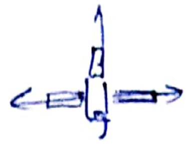
1. Viscosity → Poise to MKS → $\frac{\text{Poise}}{98.1}$

   Poise to S.I → $\frac{\text{Poise}}{10}$

2. S.I unit of viscosity = NS/m^2



3. Pressure (P) b/w inside and outside of a liquid drop

$$P = \frac{4\sigma}{d}$$

→ for liquid drop $\boxed{P = \frac{4\sigma}{d}}$

→ for soap bubble $\boxed{P = \frac{8\sigma}{d}}$

→ for liquid Jet $\boxed{P = \frac{2\sigma}{d}}$

4. Capillary rise or fall of a liquid

$$\boxed{h = \frac{4\sigma\cos\theta}{\rho g d}}$$

θ for water = 0

for mercury = 128°

5. Absolute pressure → absolute vacuum pressure is taken as datum

6. gauge pressure → atm pressure is taken as datum

$$\boxed{P_{abs} = P_{atm} + P_{gauge}}$$

7. a single column manometer (or micrometer) is used for measuring small pressures, while accuracy is required

* Centre of Pressure is defined as the point of application of the resultant Pressure.

* the depth of Centre of Pressure of an immersed Surface from free Surface of the liquid

$$\boxed{h^* = \frac{I_G}{A\bar{h}} + \bar{h}}$$ for vertically immersed Surface

$$= \boxed{\frac{I_G \sin^2\theta}{A\bar{h}} + \bar{h}}$$ for inclined immersed Surface

* the Centre of Pressure for a plane vertical Surface lies at a depth of two-third the ht of the immersed Surface

* the inclination of the resultant force on curved Surface with horizontal, $\boxed{\tan\theta = \frac{F_y}{F_x}}$

* the resultant force on a Sluice gate $\boxed{F = F_1 - F_2}$

* the point through which force of buoyancy is supposed to act is called Centre of buoyancy

* the point about which a body starts oscillating when the body is tilted is known as meta-centre

* Condition of equilibrium of a floating and Sub-merged body

equilibrium	floating body	Sub-merged body
(i) Stable equilibrium	M is above G	B is above G
(ii) unstable equilibrium	M is below G	B is below G
(iii) Neutral equilibrium	M and G Coincide	B and G Coincide

* discharge through a trapezoidal notch or weir

$$\boxed{Q = \frac{2}{3} C_{d_1} \times L \times \sqrt{2g} \times H^{3/2} + \frac{8}{15} C_{d_2} \times \tan\frac{\theta}{2} \times \sqrt{2g} \times H^{5/2}}$$

* the error in discharge due to the error in the measurement of head over a rectangular and triangular notch or weir is

$$\boxed{\frac{dQ}{Q} = \frac{3}{2}\frac{dH}{H}}$$ --- for a rectangular weir or notch

$$\boxed{\frac{dQ}{Q} = \frac{5}{2}\frac{dH}{H}}$$ --- for a triangular weir or notch

* Velocity of approach → the velocity with which the water approaches the weir or notch is called the velocity of approach.

$$\boxed{V_a = \frac{\text{Discharge over the notch or weir}}{\text{cross-sectional area of channel}}}$$

* the head due to velocity of approach is ⇒ $\boxed{h_a = \frac{V_a^2}{2g}}$

* discharge over a rectangular weir, with velocity of approach

$$\boxed{Q = \frac{2}{3} C_d L \sqrt{2g} \left[(H_1 + h_a)^{3/2} - h_a^{3/2} \right]}$$

* Bazin's formula for discharge over a rectangular weir

$$\boxed{Q = mL\sqrt{2g}\, H^{3/2}}$$ → without velocity of approach

$$\boxed{Q = mL\sqrt{2g}\left[(H + h_a)^{3/2}\right]}$$ with velocity of approach

$$m = \frac{2}{3} C_d = 0.405 + \frac{0.003}{H}$$ ... without velocity of approach

$$= 0.405 + \frac{0.003}{(H + h_a)}$$ -- with velocity of approach

* Coefficient of discharge

$$C_d = \frac{Q}{Q_{th}} = \frac{\text{Actual Velocity} \times \text{Actual area}}{\text{Theoretical Velocity} \times \text{Theoretical area}}$$

$$\boxed{C_d = C_v \times C_c}$$

$C_d = 0.61$ to 0.65

$\boxed{C_d = 0.62}$ taken

* the discharge through a large rectangular orifice is

$$\boxed{Q = \frac{2}{3} C_d \times b \times \sqrt{2g}\left[H_2^{3/2} - H_1^{3/2}\right]}$$

H_1 = Ht of liquid above top edge of orifice
H_2 = Ht of liquid above bottom edge of orifice

* the discharge through fully submerged orifice

$$\boxed{Q = C_d \times b \times (H_2 - H_1) \times \sqrt{2gH}}$$

* Discharge through Partially Sub-merged orifice

$$Q = Q_1 + Q_2$$
$$= C_d\, b\, (H_2 - H_1) \times \sqrt{2gH} + \frac{2}{3} C_d\, b \sqrt{2g}\left[H_2^{3/2} - H_1^{3/2}\right]$$

* A notch is a device used for measuring the rate of flow of a liquid through a small channel.
  – A weir is a concrete or masonary structure placed in the open channel over which the flow occurs

$$\boxed{Q = \frac{2}{3} C_d \times L \times H^{3/2}}$$

C_d = Coefficient of discharge
L = Length of notch or weir
H = Head of water over the notch or weir

* the discharge over a triangular notch or weir

$$\boxed{Q = \frac{8}{15} \times C_d \tan\frac{\theta}{2} \times \sqrt{2g} \times H^{5/2}}$$

* $h = \left(\frac{P_1}{\rho g} + z_1\right) - \left(\frac{P_2}{\rho g} + z_2\right) = x\left[1 - \frac{S_l}{S_o}\right]$ ...

[for inclined venturimeter in which differential manometer contains lighter liquid]

x = difference in the reading of differential manometer
S_h = sp. gr of heavier liquid
S_o = sp. gr of flowing through venturimeter
S_l = sp. gr of lighter liquid

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* Orifice is a small opening on the side or at the bottom of a tanks

- mouthpiece is a short length of pipe which is two or three times its diameter in length.

* Hydraulic coefficient

- Coefficient of velocity (C_v) = $\frac{\text{Actual velocity of Jet at vena contracta}}{\text{Theoretical velocity}}$

$$= \frac{V}{\sqrt{2gH}}$$

C_v = 0.95 to 0.99

$\boxed{C_v = 0.98}$ ← Sharp edged orifices.

- Coefficient of Contraction (C_c) = $\frac{\text{area of Jet at vena contracta}}{\text{area of orifice}}$

$$= \frac{a_c}{a}$$

C_c = 0.61 to 0.69

$\boxed{C_c = 0.64}$

* the time Period of oscillation or rolling of a floating body ③

$$\boxed{T = 2\pi\sqrt{\frac{k^2}{GM \times g}}}$$

k = Radius of gyration
GM = meta centric height
T = Time of one Complete oscillation

* the relation b/w tangential velocity and radius

$$\boxed{\text{for forced vortex, } V = \omega \times r}$$

$$\boxed{\text{for free vortex, } V \times r = \text{Constant}}$$

* for a forced vortex flow in a open tank

$$\boxed{\text{fall of liquid level at centre} = \text{rise of liquid level at ends}}$$

* for a free vortex flow the equation

$$\boxed{\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + z_2}$$

* Bernoulli's equation for real fluids

$$\boxed{\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + z_2 + h_L}$$

h_L = Loss of energy b/w section 1 and 2

* value of h is given by differential U-tube manometer

$$h = x\left[\frac{S_h}{S_o} - 1\right]$$ ... [when differential manometer contains heavier liquid]

$$h = x\left[1 - \frac{S_l}{S_o}\right]$$ ... [when differential manometer contains lighter liquid]

$$h = \left(\frac{P_1}{\rho g} + z_1\right) - \left(\frac{P_2}{\rho g} + z_2\right) = x\left[\frac{S_h}{S_o} - 1\right]$$ (for inclined venturimeter in which differential manometer contains heavier liquid)

* Fluid characterics like velocity, pressure, density etc, do not change at a Point with respect to the time the fluid flow is called Steady flow

$$\left(\frac{dv}{dt}\right) = 0 \text{ for Steady flow}$$

$$\left(\frac{dv}{dt}\right) \neq 0 \text{ for unsteady flow}$$

* if the velocity in a fluid flow does not change with respect to space (length of direction of flow), the flow is said to be uniform other wise non-uniform

$$\left(\frac{\partial v}{\partial s}\right) = 0 \text{ for uniform flow}$$

$$\left(\frac{\partial v}{\partial s}\right) \neq 0 \text{ for non-uniform flow}$$

* Component of velocity in x, y, and z direction in terms of velocity Potential (ϕ) are

$$\boxed{u = -\frac{\partial \phi}{\partial x}}, \quad \boxed{v = -\frac{\partial \phi}{\partial y}}, \quad \boxed{w = -\frac{\partial \phi}{\partial z}}$$

* Stream function (ψ) is defined only for two-dimensional flow. the velocity Components in x and y direction in terms of Stream function

$$\boxed{u = -\frac{\partial \psi}{\partial y}} \qquad \boxed{v = \frac{\partial \psi}{\partial x}}$$

* Angular deformation or Shear Strain rate is given by as

$$\text{Shear Strain rate} = \frac{1}{2}\left[\frac{\partial v}{\partial x} + \frac{\partial u}{\partial y}\right]$$