a) $V_{N+1} = 36$ kmol/h. $y_{N+1} = 0,04$

$A_{gas,in} = 36 \cdot 0,04 = 1,44$ kmol/h

$A_{gas,out} = 0,1 \cdot 1,44 = 0,144$ kmol/h

$V' = V_{N+1} \cdot (1 - 0,04) = 34,56$ kmol/h

$V_1 = V' + A_{gas,out} = 34,56 + 0,144$

$V_1 = 34,704$

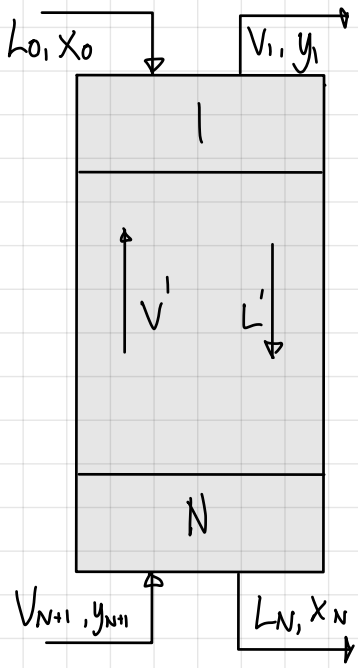
$y_1 = \frac{A_{gas,out}}{V_1} = \frac{0,144}{34,704} = 4,15 \cdot 10^{-3}$

$\frac{L_{min}}{V'} = \frac{(y_{N+1} - y_1)}{x^*_{N+1} - x_0}$, $x^*_{N+1} = \frac{y_{N+1}}{0,6} = \frac{0,04}{0,6} = \frac{1}{15}$

$L_{min} = V' \cdot \frac{(y_{N+1} - y_1)}{x^*_{N+1} - x_0} = 34,56 \cdot \frac{(0,04 - 4,15 \cdot 10^{-3})}{1/15 - 0} = \underline{\underline{18,58 \text{ kmol/h}}}$

$\Rightarrow$ Not possible, $L < L_{min}$

b) 1)



The absorption factor is given by

$$A = \frac{L/V}{m} = \frac{L/V}{K/P} = P \cdot \frac{L/V}{H}$$

To increase the absorption, we can

- Increase the pressure of the gas
- Increase L_0

$\Rightarrow$ Which increases the absorption and also the absorption factor

$\Rightarrow$ I would choose to increase L as it is most cost effective

b) 2) $V_{N+1} = 36$ kmol/h

$y_{N+1} = 0,04$

$L' = L_0 = 2 \cdot L_{min} = \underline{37,17 \text{ kmol/h}}$

$X_0 = 0$

$V' = V_{N+1} \cdot (1 - 0,04) = \underline{34,56 \text{ kmol/h}}$

$A_{gas,in} = 36 \cdot 0,04 = 1,44$ kmol/h

$A_{gas,out} = 1,44 \text{ kmol/h} \cdot 0,1 = 0,144$ kmol/h

$A_{Liquid,out} = 0,9 \cdot 1,44 = 1,296$ kmol/h

$V_1 = V' + A_{gas,out} = 34,56 + 0,144 = \underline{34,704 \text{ kmol/h}}$

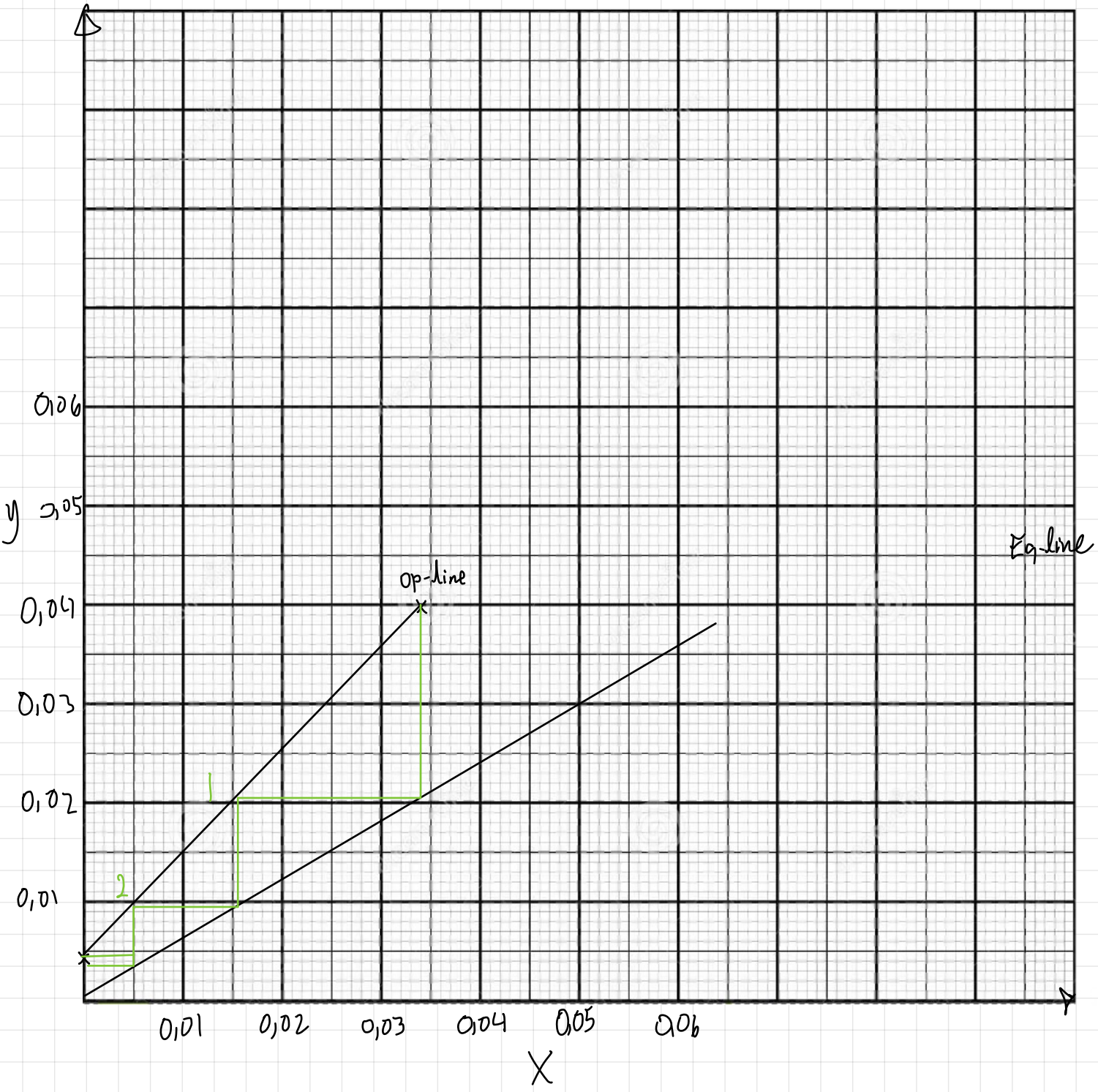
$y_1 = \frac{A_{gas,out}}{V_1} = \frac{0,144}{34,704} = \underline{4,15 \cdot 10^{-3}}$

$L_N = L' + A_{liquid,out} = 37,17 + 1,296 = \underline{38,466 \text{ kmol/h}}$

$X_N = \frac{A_{liq,out}}{L_N} = \frac{1,296}{38,466} = \underline{0,0337}$

3) Eq-line: $y = 0,6X$

Op-line: Streigh curve between (X_0, y_1) and (X_N, y_{N+1})



Get $N = 2,8$

c) $V = \frac{q}{A_c}$

$q = \frac{n \cdot RT}{p} = \frac{36\ \text{kmol/h} \cdot 0,08314\ \frac{\text{L·bar}}{\text{mol·K}} \cdot 298\text{K}}{1\ \text{bar}} = 892 \cdot 10^3\ \text{L/h} = 892\ \text{m}^3/\text{h}$

$= 0,247\ \text{m}^3/\text{s}$

$\Rightarrow A_c = \frac{q}{V} = \frac{0,247\ \text{m}^3/\text{s}}{2\ \text{m/s}} = 0,1235\ \text{m}^2$

$A_c = 0{,}1235\ m^2$

$$A_c = \pi\left(\frac{D}{2}\right)^2 = \pi\frac{D^2}{4} \Rightarrow D = \sqrt{\frac{4A_c}{\pi}}$$

$$D = \sqrt{\frac{4 \cdot 0{,}1235\ m^2}{\pi}} = 0$$

$$\underline{D = 0{,}397\ m}$$