Fluids

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Statics

- $\Delta\vec{F} = p \cdot \Delta\vec{A}$
- $\rho = \frac{\Delta m}{\Delta V}$
- $B^1 = -\frac{\Delta p}{\Delta V/V}$
- $\frac{dp}{dy} = -\rho g$
- $-\Delta p = \rho g \Delta h$
- $\frac{dp}{dy} = -\rho g$
  Since $p \propto \rho, \rho = \rho_0 \cdot \frac{p}{p_0}$
  $\Rightarrow \frac{dp}{dy} = -g\rho_0 \cdot \frac{p}{p_0}$
  After integrating, $\ln\frac{p}{p_0} = -\frac{g\rho_0}{p_0} \cdot h$
  $\Rightarrow p = p_0 e^{(g\rho_0/p_0)h 2}$
- At same point on a fluid, pressure is same in all directions.
- In the **same liquid**, pressure will be same at all points at the same level **iff** their speed is same. (no other constraint except the above two.)
- $\frac{F_1}{A_1} = \frac{F_2}{A_2}$, in the same fluid [3]
- $\Delta p = \pm\rho a x$, where a is horizontal acceleration.
  Take (+) when moving in opposite direction of acceleration and vice-versa.
- $\Delta p = \pm\rho {g_e}^4 h$, where $g_e = g \pm a$, a is vertical acceleration of fluid.
- If the fluid is accelerated and has some acceleration a_x, a_y then,

$$\frac{dp}{dx} = -\rho a_x$$
$$\frac{dp}{dy} = -\rho(g + a_y)$$

[1] Bulk's modulus
[2] Pressure Variation in Atmosphere
[3] Pascal's Law
[4] effective g

- $\Delta p = \pm\frac{p\omega^2 \Delta x^2}{2}$, in rotating fluids.
- A fluid rotating about the centroidal axis with angular velocity has the free surface in shape of a paraboloid.
- For a body floating equate weight and upthrust.
- If a container is at rest relative to ground or translating with some acceleration, then the hydrostatic pressure force acting over a **flat constant surface** is equal to *total area* $\times$ *pressure at its geometric center.*
- Buoyant force : $F = V_i \rho_L g$.
- Buoyant force in accelerating liquids : $F = V \cdot \rho_L \cdot g_{eff}$, where $g_{eff} = \mid g \pm a \mid$