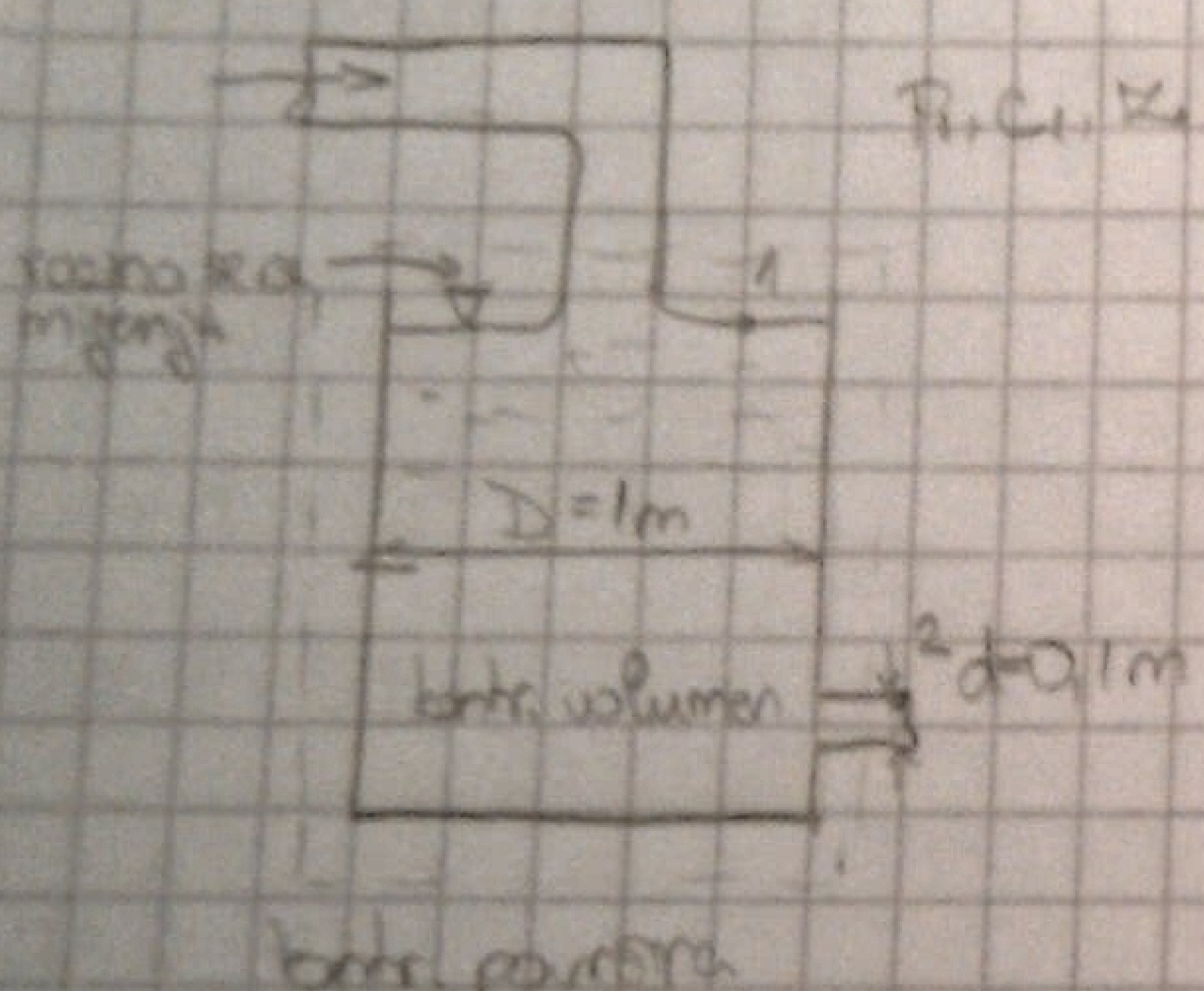
AV

1. Promatramo spremnik sa idealnom kapljevinom, a on se istodobno puni i prazni između punjenja i pražnjenja



p_1, c_1, z_1

m_w = konst.

$Q\ [m^3/s] = ?$

$c_1 \approx 0$

$c_1 \neq 0$ stat. tlak din. tlak hidrost. tlak

B.J. → $p_1 + \frac{1}{2}\rho c_1^2 + \rho g z_1 = p_2 + \frac{1}{2}\rho c_2^2 + \rho g z_2$ $[N/m^2 \equiv Pa]$ (1)

p → vak. odn. manjak u odn. na tlak okolice

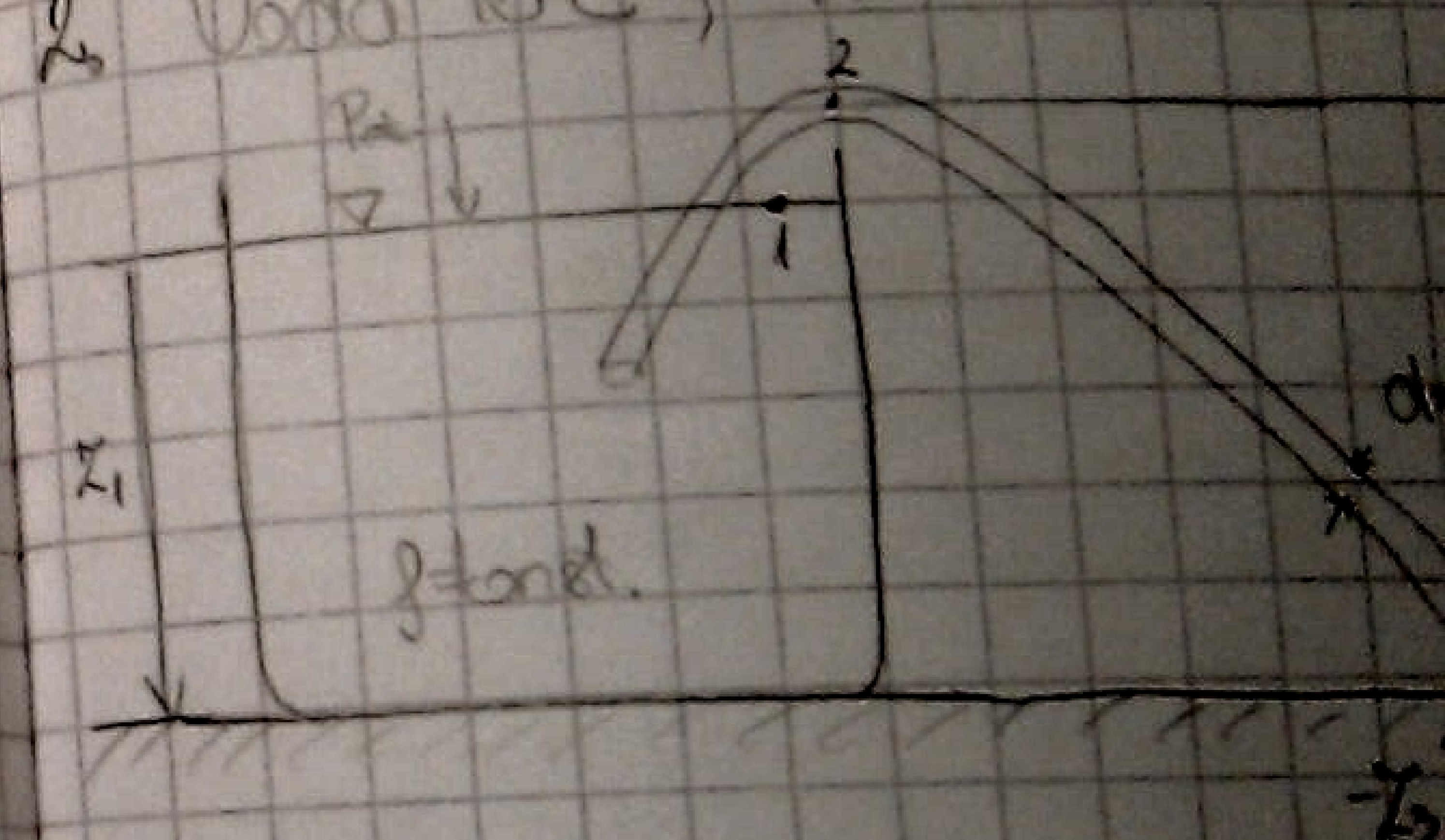
p → pretlak

$c_2 = \sqrt{\frac{2gh}{1-\left(\frac{d}{D}\right)^4}} = 6,26\ m/s$

$\left(\frac{d}{D}\right) \ll \Rightarrow c_2 = \sqrt{2gh}$

$Q = A_1 c_1 + A_2 c_2 = \frac{\pi}{4}(0,1\ m)^2 \cdot 6$

2. Voda 16°C, H = ?



$p_1 + \frac{1}{2}\rho c_1^2 + \rho g z_1 = p_2 + \frac{1}{2}\rho c_2^2$

$z_1 = 4,6\ m$; $z_2 = H = ?$; z

$p_1 = p_2 = 0$ (izraženo tlaku

$p \Rightarrow p = 1,8168$

$c_1 \approx 0$

$c_1 \neq 0$ st. tlak din. tlak hidrost. tlak

↑ ↑ ↑

B.J. → $p_1 + \frac{1}{2}\rho c_1^2 + \rho g z_1 = p_2 + \frac{1}{2}\rho c_2^2 + \rho g z_2$ $[N/m^2 \equiv Pa]$ (1)

→ vlad. atm. manjak u atm. na tlak dolje

p_{ok} → pretlak

$p_1 = p_2 = 0$ (točke 1 i 2 su izložene p_{ok}, pretlak $= 0$)

$z_1 - z_2 = h = 2m = konst.$

$z_2 = 0 \Rightarrow h = z_1 = 2m = konst.$

$\frac{1}{2}c_1^2 + g z_1 = \frac{1}{2}c_2^2$ (2)

$Q_1 = Q_2$; $Q = A \cdot c$ (ρ - konst.) $[m^3/s]$

↓

$\dot{m}$ $[kg/s]$

(c_1)

$A_1 c_1 = A_2 c_2 \Rightarrow$ (c_2)

$c_1 = \left(\frac{d}{D}\right)^2 c_2$ (3)

$p_1 + \frac{1}{2}\rho c_1^2 + \rho g z_1 = p_2 + \frac{1}{2}\rho c_2^2 + \rho g$...

$z_1 = 4,6 m$; $z_2 = H = ?$; $z_3 = -1,5$...

$p_1 = p_3 = 0$ (izložena tlaku okol...

$p_2 \Rightarrow p_{2a\,kavitacije} = 1,8168$ k...

$A_2 c_2 = A_3 c_3$ → $c_2 = c_3$

iz (1) → $c_3 = \sqrt{2g(z_1 - z_3)}$

iz (1) → (p_2) $p_2 =$ ...

$p_2 = p_{2a} = 1,8168\ kPa$

iz (2) $\underbrace{-98,2 \cdot 10^3}_{p_2}$ N/...

↳ $H = 8,5$ m

→ tlak kavitacije raste s...

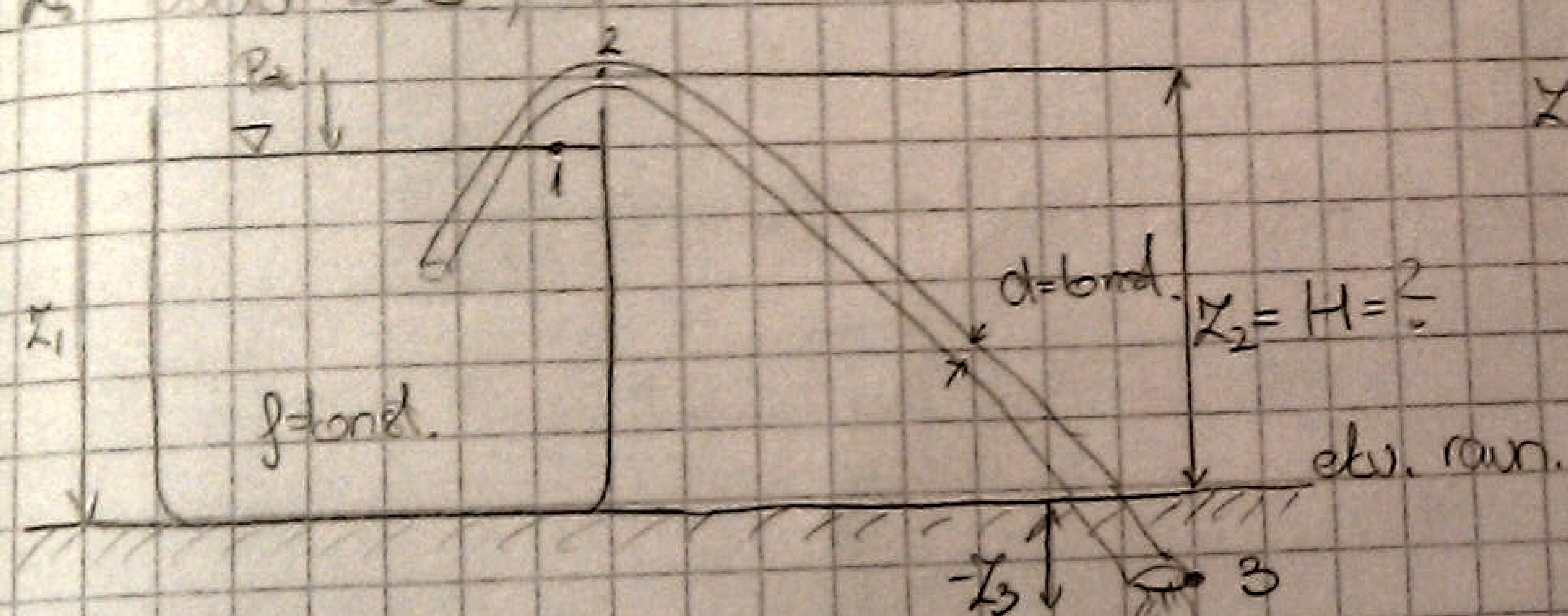
o puni i p

$$c_2 = \sqrt{\frac{2gh}{1-\left(\frac{d}{D}\right)^4}} = 6{,}26\ m/s$$

$$\left(\frac{d}{D}\right) \ll \quad \Rightarrow \quad c_2 = \sqrt{2gh}$$

$$Q = A_1 c_1 = A_2 c_2 = \frac{\pi}{4}(0{,}1\ m)^2 \cdot 6{,}26\ m/s = \underline{0{,}0492\ m^3/s}$$

2. Voda $16°C$, $H = ?$



$z_1 = 4{,}6\,m$ = konst.

$-z_3 = 1{,}5\,m$

$$p_1 + \frac{1}{2}\rho c_1^2 + \rho g z_1 = p_2 + \frac{1}{2}\rho c_2^2 + \rho g z_2 = p_3 + \frac{1}{2}\rho c_3^2 + \rho g z_3 \qquad (1)$$

$z_1 = 4{,}6\,m$; $z_2 = H = ?$; $z_3 = -1{,}5\,m$; $c_1 = 0$ (zato što je spremnik velik)

krivulje se to može pretp. ; do drugog je na pše

(1)

$p_1 = p_3 = 0$ (izabrano tlaku okolice)

$p_2 \Rightarrow p_{2a\ \text{kavitacije}} = 1{,}8168\ kPa$ (iz Tablica) ($16°C$)

$$p_1 + \frac{1}{2}\rho c_1^2 + \rho g z_1 = p_2 + \frac{1}{2}\rho c_2^2 + \rho g z_2 = p_3 + \frac{1}{2}\rho c_3^2 + \rho g z_3 \qquad (1)$$

$z_1 = 4{,}6\,m$; $z_2 = H = ?$; $z_3 = -1{,}5\,m$; $c_1 = 0$ (zato što je spremnik velik)

[illegible] se to može pretp.; do drugog ne [illegible]

$p_1 = p_3 = 0$ (izlazno tlaku okolice)

$p_2 \Rightarrow p_{2a\,kavitacije} = 1{,}8168\ kPa$ (iz Tablica) ($16°C$)

$A_2 c_2 = A_3 c_3 \rightarrow c_2 = c_3$ (d = konst.)

iz (1) $\rightarrow$ $c_3 = \sqrt{2g(z_1 - z_3)} = \left[2 \cdot 9{,}81 \cdot (4{,}6 - (-1{,}5))\right]^{\frac{1}{2}} = 10{,}94\ m/s$

iz (1) $\rightarrow$ p_2 $\qquad p_2 = \rho g (z_1 - z_2) - \frac{1}{2}\rho c_2^2 \qquad (2)$

$p_{a2} = p_{2a} = 1{,}8168\ kPa$ $\qquad p = (1{,}8168 - 100)\ kPa = -98{,}1832\ kPa$

iz (2) $\underbrace{-98{,}2 \cdot 10^3}_{p_2}\ N/m^2 = 1000\ kg/m^3 \cdot 9{,}81\ m/s^2\,(4{,}6 - H)\,m - \frac{1}{2} \cdot 1000\ \frac{kg}{m^3}\,(10{,}94)\ m^2/s^2$

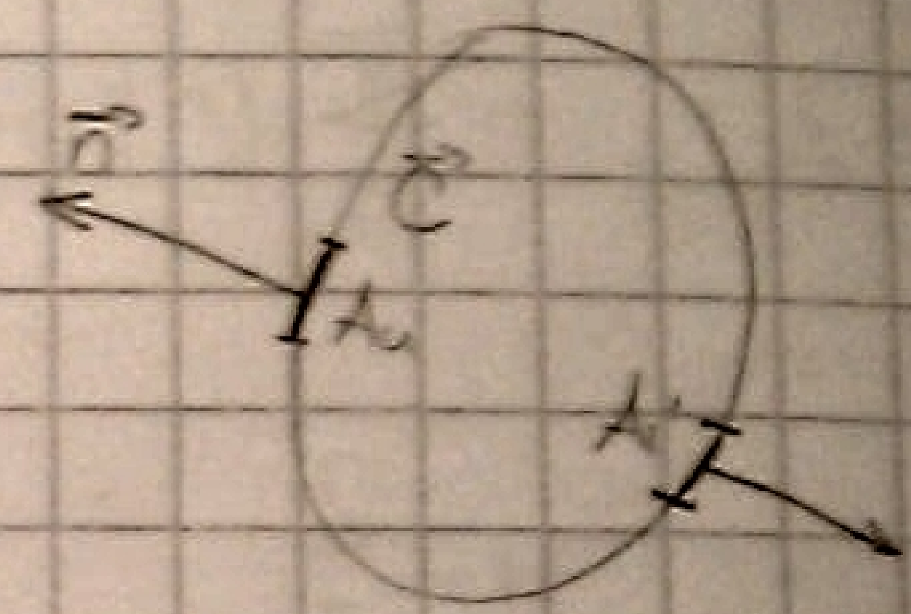
$\hookrightarrow H = 8{,}5\ m$

→ Tlak kavitacije raste s temperaturom

5. U akumulacijskom jezeru $P = 250\ km^2$, duljine $L = 100\ km$, $Q_u = 450\ m^3/s$, kroz branu izlazi $380\ m^3/s$. Za koliko će se metara povisiti razina vode u jezeru u jednom danu?

→ koliko će se [illegible] ... NE!

$$\underbrace{\frac{d}{dt}\iiint_{KV} \rho\, dV}_{m_{kv}(t)} + \underbrace{\oiint_{KP} \rho \vec{c}_r\, d\vec{A}}_{\text{izlaz} - \text{ulaz (iz KV)}} = 0$$



$$\underbrace{\frac{d}{dt}\iiint_{KV} \rho\, dV}_{\neq 0} = \underbrace{\frac{d}{dt}\left(\rho \cdot A_{jezera} \cdot h\right)}_{m_{kv}(t)} = -\oiint_{KP} \rho \vec{c}_r\, d\vec{A} = -(\dot{m}_i - \dot{m}_u) = \dot{m}_u - \dot{m}_i \quad / : \rho$$

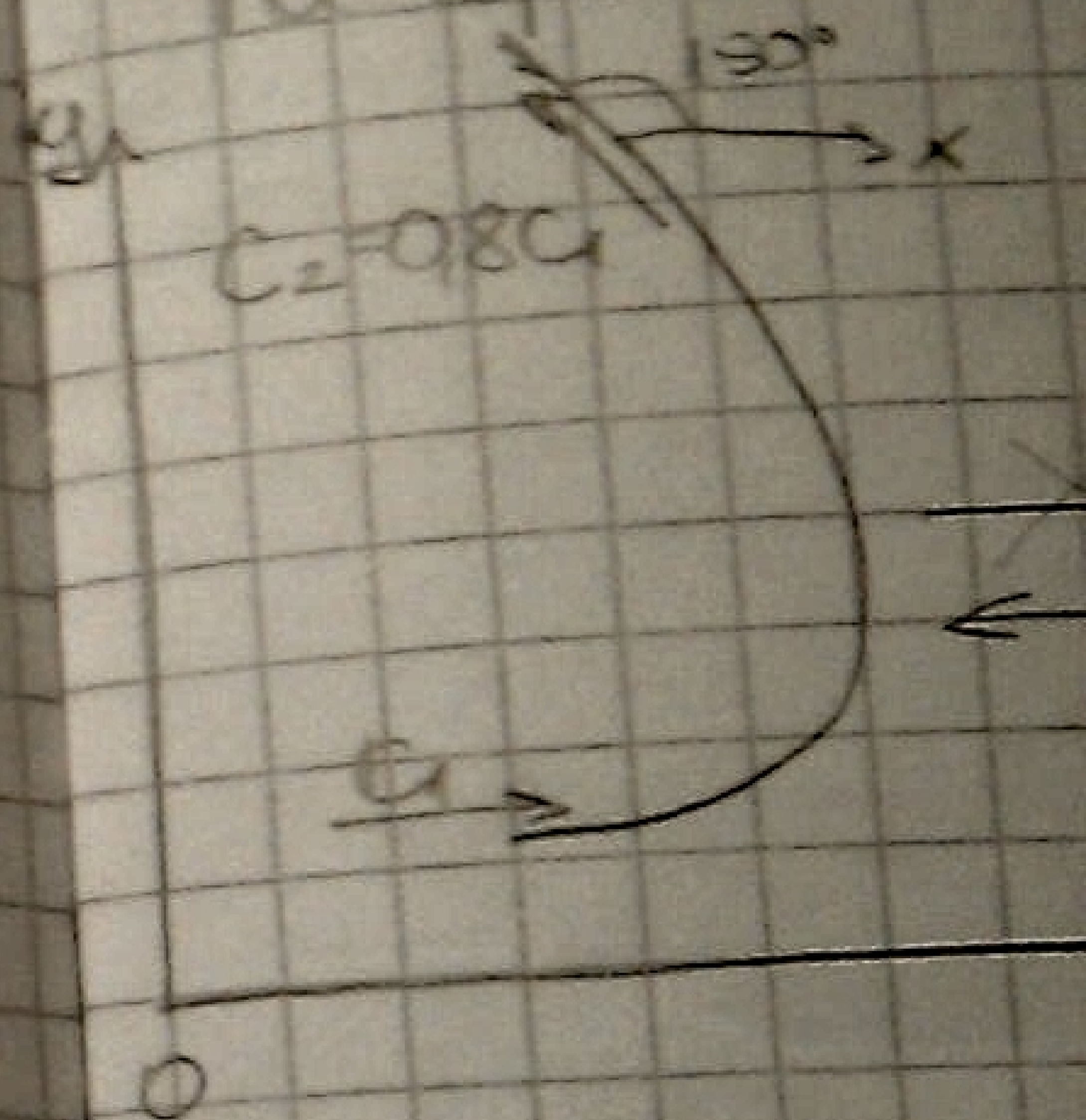
$$\dot{m} = \rho Q$$

$$\frac{d}{dt}(A_j \cdot h) = A_j \frac{dh}{dt} = Q_u - Q_i \Rightarrow \frac{dh}{dt} = \frac{Q_u - Q_i}{A_j}$$

$$\frac{dh}{dt} = \frac{(450 - 380)\ \frac{m^3}{s}}{250\ km^2} = 0{,}00028\ m/s$$? → NIJE OK!

$$0{,}00028\ \frac{m}{s} \cdot \frac{3600\ s}{1h} \cdot 24\ \frac{h}{dan} = 24{,}2\ m/dan$$

4. Ulazni je kut ...
mlaza vode 20% ...
na lopaticu 90 ...
na lopaticu ...



$$\sum \vec{F}_i = \sum \vec{F}_{povr} \ldots$$

$$\frac{d}{dt}\iiint_{KV} \rho\, dV + \ldots$$

$$\sum F_{xi} = \frac{d}{dt}\int \ldots$$

$$\sum F_{yi},\ \sum F_z \ldots$$

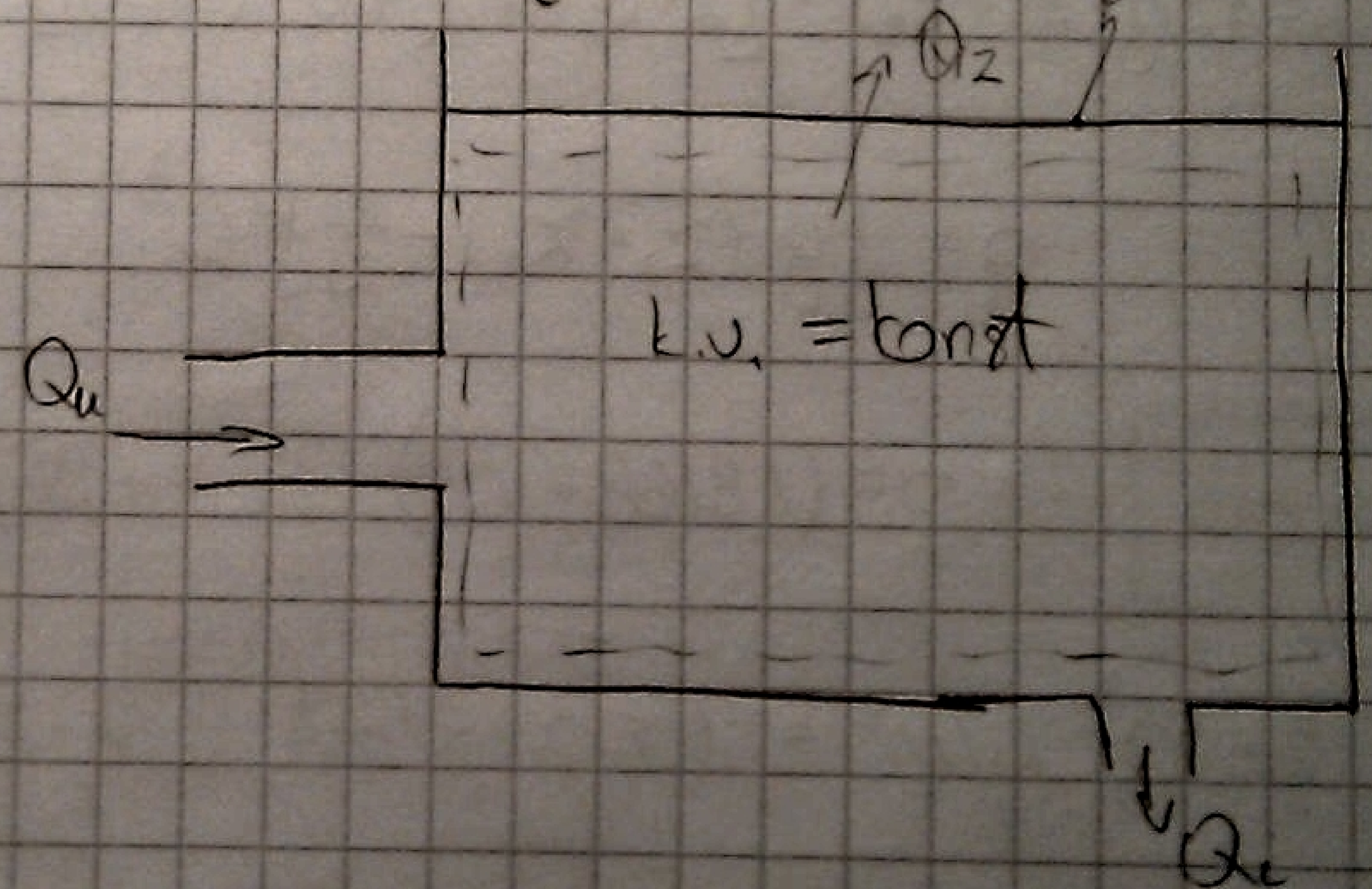
$$\frac{dh}{dt} = \frac{(190-380)\ \frac{m^3}{s}}{250\ km^2} = -0{,}00028\ m/s \quad ? \quad \rightarrow \text{NIJE OK!}$$

$$0{,}00028\ \frac{m}{s} \cdot \frac{3600\ s}{1h} \cdot 24\ \frac{h}{dan} = 24{,}2\ m/dan$$

4. U ak. jezero površine A_j dulje vrijeme utječe Q_u m³/s, a istječe Q_i m³/s. Za koliko će se m povisiti razina vode u jednom danu?

$KV = konst.$

$\rightarrow m_{kv} = konst.$



$$\underbrace{\frac{d}{dt}\iiint_{kv} \rho\, dV}_{=0\ (m_{kv} = konst)} + \oint\!\!\oint_{kp} \rho\, \vec{c}_r\, d\vec{A} = 0$$

$$\sum \dot{m}_u = \sum \dot{m}_i$$

$$\rho Q_u = \rho Q_i + \rho Q_{i2}$$

$$Q_{i2} = Q_u - Q_i$$

$$v_{penjanja} = \frac{Q_{i2}}{A_j} = \frac{Q_u - Q_i}{A_j}$$

$\sum F_{xi} = \frac{d}{dt}\iiint_{kv} c$ ...

$\sum F_{yi}$, $\sum F_{zi}$

$\frac{d}{dt}\iiint_{kv}$ ... $= 0$

$\sum F_{xi} = \oint\!\!\oint_{kp} c_x$ ...

$\sum F_{xi} = \dot{m}($ ...

$F_x = \underbrace{\rho Q}_{\dot{m}} (0{,}8$ ...

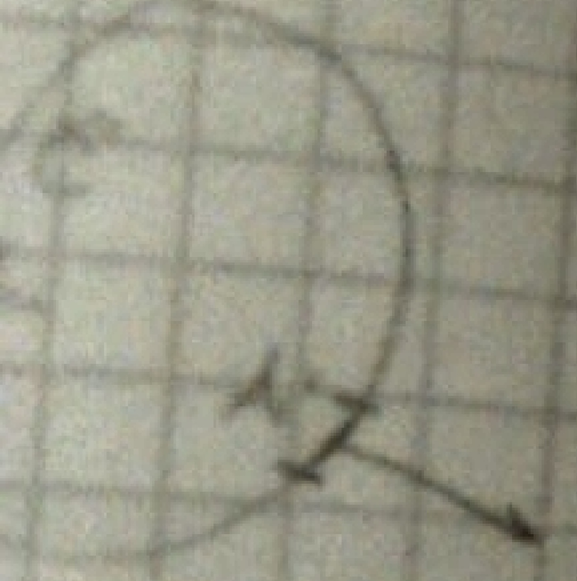
$F_y = \rho A c$ (...

$F^2 = F_x^2 + F$ ...

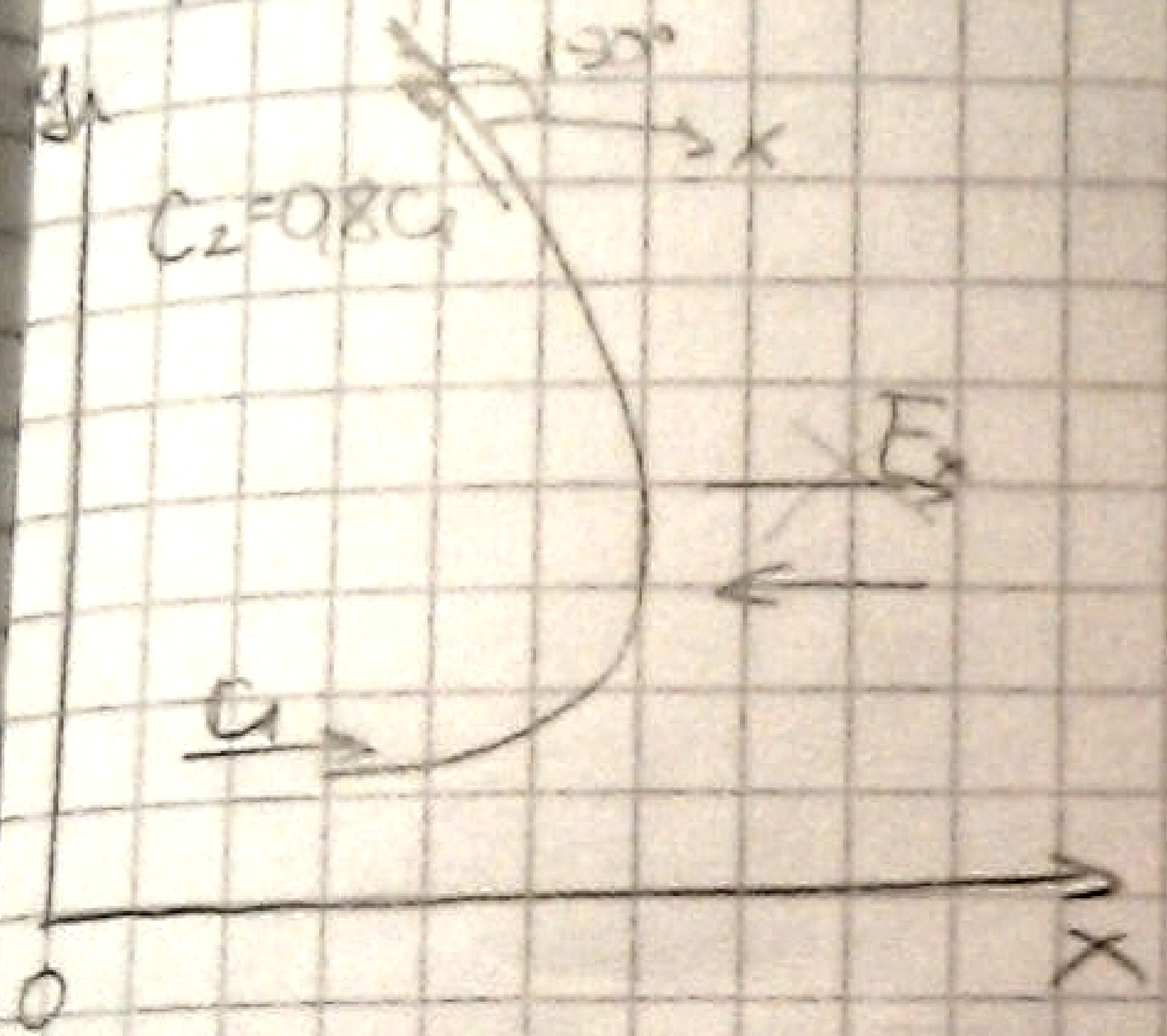
$c^2 = \frac{200}{1000\ \frac{kg}{m^3}}$ ...

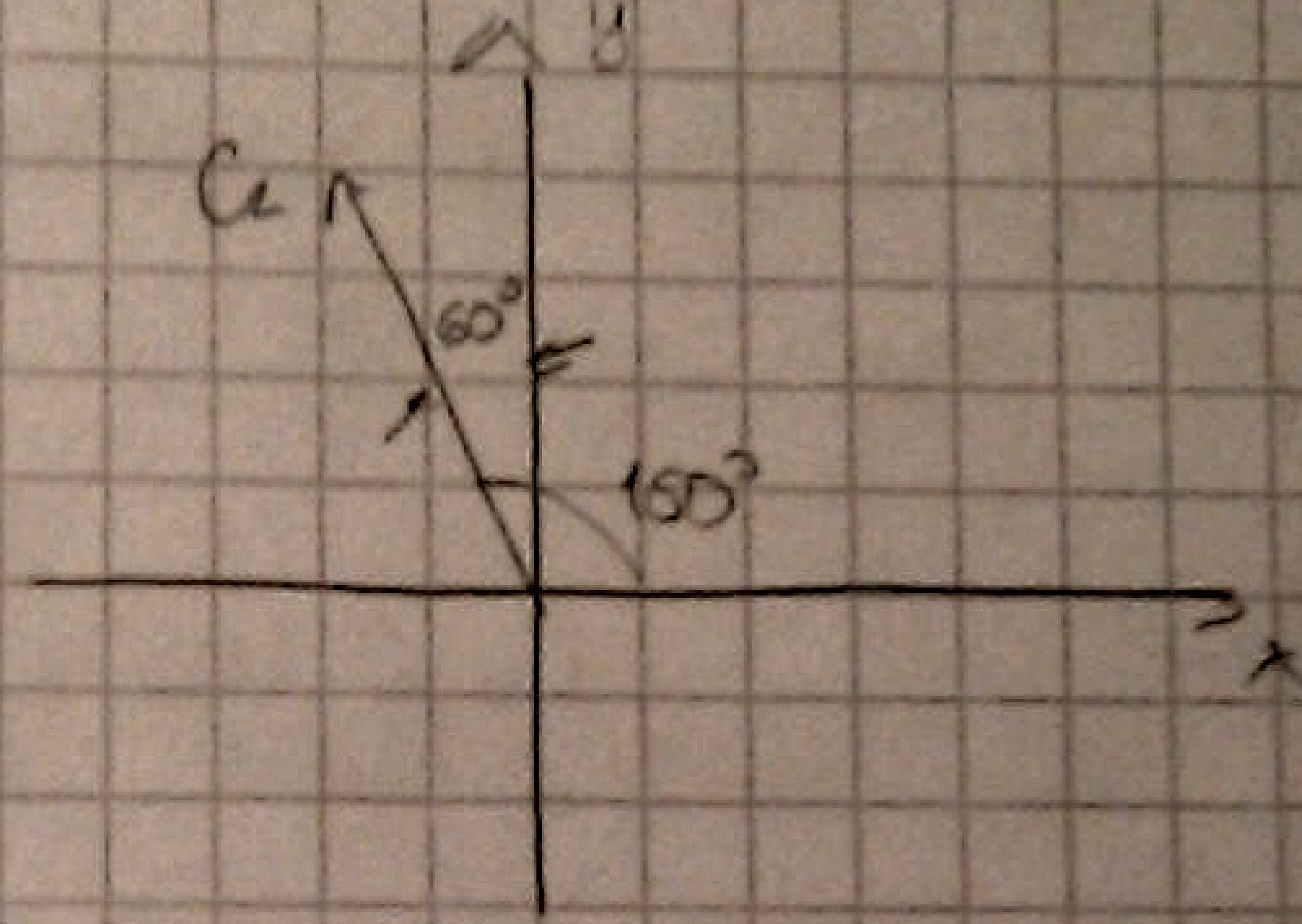
$Q = Ac = 0$ ...

... u jednom danu?



4. Ulazni je kut nepomične lopatice 0°, a izlazni 150°. Zbog trenja izl. brzina je mlaza vode 20% manja od ulazne. Ako je promjer stacionarnog mlaza vode na ulazu 50 mm kolik mora biti njegov protok da bi mlaz vode djelovao na lopaticu silom iznosa 2000 N.





$$\sum \vec{F}_i = \sum \vec{F}_{povr} + \sum \vec{F}_{mas} = \oint_{KP} \vec{\sigma}\, dA + \iiint_{KV} \rho \vec{R}\, dV = \frac{d}{dt}\iiint_{KV} \vec{c}_r \overbrace{\rho\, dV}^{dm} + \oint_{KP} \vec{c}_r \overbrace{\rho \vec{c}_r\, d\vec{A}}^{d\dot{m}}$$

$$\frac{d}{dt}\iiint_{KV} \rho\, dV + \oint_{KP} \rho \vec{c}\, d\vec{A} = 0$$

$$\sum F_{xi} = \frac{d}{dt}\iiint_{KV} c_{xr}\, \rho\, dV + \oint c_{xr} \overbrace{\rho\, c_r\, d\vec{A}}^{d\dot{m}}$$

$$\sum F_{yi}, \ \sum F_{zi}$$

$$\frac{d}{d}\iiint_{KV} \qquad = 0$$

$$\frac{d}{dt}\iiint_{cv}\rho\,dV+\oint_{cs}\rho\vec{c}\,d\vec{A}=0$$

$$\Sigma F_x+\frac{d}{dt}\iiint_{cv}c_{x_r}\rho\,dV+\oint c_{x_r}\rho\vec{c}_r\,d\vec{A}$$

$$\Sigma F_y=\Sigma F_z$$

$$\frac{d}{dt}\iiint_{cv}=0$$

$$\Sigma F_x=\oint_{cs}c_{x_r}\rho\vec{c}_r\,d\vec{A}=\Sigma\dot{m}_s c_{x_r}-\Sigma\dot{m}_e c_{x_r}$$

$$\Sigma F_x=\dot{m}(c_{x_r}-c_{x_{ur}})$$

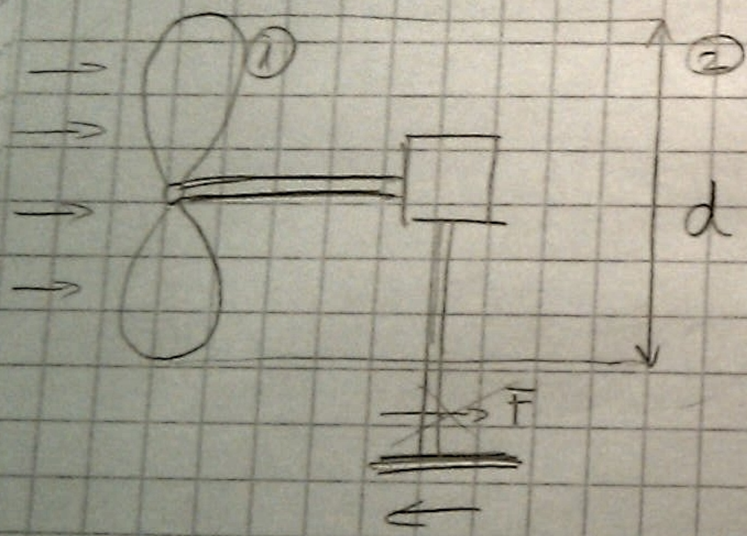
$$F_x=\rho Q(0{,}8c\cdot\cos 150^\circ-c)=-1{,}693\rho Ac^2$$

$$F_y=\rho Ac(0{,}8c\cdot\cos 60^\circ-0)=4\rho Ac^2$$

$$F^2=F_x^2+F_y^2=\rho^2A^2c^4(2{,}866+0{,}16)=\rho^2A^2c^4\cdot 3{,}026$$

$$c^2=\frac{2000}{1000\frac{kg}{m^3}\cdot\frac{\pi}{4}(0{,}05m)^2\sqrt{3{,}026}}\Rightarrow\quad c=24{,}198\ m/s$$

5. Tlonjer je vjetrobranske 90 m. Brzina vjetra je 25 km/h, a gustoća zraka 1,25 kg/m³. Strujanje vjetra smatrati izobraznim, jednodimenzionalnim, stacionarnim i neviskoznim. Strujanje dj. prek. kin. en. vjetra u el. en. vjetra je 0,32 el. dj. je razmjeran o brzini vjetra. Ostale el. djelove smatrati 1 %. Kolika je snaga proizvedene el. energije, te kolika mora biti sila koja podupire taj vjetrobran.



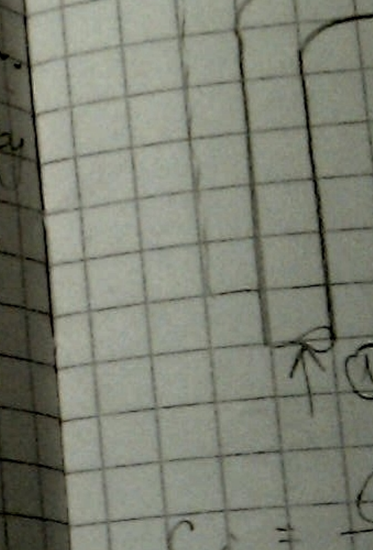
$$c_1 = 25\ km/h \frac{1\ m/s}{36\ km/h} = 6,94\ m/s$$

$$\dot{m} = \rho_1 c_1 A_1 = \rho_1 c_1 \frac{\pi d^2}{4} = 1,25 \frac{kg}{m^3} \cdot 6,94 \frac{m}{s} \cdot \frac{\pi \cdot 90^2 m^2}{4}$$

$$\dot{m} = 55200\ kg/s$$

$$\dot{W}_{max} = \dot{m} \cdot ke_1 = 55200 \frac{kg}{s} \cdot \frac{(6,94\ m/s)^2}{2} \cdot \frac{1\ kN}{1000 \frac{kgm}{s^2}} \cdot \frac{1\ kW}{1\ kN \frac{m}{s}} = 1330\ kW$$

6. Kojom vo



$c_1 =$

$\dot{m} = \rho$

ΣF_i

$F_x =$

$\dot{m} = 55200 \ kg/s$

$$\dot{W}_{meh} = \dot{m}\, ke_1 = 55200 \frac{kg}{s} \cdot \frac{(6{,}94 \ m/s)^2}{2} \cdot \frac{1 \ kN}{1000 \ \frac{kg\,m}{s^2}} \cdot \frac{1 \ kW}{1 \ kN \frac{m}{s}} = 1330 \ kW$$

$$\dot{W}_t = \eta \cdot \dot{W}_{meh} = 0{,}32 \cdot 1330 \ kW = \underline{426 \ kW}$$

$c_2 = ?$, η

$$\eta = \frac{\frac{c_1^2}{2} - \frac{c_2^2}{2}}{\frac{c_1^2}{2}} \Rightarrow c_2 = c_1 \sqrt{1-\eta} = 6{,}94 \frac{m}{s} \sqrt{1-0{,}32} = 5{,}72 \ m/s$$

$$\sum \vec{F} = \sum \dot{m}_i \vec{c}_i - \sum \dot{m}_u \vec{c}_u$$

$$F = \dot{m} c_2 - \dot{m} c_1 = 55200 \frac{kg}{s} (5{,}72 - 6{,}94) \frac{m}{s} \cdot \frac{1 \ kN}{1000 \ \frac{kg\,m}{s^2}} = \underline{\underline{-67{,}3 \ kN}}$$

↳ obrnut smjer od onog koji smo pretpostavili

$\dot{m} = \rho Q = 1000$ …

$\sum \vec{F}_i = \sum \dot{m}_i \vec{c}$ …

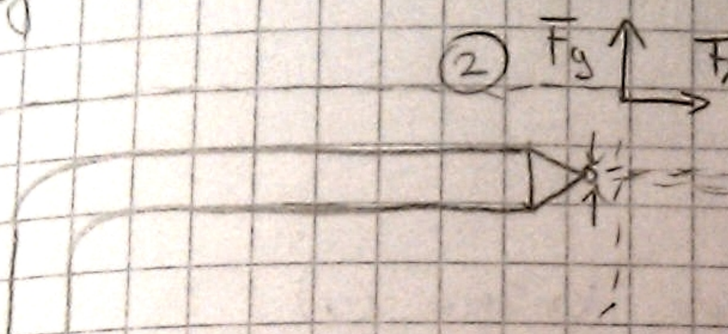
$F_x = \dot{m} c_i -$ …

ISPITI: 1) BJ

3) POKG

2) POM

6. Kojom vodoravnom silom morcja vodnogasa pridržavati crijevo



$$C_i = \frac{Q}{A} = \frac{Q}{\frac{\pi d_i^2}{4}} = \frac{5\ \frac{m^3}{min}}{\frac{\pi (0{,}006m)^2}{4}} = 1768\ m/min = 29{,}5\ m/s$$

$$\dot{m} = \rho Q = 1000\ \frac{kg}{m^3} \cdot 5\ \frac{m^3}{min} = 5000\ \frac{kg}{min} = 83{,}3\ kg/s$$

$$\sum \vec{F}_i = \sum \dot{m}_i \vec{C}_i - \sum \dot{m}_u \vec{C}_u$$

$$F_x = \dot{m} \vec{C}_i - 0 = 83{,}3\ \frac{kg}{s} \cdot 29{,}5\ \frac{m}{s} \cdot \frac{1N}{1\ kg\ \frac{m}{s^2}} = 2457\ N$$

$$c_i = \frac{Q}{A} = \frac{Q}{\frac{\pi d_i^2}{4}} = \frac{5\ \frac{m^3}{min}}{\frac{\pi (0{,}006m)^2}{4}} = 1768\ m/min = 29{,}5\ m/s$$

$$\dot{m} = \rho Q = 1000\ \frac{kg}{m^3} \cdot 5\ \frac{m^3}{min} = 5000\ \frac{kg}{min} = 83{,}3\ kg/s$$

$$\Sigma \vec{F}_i = \Sigma \dot{m}_i \vec{c}_i - \Sigma \dot{m}_u \vec{c}_u$$

$$F_x = \dot{m} c_i - 0 = 83{,}3\ \frac{kg}{s} \cdot 29{,}5\ \frac{m}{s} \cdot \frac{1N}{1kg\ \frac{m}{s^2}} = 2457\ N$$

$\underline{1\Phi\Pi}$: 1) BJ

3) POKG $\frac{d}{dt} \to 0$ (stac.) , ID

2) POM + rad. s predavanja (reverzibilna HE)

ZAD.1. Snaga P. turbine promjera $d=2m$ i masenog protoka $\dot{m}=700\ kg/s$, 500 kW kod rotira sa 180 okr/min.

a) sila kojom voda djeluje na lopatice turbine?

b) brzina vode na izlazu iz sapnice? (ulazna aps brzina c_1)

Izlazni je kut lopatica 20°

$$P = M\omega_p = F\cdot\frac{d}{2}\omega_p = 500\cdot10^3\ \frac{Nm}{s} = F\cdot 1m\cdot 180\ \frac{okr}{min}\cdot\frac{2\pi\ rad}{okr}\cdot\frac{1\ min}{60\ s} = F\cdot 1m\cdot 18{,}85\ \frac{1}{s}\ (rad)$$

$\hookrightarrow F = 26\,525{,}2\ N$

$$P = \rho Q u(c_1 - w)(1+\cos\beta_2) = \overbrace{\rho Q}^{\dot{m}} r\cdot\omega_p(c_1 - r\omega_p)(1+\cos\beta_2) =$$

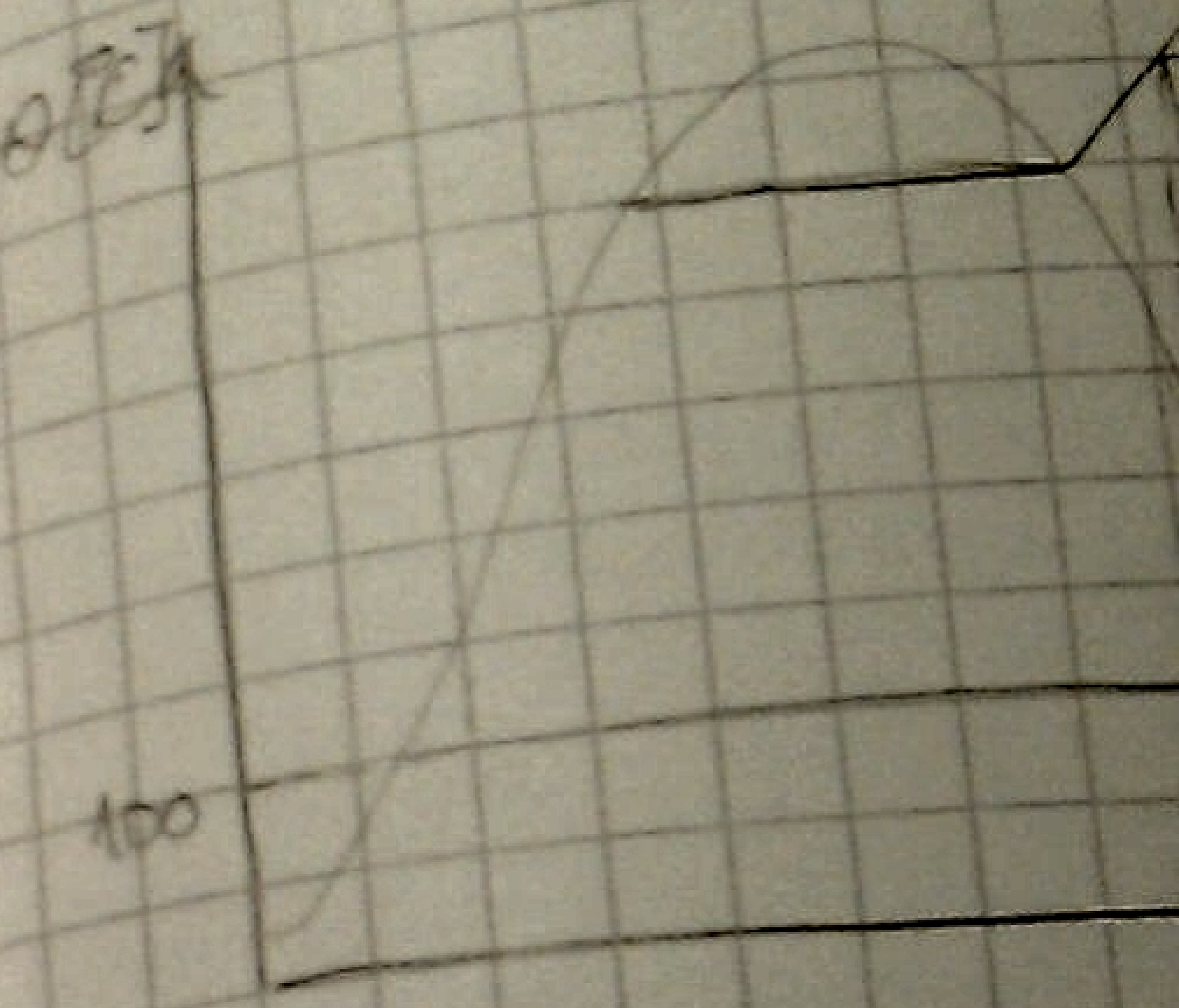
$$= 500\cdot10^3\ \frac{Nm}{s} = 700\ \frac{kg}{s}\cdot 1m\cdot 18{,}85\ \frac{1}{s}\ (c_1 - 18{,}85)\ \frac{m}{s}\ (1+\cos 20^\circ)$$

$\hookrightarrow c_1 = 38{,}5\ \frac{m}{s}$

ZAD.2. Proces je u parnoj turbini 1D, stacionarni strujni proces.

Kolika je brzina proizvodnje entropije u parnoj turbini za ...

$T_{okoline} = konst.$



$$\frac{\dot{Q}_{ok}}{\dot{m}} = \frac{\dot{W}_t}{\dot{m}} + (h_2 - h_1)$$

$= -22{,}6\ kJ/k...$

$$\frac{\dot{S}_{proizv}}{\dot{m}} = -\frac{\frac{\dot{Q}_{ok}}{\dot{m}}}{T_o}$$

Gub. eksergij. =

↳ $c_1 = 38,5 \ \frac{m}{s}$

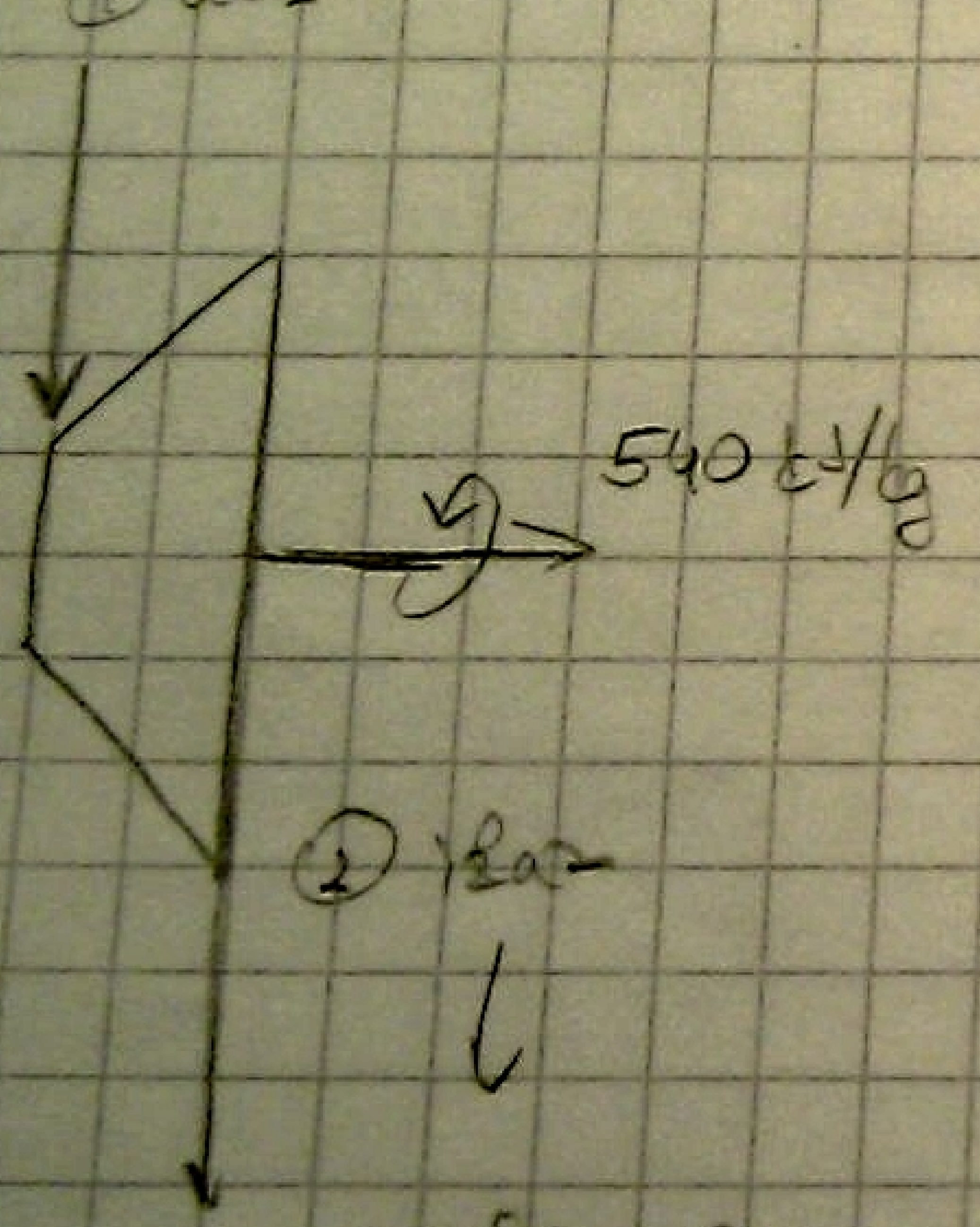
Gub. eksergij. $= T_{ok}$

ZAD.2. Proces je u parnoj turbini 1D, stacionarni strujni proces.

Kolika je brzina proizvodnje entropije u parnoj turbini po kg pare.

Topl. energija prelazi u okolinu preko stjenke turbine konst. temp. 350 K

Promjenu pot. en. zanemariti



$p_1 = 30$ bar

$\theta_1 = 400°C$

$c_1 = 160$ m/s

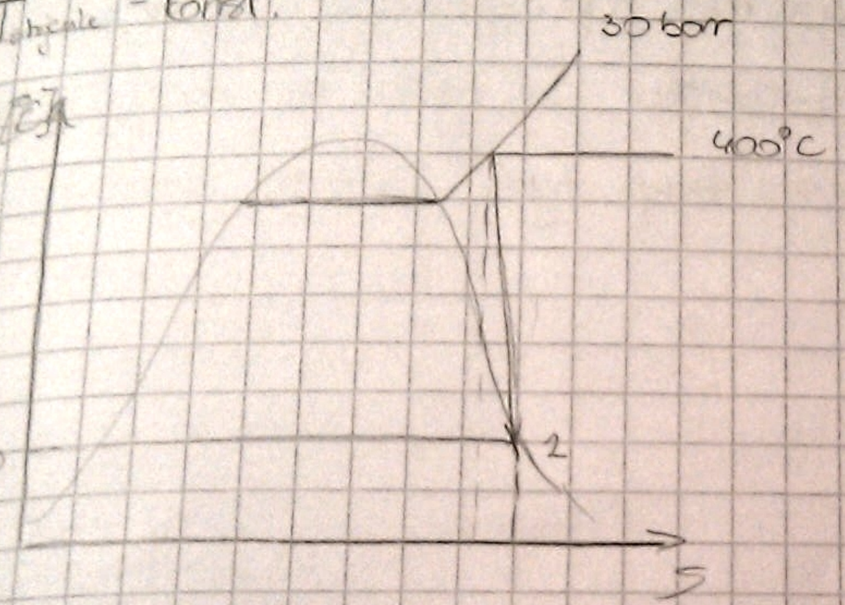
$h_1 = 3230,9$ kJ/kg
$s_1 = 6,9212$ kJ/kgK } iz tablica

zasićena para

$\theta_2 = 100°C$ $h_2 = 2676,1$ kJ/kg
$c_2 = 100$ m/s $s_1 = 7,3549$ kJ/kgK } iz tablica

→ entropija veća na izlazu nego na ulazu

$T_{otoczenia} = konst.$



2. gł. stwierdz termodyn.

$$\frac{dS_{kw}}{dt} = 0 = \frac{\dot{Q}_{kw}}{T_o} + \dot{m}(s_1 - s_2) + \dot{S}_{produkcji}$$

$$\frac{\dot{Q}_{kw}}{\dot{m}} = \frac{\dot{W}_o}{\dot{m}} + (h_2 - h_1) + \frac{c_2^2 - c_1^2}{2} = 540\,\frac{kJ}{kg} + (2676{,}1 - 3230{,}9)\,\frac{kJ}{kg} + \left(\frac{100^2 - 160^2}{2}\right)\frac{m^2}{s^2} =$$

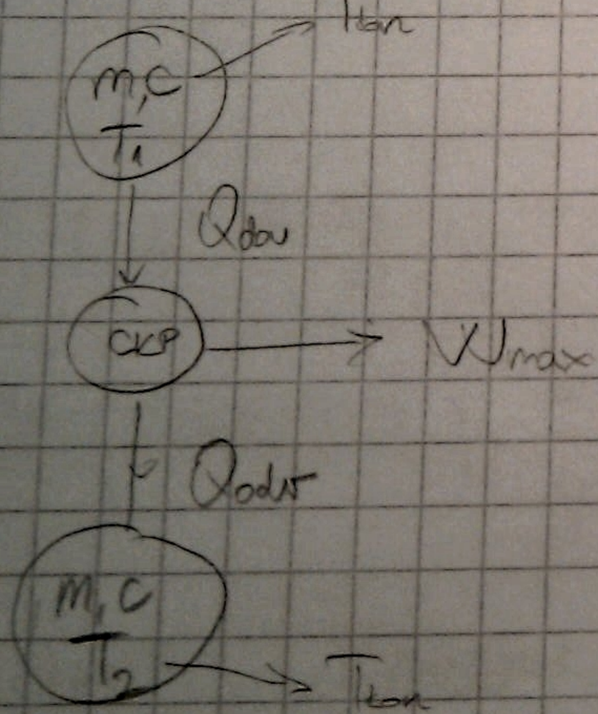
$= -22{,}6\ kJ/kg$

$$\frac{\dot{S}_{produkcji}}{\dot{m}} = -\frac{\frac{\dot{Q}_{kw}}{\dot{m}}}{T_o} + (s_2 - s_1) = -\frac{-22{,}6\ \frac{kJ}{kg}}{350K} + (7{,}3549 - 6{,}9212)\,\frac{kJ}{kgK} = 0{,}498\,\frac{kJ}{kgK}$$

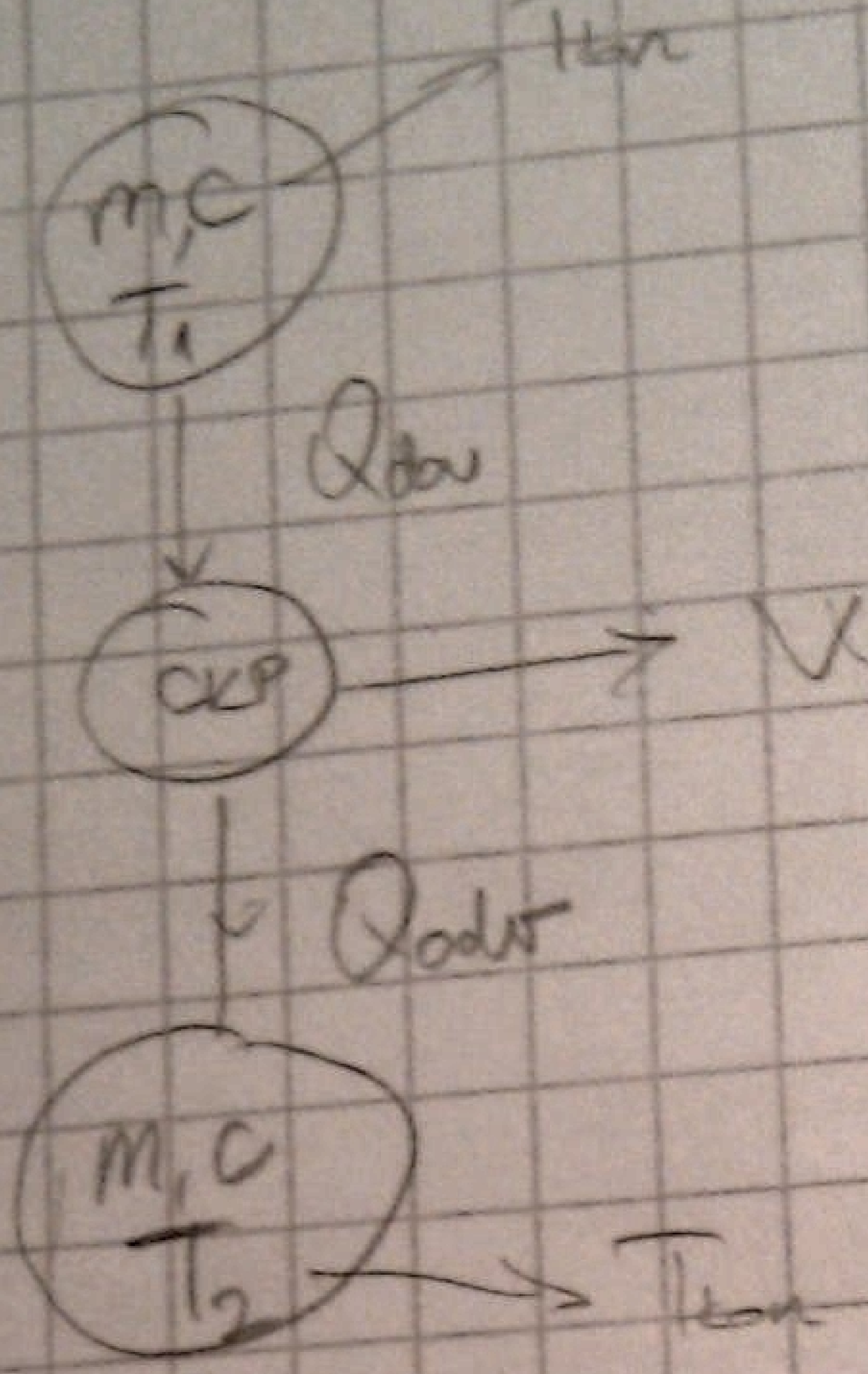
Gub. ekserg. $= T_o \cdot \Delta S$

Zd. 2 tijela jednake mase i spec. topl. kap. c dane toč topl. spremnici za termički proc.

* Temp. tijela $T_1 > T_2$. Ubilo se unutrašnja kalorička en. tijela. ne ovisi za vrijeme kružnog procesa kolika će biti konačna temp. tijela ako je proizvedeni rad kružnog procesa max. mogući.



* Temp tijela T_1 ... kolika će biti ...
vijonke kružnog procesa ...
rad kružnog procesa max. ...



$$W_{max} \Rightarrow S = konst. \Leftrightarrow S_{proizv} = 0$$

$$\delta S_{TS} + \delta S_{KP} + \delta S_{HS} = 0$$

$$\delta S_{KP} = 0$$

$$mc \ln \frac{T_{kon}}{T_1} + 0 + mc \ln \frac{T_{kon}}{T_2} = 0$$

$$T_{kon} = \sqrt{T_1 T_2}$$

2. Gnjurac "leti" pod vodom služeći se krilima uz isti napor s kojim u zraku leti brzinom 65 km/h kojom će brzinom letjeti pod vodom

$\rho_v = 1000\ kg/m^3$

$\rho_z = 1,22\ kg/m^3$

$\frac{1}{2}\rho_z \cdot c_z^2 = \frac{1}{2}\rho_v \cdot c_v^2$

$c_v = 0,633\ m/s = 2,28\ km/h$

3. Bazen jedne akumulacije reverzibilne hidroelektrane dugačak je 350 m, širok 150 m i dubok 10 m, puni se crpkama stalnim protokom 200 m^3/s. Kojom se brzinom podiže razina vode u bazenu? [cm/h]

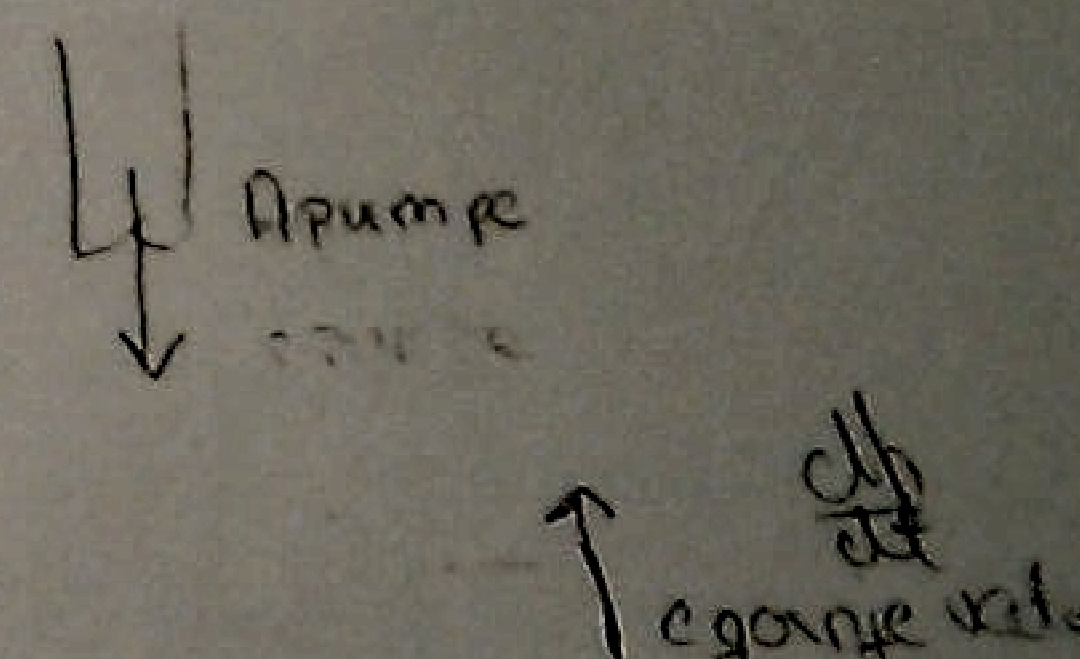
$\frac{Dm}{Dt} = \frac{d}{dt}\iiint \rho dv + \iint \rho \cdot \vec{c}_r \, d\vec{A} = 0 \quad (1)$

3. Bazen gornje akumulacije reverzibilne he dugačak je 350 m, širok 150 m i dubok 10 m, puni ga crpka stalnim protokom 200 m³/h. Kojom se brzinom podiže razina vode u bazenu? [cm/h]

$$\frac{Dm}{Dt} = \frac{d}{dt}\iiint_{kv} \rho \, dV + \oiint_{kp} \rho \cdot \vec{c}_r \, d\vec{A} = 0 \quad (1)$$

$$\frac{d}{dt}\iiint_{kv} \rho \, dV = \frac{d}{dt}(\rho \cdot h \cdot 350 \cdot 150 \, m) = \rho \cdot 52\,500 \, m^2 \frac{dh}{dt}$$

$$\oiint_{kp} \rho \vec{c}_r \, dA = -\rho\left(c_{pumpe} + \frac{dh}{dt}\right) A_{pumpe}$$



$$\frac{dh}{dt} = \frac{Q = c_{pumpe} \cdot A_{pumpe}}{52\,500 \, m^2 - A_{pumpe}} = 1{,}87 \, cm/h$$

$A_{pumpe} <<< 52\,500 \, m^2$

pa ga zanemarujemo tj

$A_{pumpe} \approx 0$

TAJ DOLAZI U ISPITU