

9th Class

➤ Archimedes' Principle

❖ Introduction:

- Archimedes' Principle is a fundamental concept in fluid mechanics, credited to the ancient Greek mathematician and scientist Archimedes.
- It explains the buoyant force experienced by objects immersed in fluids.

➤ Archimedes' Principle:

1. Statement of the Principle:

- "Any object, wholly or partially immersed in a fluid, is buoyed up by a force equal to the weight of the fluid displaced by the object."

2. Buoyant Force:

- When an object is placed in a fluid, it experiences an upward force called the buoyant force.
- The buoyant force is equal to the weight of the fluid displaced by the submerged part of the object.

3. Density and Buoyancy:

- An object will float if its average density is less than the density of the fluid it is placed in.
- An object will sink if its average density is greater than the density of the fluid.

4. Calculating Buoyant Force:

- The buoyant force (F_b) can be calculated using the formula $F_b = \rho_{\text{fluid}} \cdot V_{\text{submerged}} \cdot g$, where ρ_{fluid} is the density of the fluid, $V_{\text{submerged}}$ is the volume of the fluid displaced, and g is the acceleration due to gravity.

❖ Practical Applications:

1. Buoyancy in Ships:

- Archimedes' Principle explains why large ships made of heavy materials can float.
- The weight of the water displaced by the submerged part of the ship equals the ship's weight.

2. Hot Air Balloons:

- The principle is employed in hot air balloons, where the heated air inside the balloon is less dense than the surrounding air, causing the balloon to rise.

3. Density Determination:

- Archimedes' Principle is used to determine the density of irregularly shaped objects by measuring the buoyant force they experience when immersed in a fluid.

❖ Experimental Verification:

- Archimedes is famously known for his discovery while taking a bath. He noticed that the water level rose as he immersed himself, realizing that the buoyant force acting on his body was equal to the weight of the water displaced.

❖ **Limitations and Considerations:**

- The principle assumes that the fluid is incompressible and that there is no turbulence.
- For objects with irregular shapes, the determination of the volume submerged can be challenging.

- **Conclusion:** Archimedes' Principle is a fundamental concept that provides insights into the behavior of objects in fluids. It has widespread applications in various fields and continues to be a crucial element in the understanding of buoyancy and fluid mechanics.