

Step by Step : (Dimensional Analysis)

Parameters (3)

| | | | | |
|-----|-----------------|---------------|-----------------|--|
| v | $\frac{L}{T}$ | $\frac{K}{s}$ | $\frac{1}{T}$ | $\frac{\sqrt{\frac{K}{s^2}}}{\frac{K}{s}}$ |
| g | $\frac{L}{T^2}$ | $\frac{g}{s}$ | $\frac{1}{T^2}$ | |
| h | L | — | — | |

(2) parameters + 1



$$F_D = \frac{1}{2} \rho C_D V^2 A$$

$$F_D = f(\rho, \mu, A, v)$$

of π groups = 5 ^{# of variables} - 3 _{# of independent} = 2

| | | | |
|--------|--------------------|--|--------------------|
| F_D | — N | — $\frac{kg \cdot m}{s^2}$ | → $\frac{ML}{T^2}$ |
| ρ | — $\frac{kg}{m^3}$ | — kg/m^3 | → $\frac{M}{L^3}$ |
| μ | — Pa·s | — $\frac{kg \cdot m}{s^2} \times \frac{1}{m^2} \times s$ | → $\frac{M}{TL}$ |
| D | — m | — m | → L |
| v | — $\frac{m}{s}$ | — $\frac{m}{s}$ | → $\frac{L}{T}$ |

M, L, T
are the three independent

| | | | | | |
|--------|------------------|------------------------|-----------------|--|-----------------|
| F_D | $\frac{ML}{T^2}$ | $\frac{F_D}{\rho D^3}$ | $\frac{M}{T^2}$ | $\frac{F_D}{\rho D^3} \div \frac{\rho}{D^3}$ | $\frac{1}{T^2}$ |
| ρ | $\frac{M}{L^3}$ | $\frac{\rho}{D^3}$ | M | — | — |
| μ | $\frac{M}{TL}$ | $\frac{\mu}{D}$ | $\frac{M}{T}$ | $\frac{\mu}{D} \div \frac{\rho}{D^3}$ | $\frac{1}{T}$ |
| D | L | — | — | — | — |
| v | $\frac{L}{T}$ | $\frac{v}{D}$ | $\frac{1}{T}$ | $\frac{v}{D}$ | $\frac{1}{T}$ |