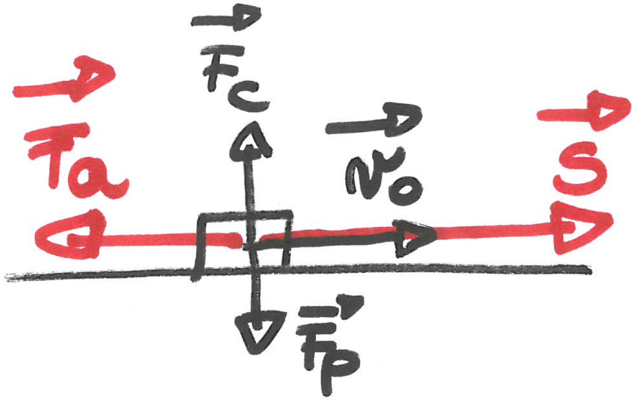


$v_0 = 5\ m/s$

$v_f = 0$

$F_c = F_p$

$L = \vec{F} \cdot \vec{s} = F \cdot s \cos\theta$

$\frac{\pi}{2}$

$\Delta E_k = L_{TOT}$

$$\cancel{\frac{1}{2} m v_f^2} - \frac{1}{2} m v_0^2 = \cancel{L_{F_p}} + \cancel{L_{F_c}} + L_{F_a}$$

$v_f = 0$

$$-\frac{1}{2} m v_0^2 = \vec{F_a} \cdot \vec{s}$$

$F_a = \mu_d F_c$

$$-\frac{1}{2} m v_0^2 = F_a \cdot s \cdot \cos\theta$$

$$-\frac{1}{2} m v_0^2 = \mu F_c \cdot s \cos\pi$$

$= -1$

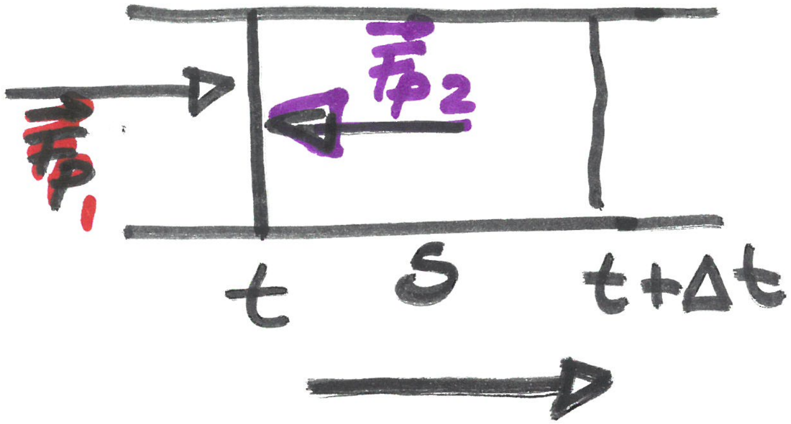
$$\cancel{+}\ \frac{1}{2}\cancel{m}v_0^2 = \cancel{+}\mu\, \cancel{m}g \cdot s$$

$$s = \frac{v_0^2}{2\mu g} = \frac{(5\,m/s)^2}{2 \cdot 0{,}10 \cdot 9{,}81\, m/s^2}$$

$$= 12{,}7\ m$$

$$P = \frac{F_\perp}{S}$$

CONDOTTO RIGIDO



fluido perfetto
(senza attrito)

$$F_p = P \cdot S$$

$$L = \vec{F}_p \cdot \vec{s} = F_p \cdot s \cos\vartheta = F_p \cdot s \cdot (\pm 1)$$

$\vartheta = 0 \quad \cos 0 = 1$

$\vartheta = \pi \quad \cos \pi = -1$

$$L = \pm F_p \cdot s = \pm P \cdot S s = \pm P V$$

$$\boxed{L = \pm PV}$$ se P e' costante

$$dL = \pm P\,dV$$ se P non e' costante

$$\int dL = \pm \int P\,dV \longrightarrow L = \pm \int P\,dV$$

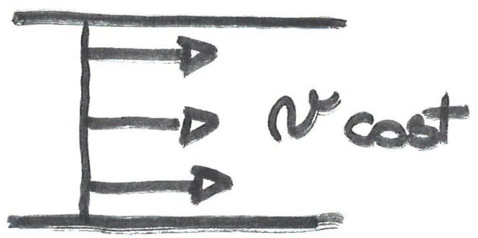
PORTATA VOLUMICA (Q)

Volume di fluido che attraversa la sezione di un condotto nel tempo Δt

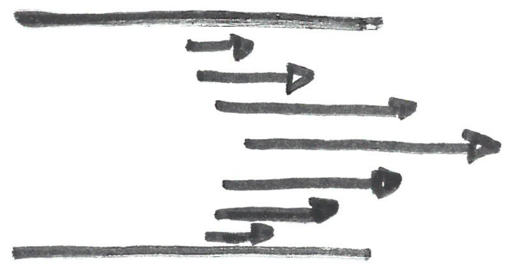
$$Q = \frac{V}{\Delta t} \quad \left[\frac{m^3}{s}\right]$$

$$V = S \cdot s$$

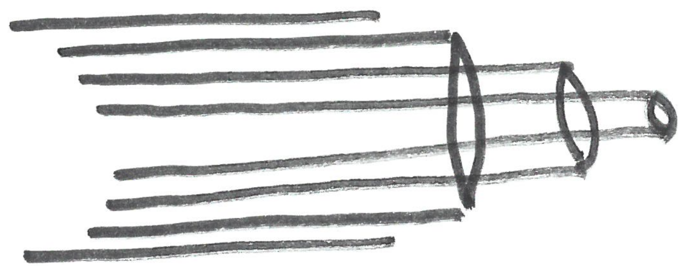
$$Q = \frac{S \cdot s}{\Delta t} = S\, v$$



FLUIDO IDEALE



FLUIDO VISCOSO



$$dQ = v\, dS$$

$$\int_{\text{SUP.}} dQ = \int_{\text{SUPERFICIE}} v\, dS \longrightarrow Q = \int_{\text{SUPERFICIE}} v\, dS$$

PORTATA MASSICA (Q_M)

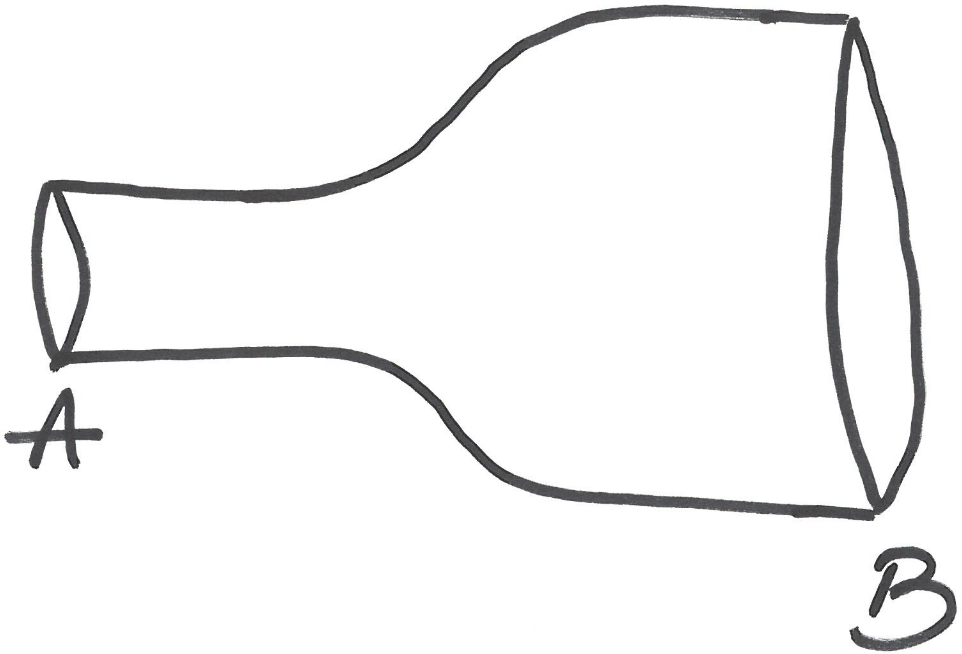
massa che attraversa la sezione di un condotto nel tempo Δt

$$Q_M = \frac{M}{\Delta t} \left[\frac{kg}{s}\right]$$

$$\delta = \frac{M}{V} \longrightarrow M = \delta V$$

$$Q_M = \frac{\delta V}{\Delta t} = \delta \frac{V}{\Delta t} = \delta Q = \delta v S$$

EQUAZIONE DI CONTINUITA'



Condotto rigido a sezione invariabile

fluido ideale in moto stazionario

ne' pozzi ne' SORGENTI

la MASSA si CONSERVA

$$Q_{M_A} = Q_{M_B}$$

$$\underbrace{\delta_A v_A S_A = \delta_B v_B S_B}$$

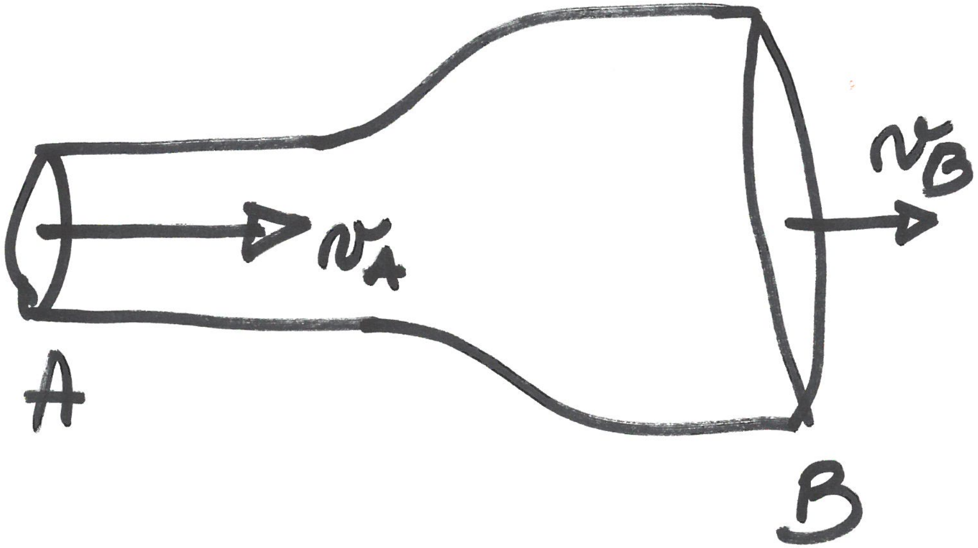
TUTTI i FLUIDI

SOLO FLUIDI INCOMPRIMIBILI $\delta_A = \delta_B$

$$\cancel{\delta_A} v_A S_A = \cancel{\delta_B} v_B S_B$$

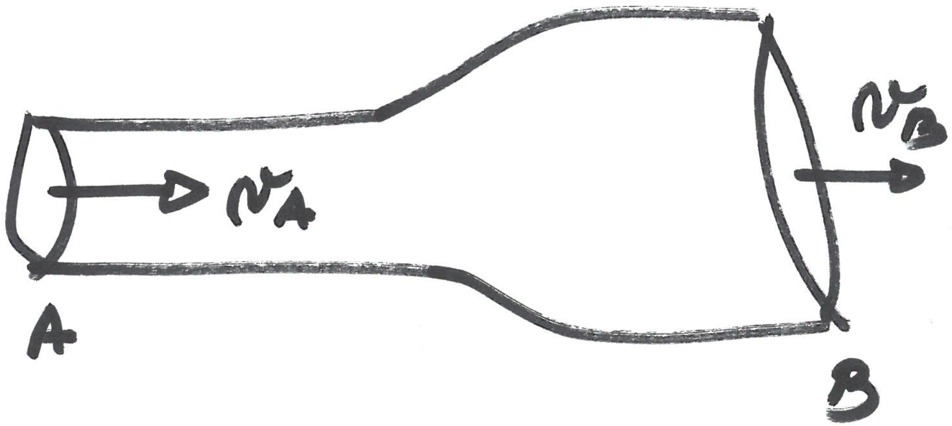
$$v_A S_A = v_B S_B$$

FLUIDI INCOMPRIMIBILI (ES ACQUA)



MOTO STAZIONARIO

v fluido nel condotto e' costante nel tempo ma puo' variare da punto a punto



POTENZA

$$W = \frac{L}{\Delta t} = \frac{PV}{\Delta t} = PQ \qquad [\text{WATT}]$$

*

ANALISI DIMENSIONALE

POTENZA IN FLUIDODINAMICA

$$W = PQ = Pa \cdot \frac{m^3}{s} = \frac{N}{\cancel{m^2}} \cdot \frac{m^{\cancel{3}\,1}}{s} = \frac{N \cdot m}{s}$$

PRESSIONE

PORTATA VOLUMICA

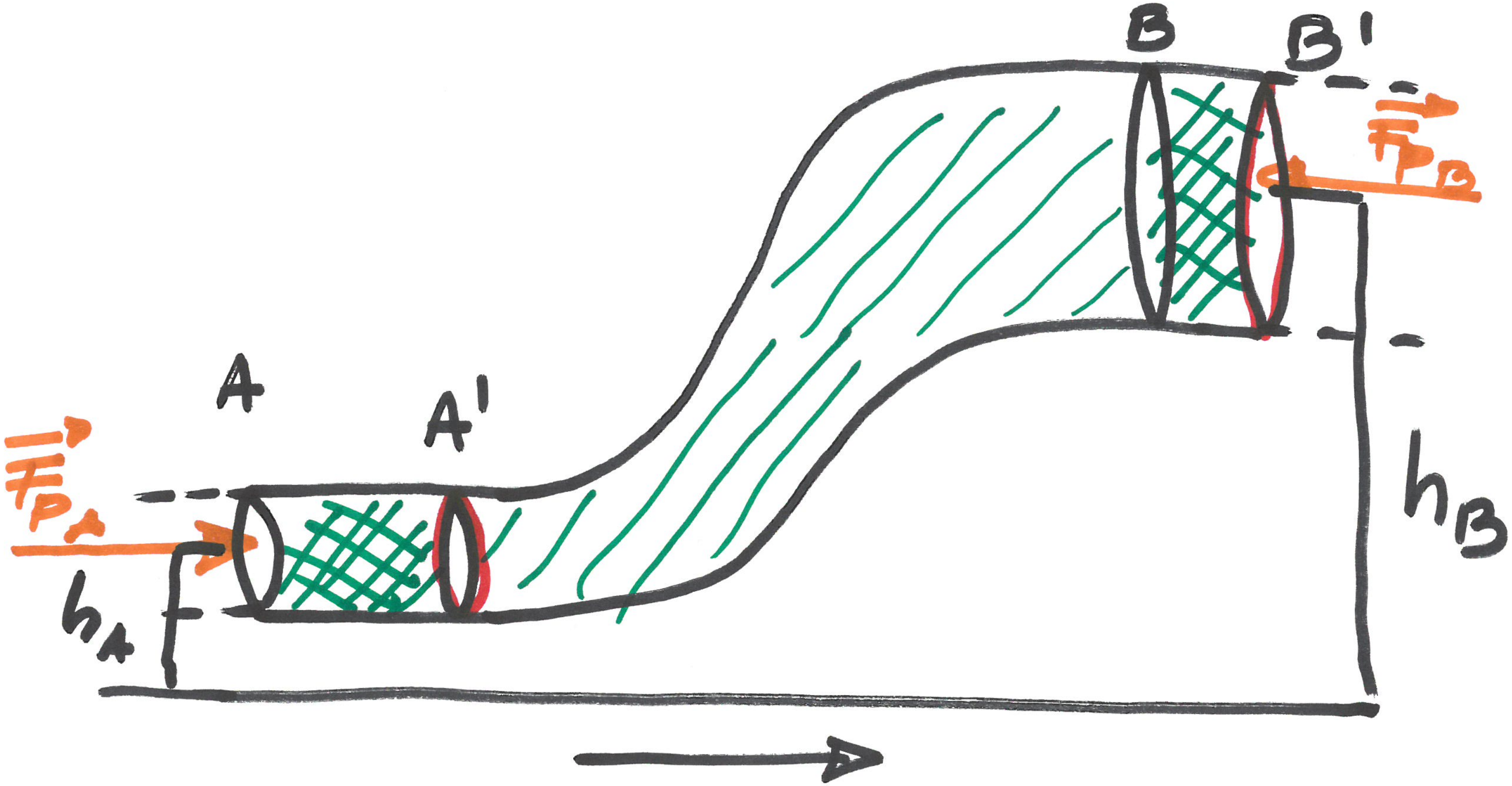
JOULE

$$\frac{N \cdot m}{s} = \frac{J}{s} = \text{WATT}$$

TEOREMA di BERNOULLI

= Conservazione dell'energia in fluidod.

FLUIDO IDEALE in MOTO STAZIONARIO INCOMPRIMIBILE IN UN CONDOTTO RIGIDO A SEZIONE E ALTEZZA VARIABILE



AB in t

A'B' in $t+\Delta t$

$$\Delta E_k + \Delta U + \cancel{\Delta I} = L_{est}$$

$\Delta I = 0$

no attrito

$L_{est} \rightarrow F_{\text{pressione}}$ dovute al fluido a monte e a valle di AB

$$\Delta E_k = E_{k_f} - E_{k_i} = E_{K_{A'B'}} - E_{k_{AB}}$$

$$= E_{k_{A'B}} + E_{BB'} - \left(E_{k_{AA'}} + E_{K_{A'B}}\right)$$

$$= \cancel{E_{k_{A'B}}} + E_{k_{BB'}} - E_{k_{AA'}} - \cancel{E_{k_{A'B}}}$$

$$= E_{k_{BB'}} - E_{k_{AA'}}$$

$$\Delta E_K = \frac{1}{2} m v_B^2 - \frac{1}{2} m v_A^2$$

$$\Delta U = U_{BB'} - U_{AA'} = mgh_B - mgh_A$$

$$L_{est} = L_{F_A} - L_{F_B} = P_A V_A - P_B V_B$$

$$\underline{\underline{|}}\ P_A V - P_B V \qquad V_A = V_B$$

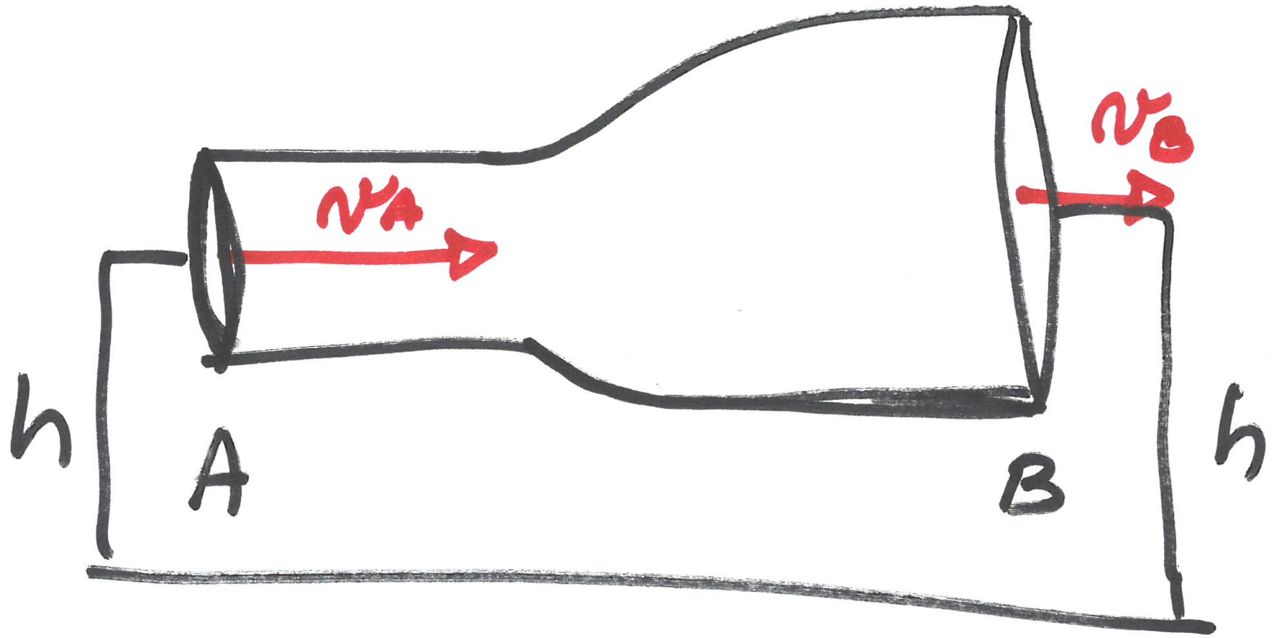
$$\frac{1}{2}\frac{m v_B^2}{V} - \frac{1}{2}\frac{m v_A^2}{V} + \frac{mgh_B}{V} - \frac{mgh_A}{V} = \frac{P_A \cancel{V}}{\cancel{V}} - \frac{P_B \cancel{V}}{\cancel{V}}$$

$$\frac{1}{2}\delta v_B^2 - \frac{1}{2}\delta v_A^2 + \delta g h_B - \delta g h_A = P_A - P_B$$

$$\underbrace{\frac{1}{2}\delta v_B^2}_{\text{PRESSIONE DINAMICA}} + \underbrace{\delta g h_B}_{\text{PRESSIONE STATICA GRAVITAZIONALE}} + \underbrace{P_B}_{\text{PRESSIONE ESTERNA}} = \frac{1}{2}\delta v_A^2 + \delta g h_A + P_A$$

$$\underbrace{\frac{1}{2}\delta v_B^2 - \frac{1}{2}\delta v_A^2}_{\Delta P_d} + \underbrace{\delta g h_B - \delta g h_A}_{\Delta P_g} + \underbrace{P_B - P_A}_{\Delta P_{est}} = 0$$

$$\Delta P_d + \Delta P_g + \Delta P_{est} = 0$$



CONDOTTO ORIZZONTALE A SEZIONE VARIABILE

$$\frac{1}{2}\delta v_B^2 - \frac{1}{2}\delta v_A^2 + \cancel{\delta g h_B} - \cancel{\delta g h_A} + P_B - P_A = 0$$

$h_A = h_B$

$$\frac{1}{2}\delta v_B^2 - \frac{1}{2}\delta v_A^2 = P_A - P_B$$

$v_A > v_B$

$$\frac{1}{2}\delta \underbrace{\left(v_B^2 - v_A^2\right)}_{<0} = P_A - P_B < 0$$

$P_A < P_B$