluid, V is the volume of the object, and g is the acceleration due to gravity.
ii. The buoyant force (F_b) is equal to the effective weight loss of the object in the fluid (W_in_air - W_in_fluid).
iii. The object's volume (V) can be estimated using the equation V = F_b / (_fluid * g).
iv. Once you have the volume, you may determine the object's density (_object) using the formula _object = m / V, where m is the object's mass measured in air.