Physik, G2d, Mo., 6.6.2011

(1) $m = 35'000\,t = 35'000'000\,kg = 35 \cdot 10^6\,kg$
$\ell = 300\,m$, $b = 50\,m$, $\rho = 7'850\,kg/m^3$

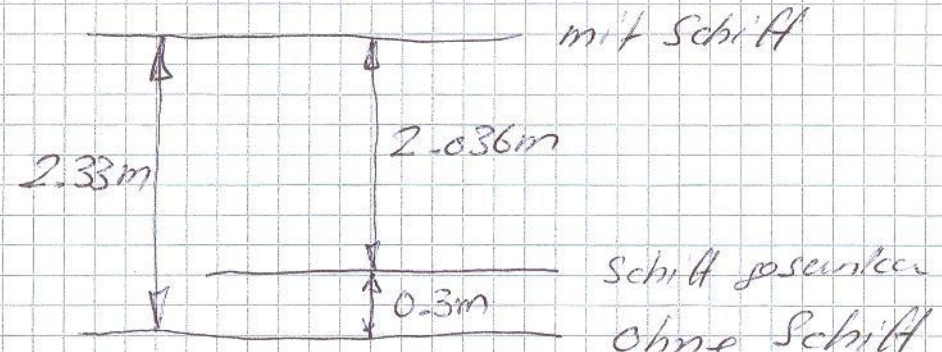
a) Schiff verdrängt 35'000 m^3 Wasser
$V = \ell \cdot b \cdot h_1 \Rightarrow h_1 = \frac{V}{\ell \cdot b} = \underline{\underline{2.\bar{3}\,m}}$

b) Volumen des Stahls:

$$m = \rho_{Stahl} \cdot V \Rightarrow V_{Stahl} = \frac{m}{\rho_{Stahl}}$$

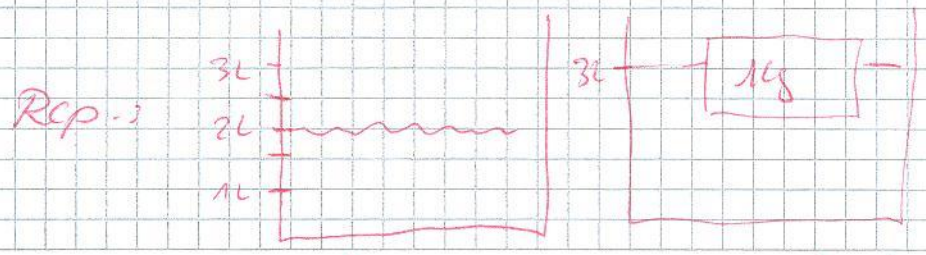
$$h_2 = \frac{V_{Stahl}}{\ell \cdot b} = \frac{m}{\ell \cdot b \cdot \rho_{Stahl}}$$

$$\approx 0.297\,m$$



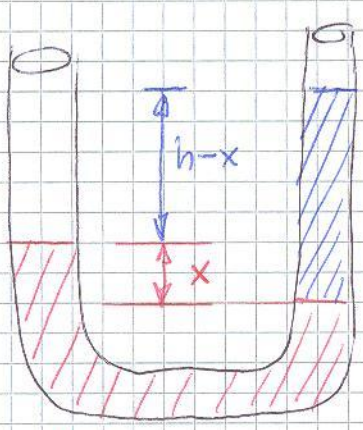
a) $35'000\,m^3 : (300\,m \cdot 50\,m) = 2.\bar{3}\,m$

b) $V_{Stahl} = \frac{m}{\rho_{Stahl}} = \frac{35'000'000\,kg}{7850\,kg/m^3} = 4'458.599\,m^3$
$\approx 4'458.6\,m^3$



+ 1P. für Schlussresultat

(2)



H_2O

Hg, $\rho_{Hg} = 13'546\ kg/m^3$

$$p_{links} = p_{rechts}$$

$$\rho_{Hg} \cdot g \cdot x = \rho_{H_2O} \cdot g \cdot h$$

$$x = \frac{\rho_{H_2O}}{\rho_{Hg}} \cdot h = \frac{1000}{13'546} \cdot 0.1m$$

$$x = 7.38mm$$

$$\Delta h = h - x = 100mm - 7.38mm$$

$$\hat{=} 92.6177mm$$

$$\hat{=} 92.62mm$$

↳ vernünftige Skizze machen !

(3) $d = 5\,cm$, $m = 2000\,kg$

$$F_G = mg = F_{Hydr.} = p \cdot A = p \cdot \pi \left(\frac{d}{2}\right)^2$$

$$mg = p \cdot \pi \cdot \left(\frac{d}{2}\right)^2$$

$$p = \frac{mg}{\pi (d/2)^2} = \frac{2000\,kg \cdot 9.81\,N/kg}{\pi\,(0.025\,m)^2}$$

$$= 99.92384\,bar$$

$$\approx 99.9\,bar \approx 100\,bar$$

"halbes Lelo": $4'996'191.97\,Pa \triangleq 49.96\,Bar \sim 50\,bar$

(4) $p_1 = 1\,atm$, $p_2 = 1\,atm + \rho g h$

$h = 11'000\,m$, $\rho = 1'020\,kg/m^3$

$V_2 = 1\,L$, $V_1 = ?$

$$p_1 V_1 = p_2 V_2 = (1\,atm + \rho g h) V_2$$

$$V_1 = \frac{1\,atm + \rho g h}{1\,atm} \cdot V_2$$

$$= \frac{1\,atm + 1020 \cdot 9.81 \cdot 11'000}{1\,atm}\,1L$$

$$V_1 = 1'087.29\,Liter$$

$$= 1.087\,m^3$$

$p_2 = 110'169'525\,Pa$

$1'101.7\,bar$

(5) $m_1 = 200\,kg$, $V = 467.585\,m^3$

$\rho_{Luft} = 1.293\,kg/m^3$, $\rho_{He} = 0.1785\,kg/m^3$

$F_{Auftrieb} = m_1 g + m_{He} \cdot g + \underbrace{\text{Nutzlast} \cdot g}_{M}$

$\rho_{Luft} \cdot V \cdot g = m_1 g + \rho_{He} \cdot V \cdot g + M g \quad | : g$

$\rho_{Luft} \cdot V = m_1 + \rho_{He} V + M$

$M = \rho_{Luft} \cdot V - m_1 - \rho_{He} \cdot V$

$M = (\rho_{Luft} - \rho_{He}) \cdot V - m_1$

$M = 321.123\,kg$

Netto: 200 kg 1962N 200 kg

Helium: $\rho_{He} \cdot V \cdot g$ 818.78N 83.464 kg

Auftrieb: $\rho_{Luft} \cdot V \cdot g$ 5931.002N 604.557 kg

321.123 kg

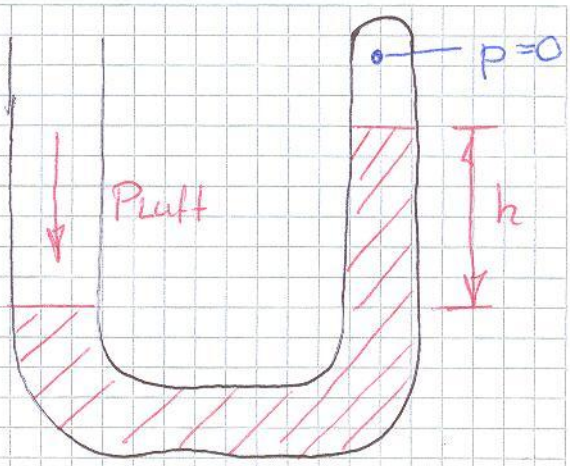
3150.22N

1P: F/m Helium

1P: $F_{Auftrieb}$ resp. Masse

(6)

Betrachte U-Rohr, rechts verschlossen mit $p = 0$, links mit Luftdruck



$$p_{Luft} = \rho g \cdot h$$

$$h = \frac{p_{Luft}}{\rho \cdot g}$$

$\rho_{Alk} = 798\ kg/m^3 \Rightarrow h \cong \underline{13.07m}$

$\rho_{H_2O} = 1000\ kg/m^3 \Rightarrow h \cong \underline{10.33m}$

$\rho_{Hg} = 13'546\ kg/m^3 \Rightarrow h \cong \underline{0.762m}$

$= \underline{762.5mm}$

1.5 / 3 / 4 P.

(7) $m_1 = 1'200\,g$, $m_2 = 1'094\,g$

$\rho_{Au} = 19290\,kg/m^3$, $\rho_{Pb} = 11'340\,kg/m^3$

$m_1 = \rho_x \cdot V$; $F_{Auftrieb} = \rho_{H_2O} \cdot g \cdot V$, $V = \frac{m_1}{\rho_x}$

$m_2 g = m_1 g - F_{Auftrieb}$

$m_2 g = m_1 g - \rho_{H_2O} \cdot g \cdot \frac{m_1}{\rho_x} \quad / : g$

$m_2 = m_1 - \rho_{H_2O} \frac{m_1}{\rho_x}$

$\frac{\rho_{H_2O} \cdot m_1}{\rho_x} = m_1 - m_2$

$\frac{\rho_x}{\rho_{H_2O} \cdot m_1} = \frac{1}{m_1 - m_2}$

$\rho_x = \frac{m_1 - m_2}{\rho_{H_2O} \cdot m_1}$

$\rho_x = \frac{\rho_{H_2O} \cdot m_1}{m_1 - m} = 1000 kg/m^3 \frac{1.2}{1.2 - 1.094}$

$\rho_x \cong 11'320\,kg/m^3$

V = 62.2 ml
F_A (Gold) = 0.6103 N
62.21 g

V = 105.32 ml
F_A (Blei) = 1.038 N
105.82 g

Gold: $m_1' = m_1 \left(1 - \frac{\rho_{H_2O}}{\rho_{Au}}\right) = 1137.79\,g$

Blei: $m_1' = m_1 \left(1 - \frac{\rho_{H_2O}}{\rho_{Pb}}\right) = 1'094.18\,g$

kein Gleichgewicht