Chapter-8

1. Introduction to Pressure

Pressure is defined as the **force applied per unit area**.

Formula:

Pressure (P) = Force (F) / Area (A)
P = F / A

SI Unit: Pascal (Pa)

1 Pascal = 1 N/m²

Examples in Daily Life

- Sharp knife cuts better (less area → more pressure).
- Camels have broad feet to walk on sand (larger area → less pressure).
- School bags with wide straps reduce pressure on shoulders.

2. Atmospheric Pressure

- Air exerts pressure on everything.
- At sea level:

Atmospheric Pressure = 1.01×10^5 Pa

Applications

- **Hydraulic press**
- **Deep sea diving suits**
- **Tire pressure monitoring**
- **Human body balance** (internal body pressure matches atmospheric pressure)

3. Fluid and Fluid Pressure

- **Fluids** = liquids and gases.
- Fluids exert **pressure equally in all directions**.
- Fluid pressure **increases with depth**.

4. Transmission of P in Fluids

Pascal's Law

Pressure applied at any point in a confined fluid is transmitted equally in all directions throughout the fluid.

Formula:

Pressure Formula :- $P = F / A$

Uses of Pascal's Law

- Hydraulic press
- Car brakes (hydraulic brakes)
- Scuba diving gear
- Syringes
- Aircraft control surfaces

5. Hydraulic Machines

Structure

- Two pistons (small and large)
- Cylinders connected with fluid
- Incompressible fluid

Working Mechanism

1. **Pumping:** Force applied to smaller piston
2. **Transmission:** Pressure transmitted equally through fluid
3. **Output Force:** Larger piston moves with greater force
4. **Output Motion:** Performs mechanical task (e.g., lifting)

Pascal's Law Proof: Hydraulic Press as Force Multiplier

Pascal's Law

Let:
F_1 = Input Force, A_1 = Area of small piston
F_2 = Output Force, A_2 = Area of large piston

$$F_1/A_1 = F_2/A_2 \quad \Rightarrow \quad F_2 = A_2/A_1 \times F_1$$

Since $A_2 > A_1$, $F_2 > F_1$ → **force is multiplied**.

🔢 Worked Out Problem

Example: Calculating Pressure

Q: A force of 200 N is applied on a piston of area 0.01 m². Find pressure.

$$P = F/A = 200/0.01 = 20{,}000 \text{ Pa}$$

Answer: Pressure = **20,000 Pa**

⚙️ Examples of Hydraulic Machines

Hydraulic Machine	Uses
Hydraulic brake	Braking in vehicles

Hydraulic lift	Lifting cars in garages
Hydraulic press	Molding, pressing metal
Hydraulic jack	Lifting heavy objects like cars

6. Upthrust

Upthrust is the upward force exerted by a fluid on a submerged object.

- **SI Unit:** Newton (N)

➤ **Causes:**

- Fluid exerts pressure in **all directions**
- p is **greater at bottom**, creating a net upward force

➤ **Factors Affecting Upthrust**

- Volume of object
- Density of fluid
- Acceleration due to gravity

7. Archimedes' Principle

"When a body is fully or partially immersed in a fluid, it experiences an upthrust equal to the weight of the displaced fluid."

🧪 **Experimental Verification**

- Weigh object in air → W_1
- Weigh object in water → W_2
- Difference = upthrust

Upthrust Formula

Upthrust = $W_1 - W_2$ = Weight of displaced fluid

Where:
W_1 = Weight of object in air
W_2 = Weight of object in fluid

🔢 **Worked Out Problem**

Q: A body weighs 20 N in air and 15 N in water.
Upthrust = 20 – 15 = **5 N**

8. Floatation of Objects

Law of Floatation:
A body floats in a fluid if the weight of the fluid displaced equals the weight of the object.

Conditions:

Condition	What Happens
Weight < Upthrust	Object floats
Weight > Upthrust	Object sinks
Weight = Upthrust	Object hovers/suspends

9. Floatation in Atmosphere

Similar to water, objects can **float in air** if they displace air equal to their own weight.

📌 Examples

- **Hot air balloons**
- **Weather balloons**
- **Paragliders**
- **Kites**
- **Microscopic particles (dust, pollen)**

📘 Difference: Archimedes' Principle vs. Law of Floatation

Archimedes' Principle	Law of Floatation
Deals with upthrust	Deals with floating
Applies to all submerged bodies	Only to floating bodies
Upthrust = weight of displaced fluid	Weight = upthrust

Interesting Facts

- Air pressure can lift cars (hydraulic lift)!
- The deepest point in ocean faces pressure >1000 times atmospheric pressure.
- Archimedes discovered his principle in a **bathtub** shouting "Eureka!"
- A ship floats despite being heavy due to its **large volume** displacing more water.

Quick Revision Summary

- $P = {}^{F}/_{A}$
- **Pascal's Law**: Pressure in fluid transmitted equally
- **Hydraulic machines**: Lift, brake, jack, press
- **Upthrust** = Weight of displaced fluid
- **Archimedes Principle**: Upthrust = weight of displaced fluid
- **Floating Condition**: Weight = Upthrust

Common Mistakes

- Confusing pressure with force
- Forgetting that pressure is inversely related to area
- Ignoring units in Pascal's law applications
- Misinterpreting floatation conditions
- Thinking heavier objects always sink