GATE PATHSHALA

Fluid Statics Formula Sheet

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1. Pressure at a Depth (Hydrostatic Pressure)

$$P = P_0 + \rho g h$$

Where:
P = Absolute pressure at depth [Pa]
P_0 = Surface (reference) pressure [Pa]
ρ = Fluid density [kg/m^3]
g = Gravitational acceleration [m/s^2]
h = Depth below surface [m]

2. Pascal's Law

$$\Delta P = \rho g \Delta h$$

Where:
Pressure difference is due to vertical height difference in static fluid.

3. Gauge Pressure

$$P_{\text{gauge}} = P_{\text{absolute}} - P_{\text{atm}}$$

Where:
P_{gauge} = Gauge pressure
P_{absolute} = Absolute pressure
P_{atm} = Atmospheric pressure

4. Manometer Equation

$$P_A + \rho_A g h_A = P_B + \rho_B g h_B$$

Where:
Used to determine pressure difference in a fluid column.
ρ = Fluid density, h = Fluid height

5. Hydrostatic Force on a Submerged Vertical Surface

$$F = \rho g A \bar{h}$$

Where:
F = Total hydrostatic force [N]
A = Area of submerged surface [m^2]
$\bar{h}$ = Depth of centroid from free surface [m]

6. Center of Pressure

$$h_{cp} = \bar{h} + \frac{I_G}{\bar{h}A}$$

Where:
h_{cp} = Depth of center of pressure
$\bar{h}$ = Depth of centroid
I_G = Second moment of area about the horizontal centroidal axis [m^4]
A = Area of submerged surface [m^2]

7. Buoyant Force (Archimedes' Principle)

$$F_B = \rho_{\text{fluid}} g V_{\text{displaced}}$$

Where:
F_B = Buoyant force [N]
ρ_{fluid} = Density of displaced fluid [kg/m^3]
$V_{\text{displaced}}$ = Volume of displaced fluid [m^3]

8. Stability of Floating Bodies

$$GM = BM - BG$$

Where:
GM = Metacentric height (stability indicator)
$BM = \frac{I}{V}$, with:

- I = Moment of inertia of waterplane area [m^4]
- V = Volume of displaced fluid [m^3]

BG = Distance between center of buoyancy and center of gravity
Stability Condition: The body is stable if $GM > 0$.