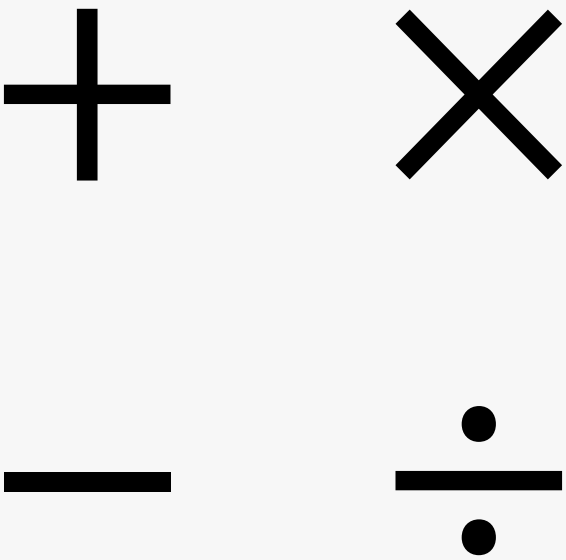
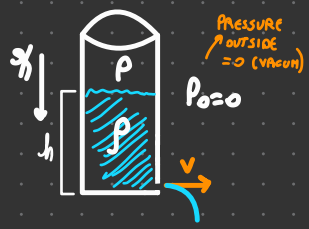


1) DIMENSIONAL ANALYSIS

- CHECKING RESULTS
- GUESSING RESULTS → REYLEIGH ALGO.
  - $\{M, L, T\}$ (MASS, LENGTH, TIME)
  - PHYSICAL QUANTITIES $\{a, b, \dots\}$
  - $x \propto a^{\alpha} b^{\beta} c^{\gamma} \dots \Rightarrow [x] = [a]^{\alpha} [b]^{\beta} \dots$ (∝ PROPORTIONAL)

EXERCISE: TORRICELLI'S LAW



DATA: $\{\rho, \gamma, h, P\}$ — ρ: DENSITY OF LIQUID; P: PRESSURE (ABOVE WATER); γ: GRAVITATIONAL FORCE; h: HEIGHT OF THE LIQUID

$[v] = \frac{L}{T}$

$[P] = \frac{[F]}{L^2}$

$[v] = [h]^{\alpha} [\gamma]^{\beta} [P]^{\gamma} [\rho]^{\delta}$

$\frac{L}{T} = L^{\alpha} \left[\frac{L}{T^2}\right]^{\beta} \left(\frac{ML}{T^2 L^2}\right)^{\gamma} \left(\frac{M}{L^3}\right)^{\delta}$

$\begin{cases} \delta + \gamma = 0 \\ \gamma = \frac{1}{2} - \beta \\ \alpha = \beta \end{cases}$

CONSIDER 2 LIMITS

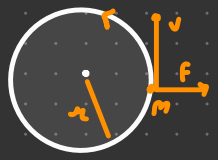
- $P \to 0$: $\gamma = 0$ $\quad \alpha = \beta = 1/2 \quad \delta = 0 \quad \Rightarrow v \propto \sqrt{h\gamma}$
- $h \to 0$: $\alpha = 0 \quad v \propto \sqrt{\frac{P}{\rho}}$

CONNECT THEM

(A) $\tau \propto \sqrt{hg} + \sqrt{\frac{\rho}{\rho}}$

(B) $\tau \propto \sqrt{hg + \frac{\rho}{\rho}}$

PROBLEM 1: CENTRIPETAL FORCE



COMPUTE F IN TERMS OF $\{v, r, m\}$ (v: (MODULUS of) VELOCITY; r: RADIUS; m: MASS)

F?

$$F = [M]^{\alpha}[\omega]^{\beta} = [M]^{\alpha}\left[\frac{v}{t}\right]^{\beta} = [M]^{\alpha}\left[\frac{L}{T^2}\right]^{\beta} =$$

$M = 0$

$$M \cdot \frac{L}{T^2} = [v]^{\alpha}[r]^{\beta}[M]^{\gamma}$$

$$\left[\frac{L}{T}\right]^{\alpha}$$

$$M\frac{L}{T^2} = \left[\frac{L}{T}\right]^{\alpha}$$

$$M\frac{L}{T^2} = \left[\frac{L}{T}\right]^{\alpha}[L]^{\beta}[M]^{\gamma}$$

$$\begin{cases} M=1 \\ L=1 \\ T=-2 \end{cases} \qquad \begin{cases} \gamma = 1 \\ \alpha + \beta = 1 \\ \alpha = 2 \end{cases} \qquad \begin{cases} \gamma = 1 \\ \beta = -1 \\ \alpha = 2 \end{cases}$$

$$F = \frac{L^2}{T^2}\frac{1}{L}M \Rightarrow F = \left(\frac{L}{T^2}\right)M \Rightarrow F = Ma$$

a

$$F \propto M\frac{v^2}{R}$$

PROBLEM 2: ESCAPE VELOCITY

$\{G, M, R\}$

$v_e \propto \sqrt{\frac{GM}{R}}$

$v \geq v_e$ THEN THE OBJECT WILL GET DOWN THE ORBIT OF THE SCRAFT

(v_e: ESCAPE VELOCITY)

$F = G\frac{M^2}{L^2}$

$V_e = ?$

$G = F\frac{L^2}{M^2}$

$V_e = \frac{L}{T}$

$$\frac{L}{T} = [G]^{\alpha}[M]^{\beta}[R]^{\gamma} \Rightarrow \frac{L}{T} = \left[F\frac{L^2}{M^2}\right]^{\alpha}[M]^{\beta}[R]^{\gamma}$$

$\begin{cases} L = 1 \\ T = -1 \end{cases}$