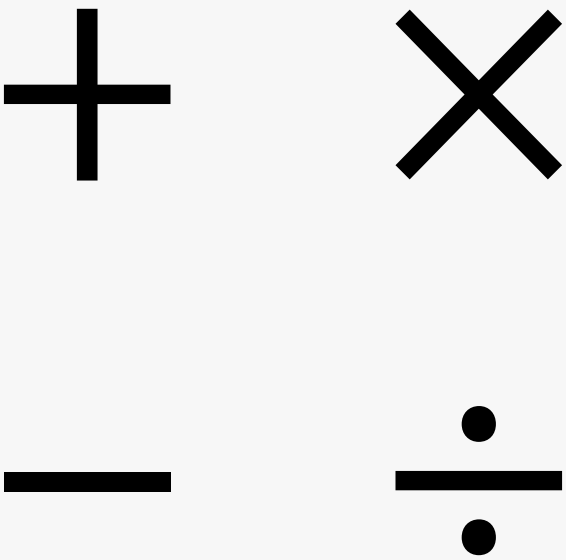


1) DIMENSIONAL ANALYSIS & SCALING

DIMENSIONS

PHYSICAL QUANTITIES THAT YOU CAN **MEASURE** AND QUANTIFY

UNITS OF MEASURE → METER, SECONDS, ...

STANDARDIZE REFERENCE MAGNITUDES

FUNDAMENTAL DIMENSION (SI SYSTEM) → INTERNATIONAL STANDARD

↓

7 BASE DIMENSION

↓

NOT INDIPENDENT
WE COULD RIGTH SOME AS FUNCTION OF OTHERS

- TIME
- LENGTH
- MASS
- CURRENT
- TEMPERATURE
- AMOUNT OF SUBSTANCE MOL
- LIGTH INTENSITY

T, L, M → ENOUGH FOR MECHANICS AND TERMODINAMICS

θ → SINCE IT CAN FLOW WE CAN "AVOID IT" IF WE CAN NOT SOLVE WITH T, L, M ADD θ

DIMENSIONAL ANALYSIS: CAN ALWAYS BE DONE. CAN BE USED

1) CHECK RESULTS OF CALCULATION
2) TO GUESS THE RESULT OF CALCULATION W/OUT DOING THE CALCULATION → REYLEIGH ALGO.

→ CHECK IF THE UNITS OF MEASUREMENT ARE CORRECT AND THE ONE EXPECTED

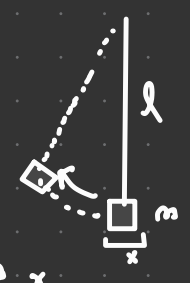
- TREAT DIMS AS IF THEY WERE VARIABLES (ONLY IN PRODUCTS)
- FOR SUM ALL TERMS MUST HAVE THE SAME DIMENSION

a) SENSIBLE CHOICE OF FUNDAMENTAL DIMENSIONS

b) SENSIBLE CHOICE OF WHAT PHYSICAL QUANTITIES THE RESULT MIGTH DEPENDS ON

EXAMPLE

PERIOD OF ROTATION



a) $\{\tau, T, M\}$

b) $m, l,$

$[\text{PERIOD}] = T$

ANSATZ: $\tau = m^\alpha l^\beta g^\gamma$ → "TRIAL TO SEE IF IT WORKS"

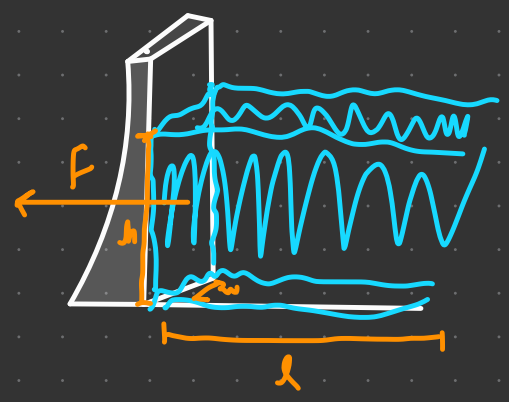
DIM. ANALYSIS

$$T = M^\alpha L^\beta \left(\frac{L}{T^2}\right)^\gamma = M^\alpha T^{-2\gamma} L^{\beta+\gamma}$$

I WANT THE EQ. HT, M, L TO BE SATISFIED IDENTICALLY ⇒ MATCH THE POWERS OF T, M, L

$$\begin{aligned} M:&\ \alpha = 0 \\ L:&\ \beta+\gamma = 0 \\ T:&\ -2\gamma = 1 \end{aligned} \quad \left.\begin{matrix} \\ \\ \\ \end{matrix}\right\} \begin{aligned} &\alpha = 0 \\ &\beta = 1/2 \\ &\gamma = -1/2 \end{aligned}$$

EXAMPLE DAMM (DIGA)



DENSITY WATER

VOLUME of WATER

SURFACE AREA of THE WATER

PRESSURE CONSTANT

$\{\rho, V, A, \cancel{m}, \cancel{R}, g$

w, l, h

DON'T CARE MASS of THE DAMM THE FORCE DOES NOT CHANGE

ASSUME THAT l DOES NOT COUNT $\quad [F] = [ma] = M\frac{L}{T^2}$

$$M\frac{L}{T^2} = [\rho]^\alpha [g]^\beta [w]^\gamma [h]^\delta$$

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

M:	$1 = \alpha$
T:	$-2 = -2\beta$
L:	$1 = -3\alpha + \beta + \gamma + \delta \Rightarrow 3 = \gamma + \delta$

$\alpha = \beta = 1$

$$F \propto \rho g w^\gamma h^\delta$$

SCALING ARGUMENT $\Rightarrow F \propto w \Rightarrow \gamma = 1 \rightarrow \gamma = 2$

$$F \propto \rho g w h^2$$