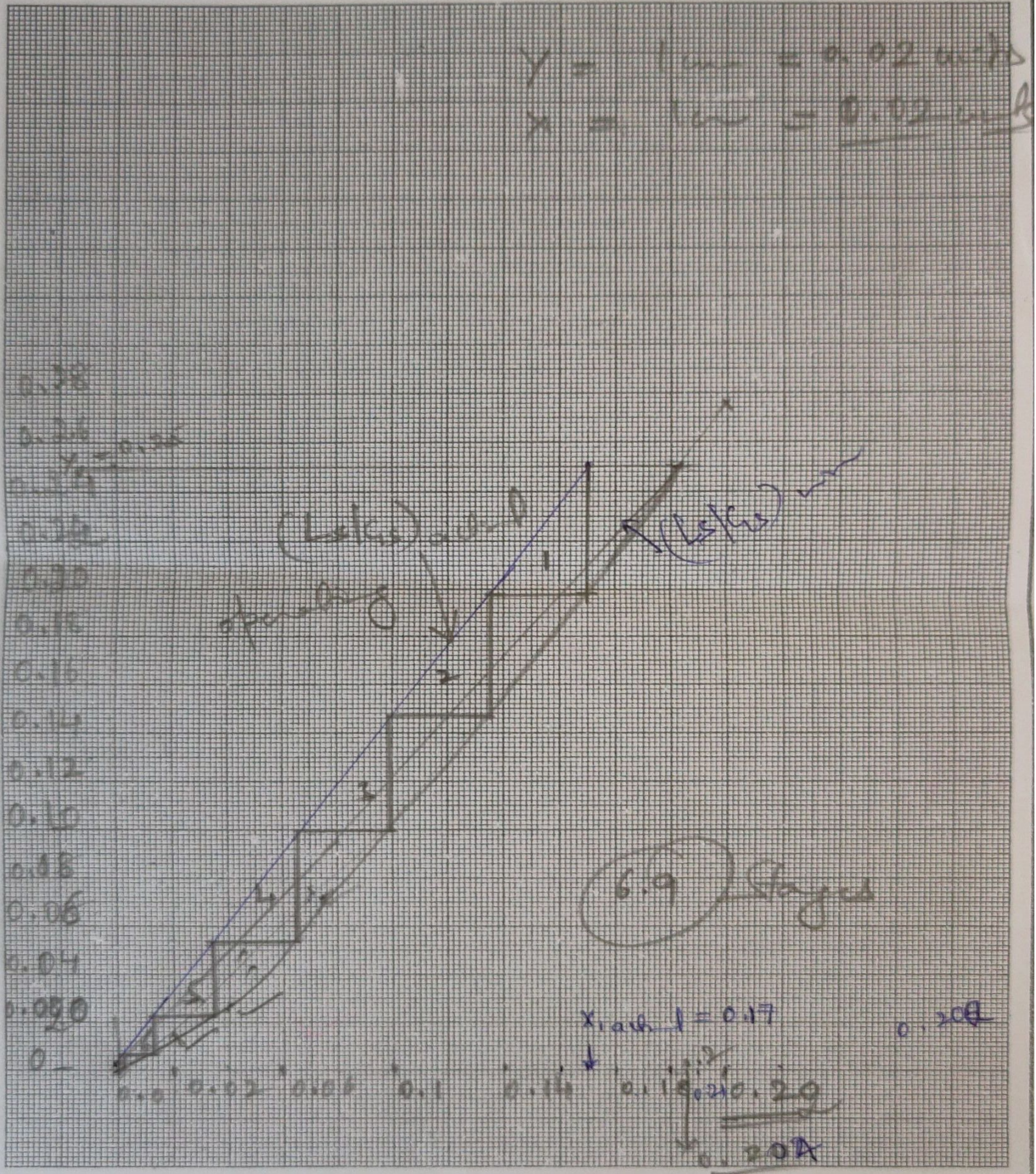

Y = 1cm = 0.02 units
X = 1cm = 0.02 units
0.28
0.26
0.24
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0
0.02
0.06
0.1
0.14
0.2
operating
1
2
3
4
5
6.9
Stages
0.204

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Absorption of NH_3 in water

To evaluate the equilibrium data

NH_3 — is the solute

Given partial pressure of NH_3

(NH_3 in Gas stream)

$$Y = \frac{NH_3 \text{ (moles)}}{\text{Inert (moles)}}$$

IG – Inert gas (air)

$\boxed{p = yP}$; $y_{NH_3/IG} = \frac{p_{NH_3/IG}}{P}$;

$$Y = \frac{12}{748} = 0.016$$

$$Y = \frac{y_{NH_3}}{y_{Inert}} = \frac{p_{NH_3}/\cancel{P}}{p_{IG}/\cancel{P}}$$

we have Dalton's

$$\boxed{P = p_{NH_3} + p_{IG}}$$

$$P - p_{NH_3} = p_{IG}$$

Given

$P = 1\text{ atm} = 760$ mmHg

$p_{IG} = 760 - 12 = 748$ mmHg

Similarly calculate 'Y' values from given 'p' values

Y	0.016	0.024	0.044	0.070	0.10	0.279
X	0.021	0.02318	5.3×10^{-2}	7.95×10^{-2}	0.0106	0.0212

To find the values of X = ?

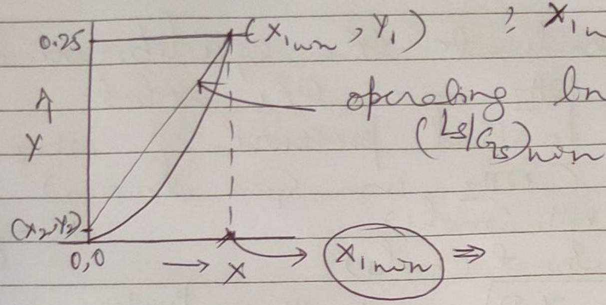
$$X = \frac{\text{Moles of } NH_3}{\text{Moles of solvent (pure)}}$$

Given $\frac{g \text{ of } NH_3}{10g \; NH_3}$

$$X = \frac{(g/g/gmole)_{NH_3}}{(g/g/gmol)_{H_2O}} = \frac{0.2/17}{10/18} = 0.021$$

$$\left(\frac{1}{17/(10/18)}\right) = 0.021$$

Draw the equilibrium curve



; $X_{1min} = X_1^*$

Now

i. Locate the data (X, Y) on the graph sheet and draw the curve (line)

ii. Locate 'Y_1, Y_2 and X_2 on Y-axis' and 'inside the graph (Y_2, X_2) point'

$Y_1 = 0.25$, $Y_2 = 0.002$ and $X_2 = 0$

No information is given about NH_3 content in the solvent hence assume that the solvent is pure water.

Hence $X_2 = 0$

iii. Draw horizontal line at Y_1 to intersect the equilibrium curve. (see the fig) This means that equilibrium is attained between Y_1 and X_{1min} and the flow rate of solvent refers to minimum solvent rate. Slope of the line $= \frac{L_{S min}}{G_S}$

iv. To find minimum solvent rate

Join (X_2, Y_2) point to the Y_1 intersection point at X_{1min} (referred as) on equilibrium curve (X-axis value). Find the slope of the line (O.L) drawn.

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To find the slope ; $x_{1min} = 0.194$

$$\left(\frac{L_s}{G_s}\right)_{min} = \frac{Y_1 - Y_2}{x_{1min} - x_2}$$

$$= \frac{0.25 - 0.002004}{0.194 - 0} = 1.278$$

v. Use the slope value to find $L_{s\,min}$

$(L_s)_{min} = G_s$ (Slope of O.L.min)

$= 105.\ (1.278)$

$= 134$ kmol/h

vi. Find the L_s operating

Given $L_{s\,operating} = 1.2\ L_{s\,minimum}$

Note: If not given assume 1.2 to 2 times

$L_{s\,op} = 1.2(134)$

$= 160.8$ kmol/h

vii. L_s'-Mass flow rate: To convert to kg/h, since it is liquid ($L_{s\,op}$), use mole wt of solvent

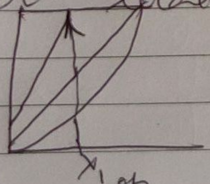
$L'_{op} = L'_{s\,op} = 160.8 \times 18 = 2894.4$ kg/h

$L'_{op}\ \frac{kg}{h} = L_s \times M_{H_2O}\ \frac{kmol}{h} \times \frac{kg}{kmol}$

viii. Stages

Draw $(L_{sop}/G_s)_{op}$ line from (x_2, Y_2)

a) after locating $x_{1\,op}$ on x-axis



b) locating x_{2op} on Y_1 horizontal line (point $x_{1\,op}, Y_1$)

$x_{1\,op}$