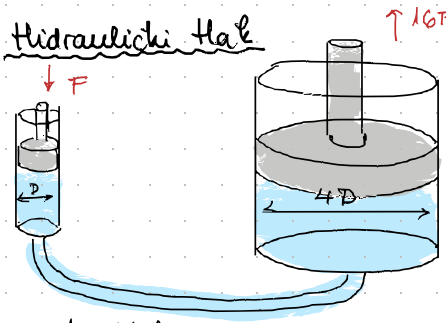
3A MEHANIKA FLUIDA

Tlak – sila kojom čestica fluida djeluje na površinu S

$$p = \frac{|\vec{F}_1|}{S} \quad \text{ili} \quad -d\vec{F} = p\,d\vec{S}$$

(skalarna veličina) $[p_a] = \left[\frac{N}{m^2}\right]$

Hidraulički tlak



$$p_1 = \frac{F_1}{S}$$

$$p_2 = \frac{F_2}{S}$$

$$\frac{F_1}{S_1} = \frac{F_2}{S_2}$$

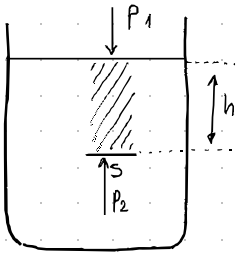
Pascalov zakon

- ako na tekućinu djeluje vanjska F, svaka točka fluida mora biti podvrgnuta istoj sili

– vanjski tlak uslijed primjene sile na tekućini prenosi se jednako na sve točke fluida i stijenke posude

Hidrostatski tlak – na čestice fluida djeluje sila teža

× miran nestlačivi fluid stalne gustoće



$$p_1 \cdot S + mg = p_2 S$$

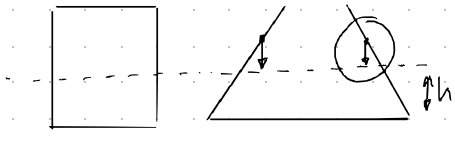
$$p_{atm} \cdot S + \rho_{tek} \cdot V_{tek} \cdot g = p_2 S$$

$$p_{atm} \cdot S + \rho_{tek} \cdot S \cdot h \cdot g = p_2 S \,/ : S$$

$$p_{atm} + \rho_{tek} \cdot hg = p_2 \longrightarrow p_2 - p_1 = \rho g h$$

hidrostatski tlak

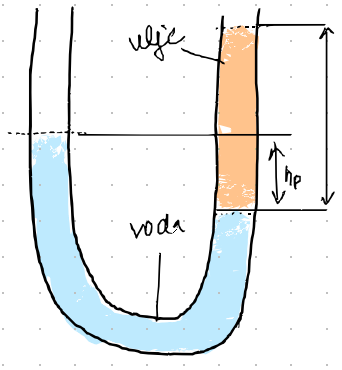
• ovisi samo o površini i visini fluida



Stijenke „kompenziraju" razliku koju bi činali tlakovi

↳ na istoj h, tlak je isti (pokus spojenih posuda)

Spojene posude - različite tekućine



– ista razina tekućine u svim posudama na istoj visini vrijedi SAMO ako je gustoća tekućine svugdje jednaka

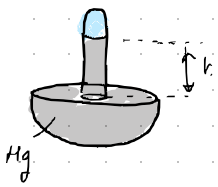
▷ pretpostavljamo da je horizontalan presjek na tim visinama jednak!

$$\frac{h_{plava}}{h_{naranč}} = \frac{\rho_{naranč}}{\rho_{plava}}$$

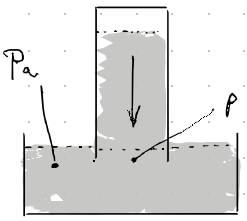
Atmosferski tlak: tlak stupca zemljine atmosfere koji djeluje na neku površinu

$p_{atm} = 101325\ Pa$

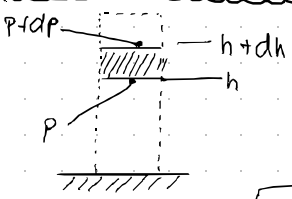
Torricellijev pokus:



$\Rightarrow$



Barometarska formula



$p = \rho g h \ / \cdot \lambda \longrightarrow -dp = \rho(h) g\, dh$

jednadžba stanja plina: $pV = nRT = \frac{m}{M} RT \ / \cdot \frac{M}{V}$

$*T = konst$

$pM = \frac{mRT}{V} \Rightarrow pM = \rho RT \ / \cdot \frac{1}{\rho M}$

$\frac{p}{\rho} = \frac{RT}{M}$ → konstanta, ne mijenja se vanjskim utjecajem

$\frac{p_e}{\rho_0} = \frac{p(h)}{\rho(h)} \Rightarrow \rho(h) = p(h) \cdot \frac{\rho_0}{p_0}$

$-dp = p(h) \cdot \frac{\rho_0}{p_0} \cdot g\, dh \ / : p \longrightarrow \frac{-dp}{p} = \frac{\rho_0}{p_0} g\, dh \ / \int$

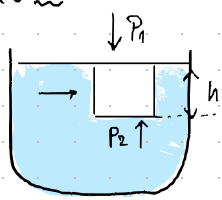
$-\int_{p_0}^{p} \frac{dp}{p} = \int_0^h \frac{\rho_0}{p_0} g\, dh \Rightarrow \ln\left(\frac{p}{p_0}\right) = \frac{\rho_0}{p_0} g h \ / e$

$\frac{p}{p_0} = e^{\frac{\rho_0}{p_0} g h}$

Arhimedov zakon i uzgon

Arhimedov zakon – tijelo uronjeno u fluid gubi na težini onoliko koliko teži volumen tekućine koji je istisnulo to tijelo

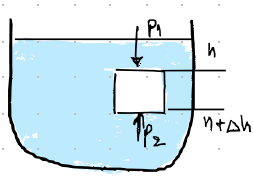
Uzgon – sila koja djeluje na tijelo u fluidu zbog razlike hidrostat. tlaka (suprotno od F_g)



$p_2 \cdot S = p_1 \cdot S + \rho g V = p_1 S + \rho g S \cdot h \ / : S$

$p_2 = p_1 + \rho g h$

$p_1 = p_{atm}$

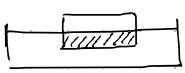


$F_1 = S \cdot p_1 = S(p_{atm} + \rho_{fluid} g h)$

$F_2 = S \cdot p_2 = S(p_{atm} + \rho_{fluid} g (h + \Delta h))$

$F_2 - F_1 = F_{uzgon}$

$F_u = \rho_{fluid} \cdot g \cdot \Delta h \cdot S \longrightarrow \boxed{F_u = \rho_{fluid}\, g\, V_{tijelo}}$

ako je 

$V_{izvan\ vode} = V_{uronjen} \longrightarrow F_g = F_u \quad mg = F_u$

$\rho_{tijela} \cdot V_{tijelo}\, g = \rho_{fluid} V_{tijelo}\, g$

$\rho_{tijela} = \rho_{fluid}$