Day-2

- **Continuum :**

Choosing length scale comparable to mean-free path — matter appears discrete

$$\text{Knudsen's no.} = \frac{\text{mean free path length}}{\text{length scale}}$$

$\rho, P, T, \underline{v}$ → smooth functions of space (validity of continuum)

→ No. of ideal gas molecules at 1 atm, 273 K in a cube of side 1 mm ?

Ans.) $$N = \frac{1}{22.4 \times 10^{6}} \times 6.022 \times 10^{23} = 2.688 \times 10^{16}$$

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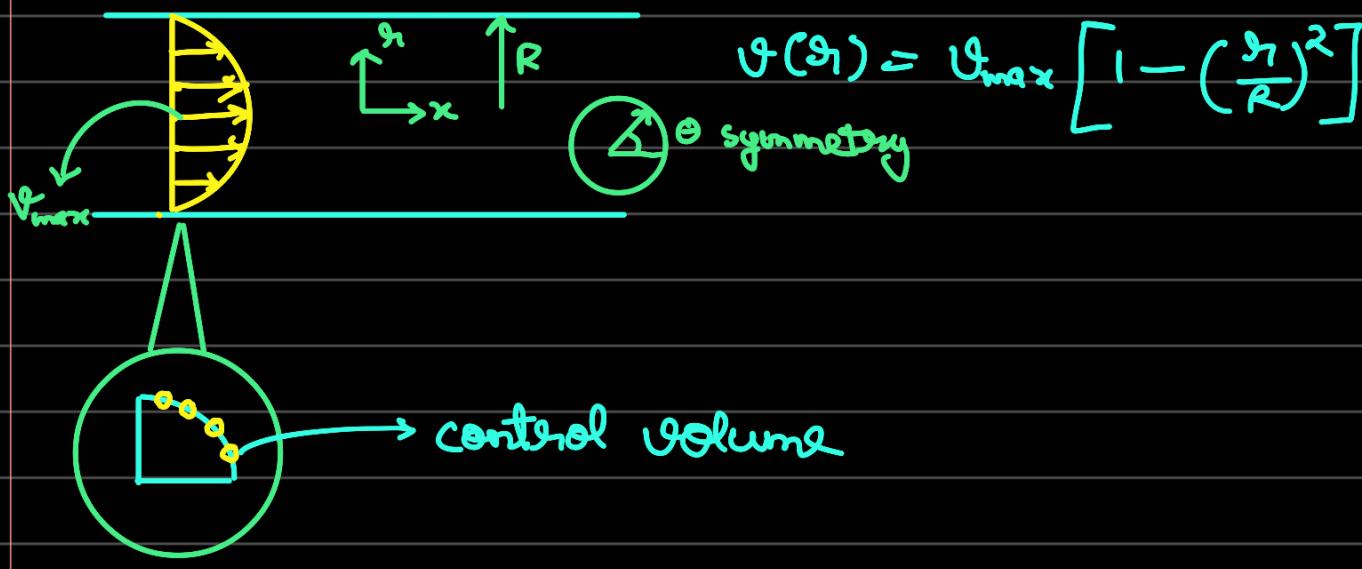

$$v(r) = v_{max}\left[1 - \left(\frac{r}{R}\right)^2\right]$$

- **Incompressibility**

$$\text{mach no.} = v/c \qquad \left(\begin{array}{l} v \rightarrow \text{fluid speed} \\ c \rightarrow \text{sound speed} \end{array}\right)$$

$$\frac{1}{c^2} = \frac{d\rho}{dP}$$

mach no. $< 0.3 \longrightarrow$ incompressible fluid

[Book: Philip J. Pritchard
Fox & mcDonald's
Introduction to fluid mechanics]

- **Steady flow**

If at a point, $v \rightarrow$ func^n of time, it is unsteady flow, else steady flow.

- **Streamlines:**

$$\frac{dy}{dx} = \frac{v}{u} \left(\text{or } \frac{v_y}{v_x}\right)$$

velocity vector $\vec{v}$ is tangent to streamlines.