Exercise Problem 1

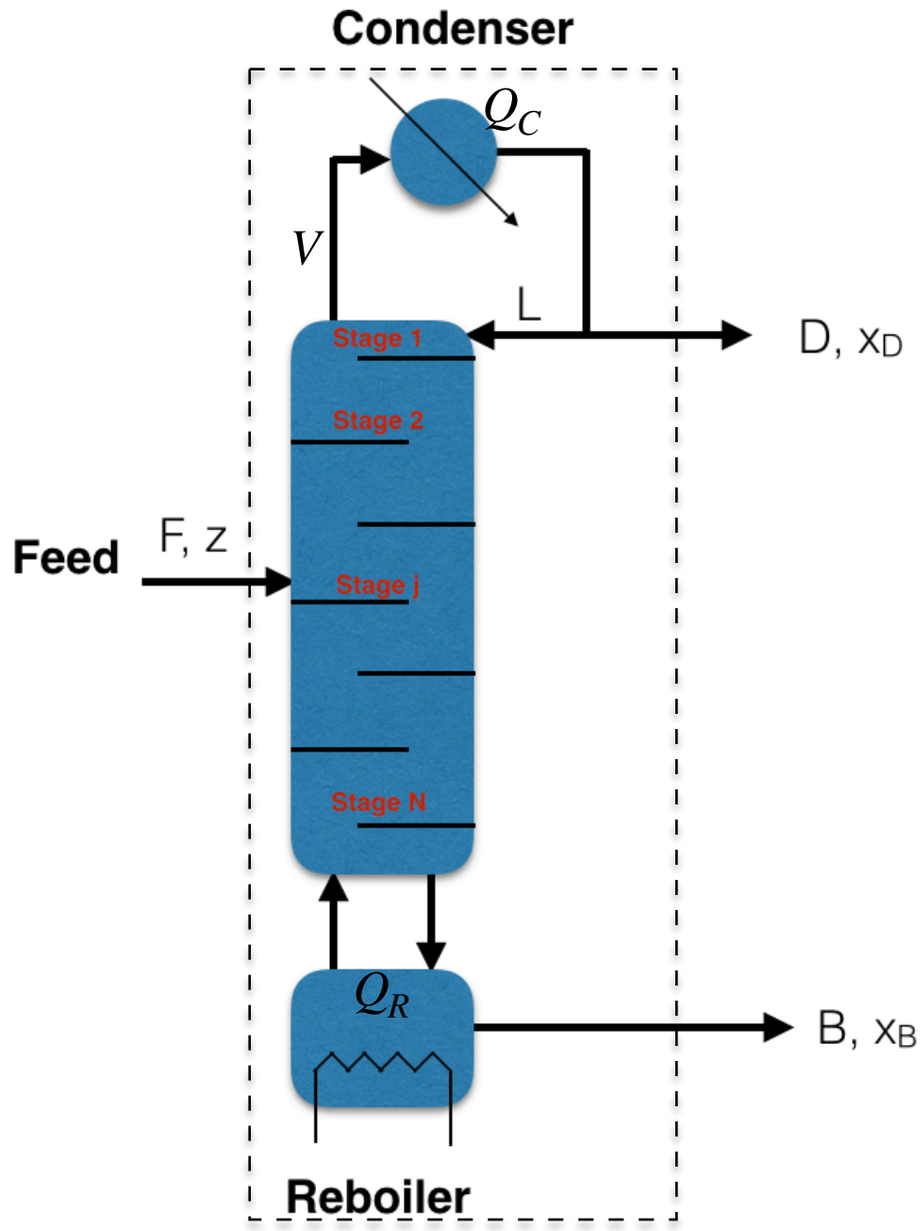
Calculate D, B, L, V.
Calculate energy input by the condeser

F = 100 mole/hr R = 1

z = 0.5 Latent heat of vap at condenser = 1500 Joule/mole

$x_B = 0.1$

$x_D = 0.9$



Exercise problem 2:

Calculate number of stages and label composition from the column

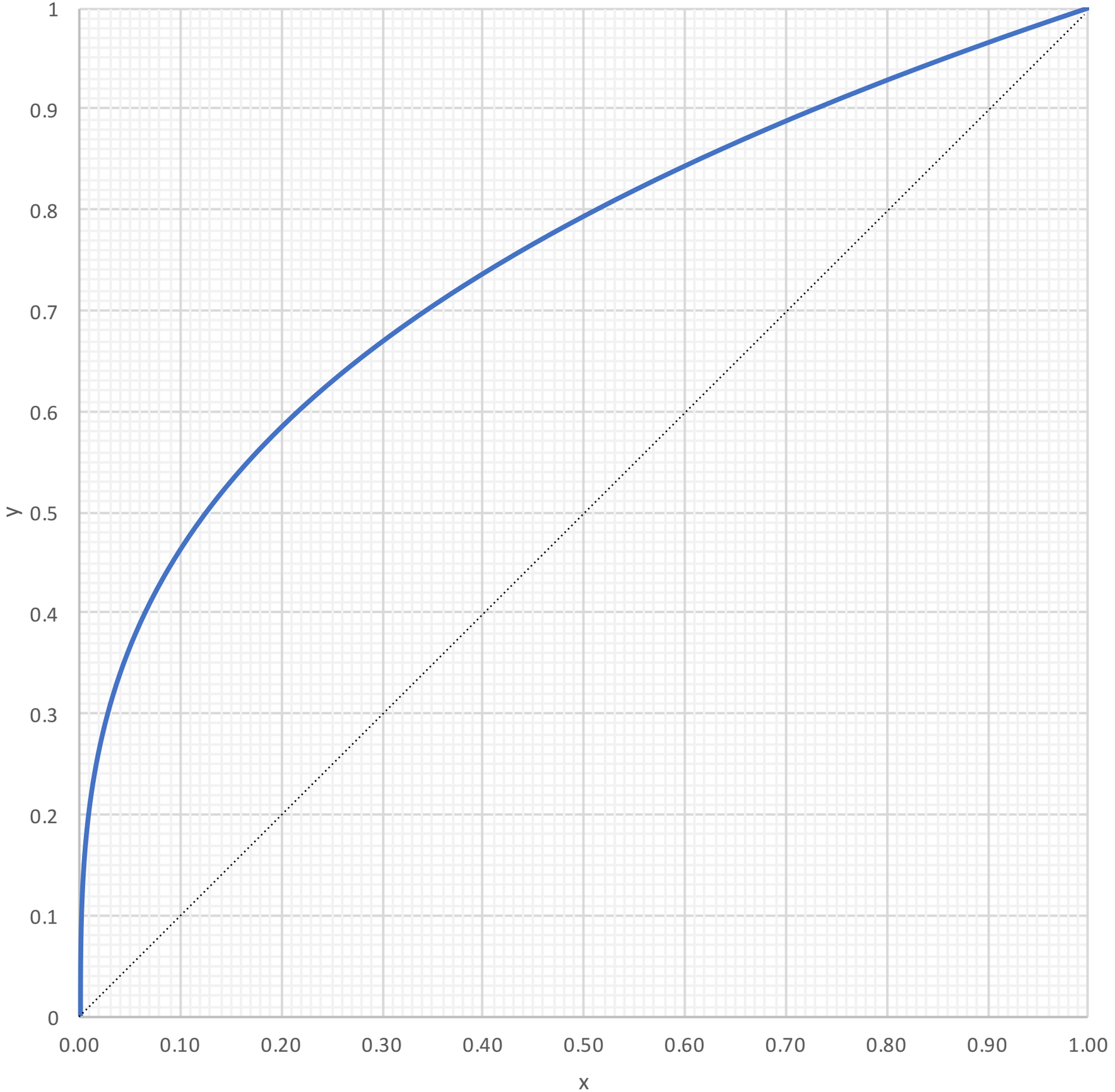
x_D = 0.8,

x_B = 0.2,

z = 0.5,

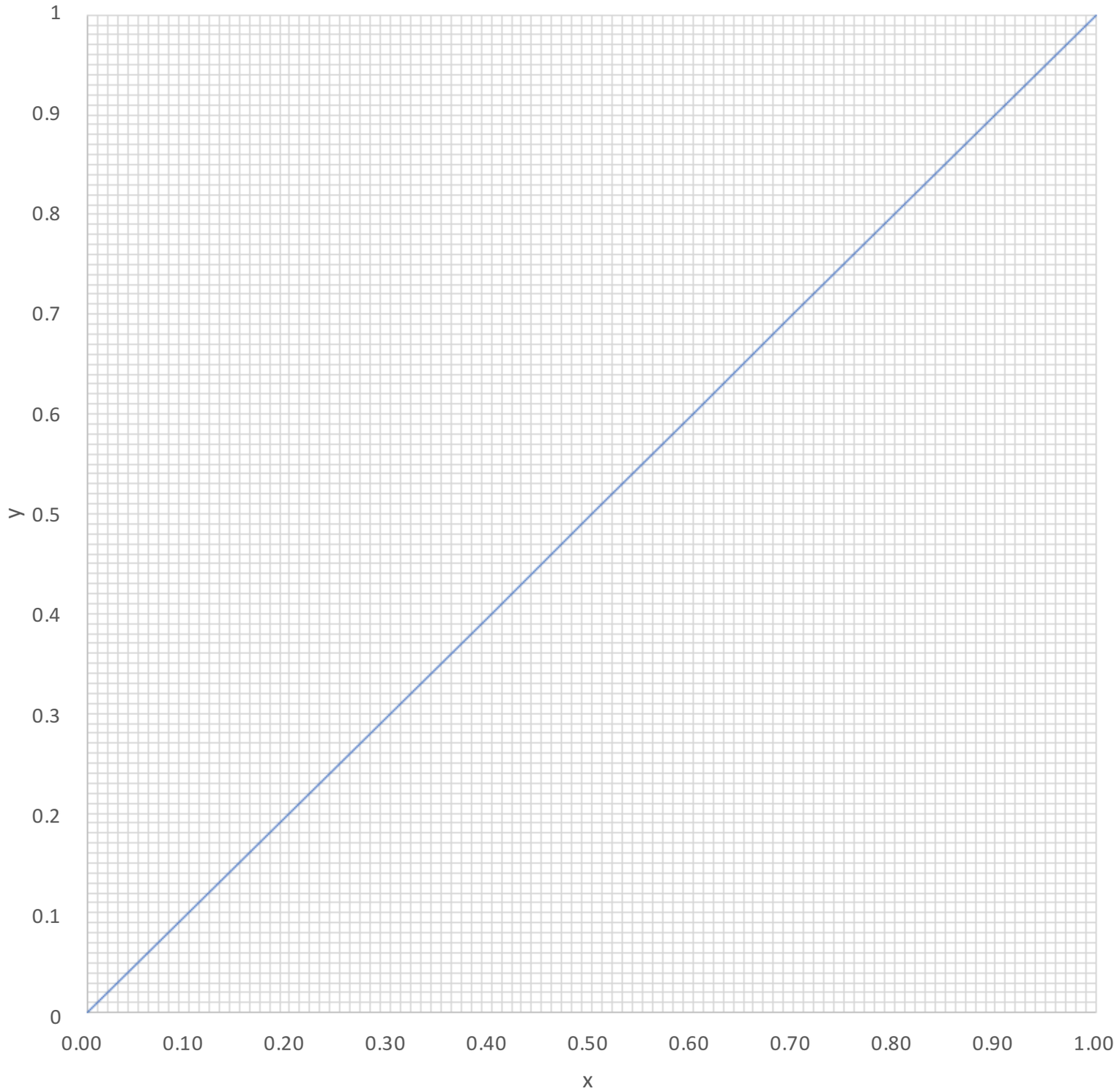
R = 1,

V_B =1.



Exercise problem 3:

Consider the separation of ideal mixture with constant relative volatility of 10. Feed flow rate (z_1 = 0.5) is 100 liter/hr and distillate flow rates is 60 liter/hr. Calculate the number of stages to obtain distillate purity of 80% if both reflux and reboiler ratios are 1.



Exercise Problem 1: Solution

Calculate D, B, L, V.
Calculate energy input by the condeser

F = 100 mole/hr R = 1

z = 0.5 Latent heat of vap at condenser = 1500 Joule/mole

$x_B = 0.1$

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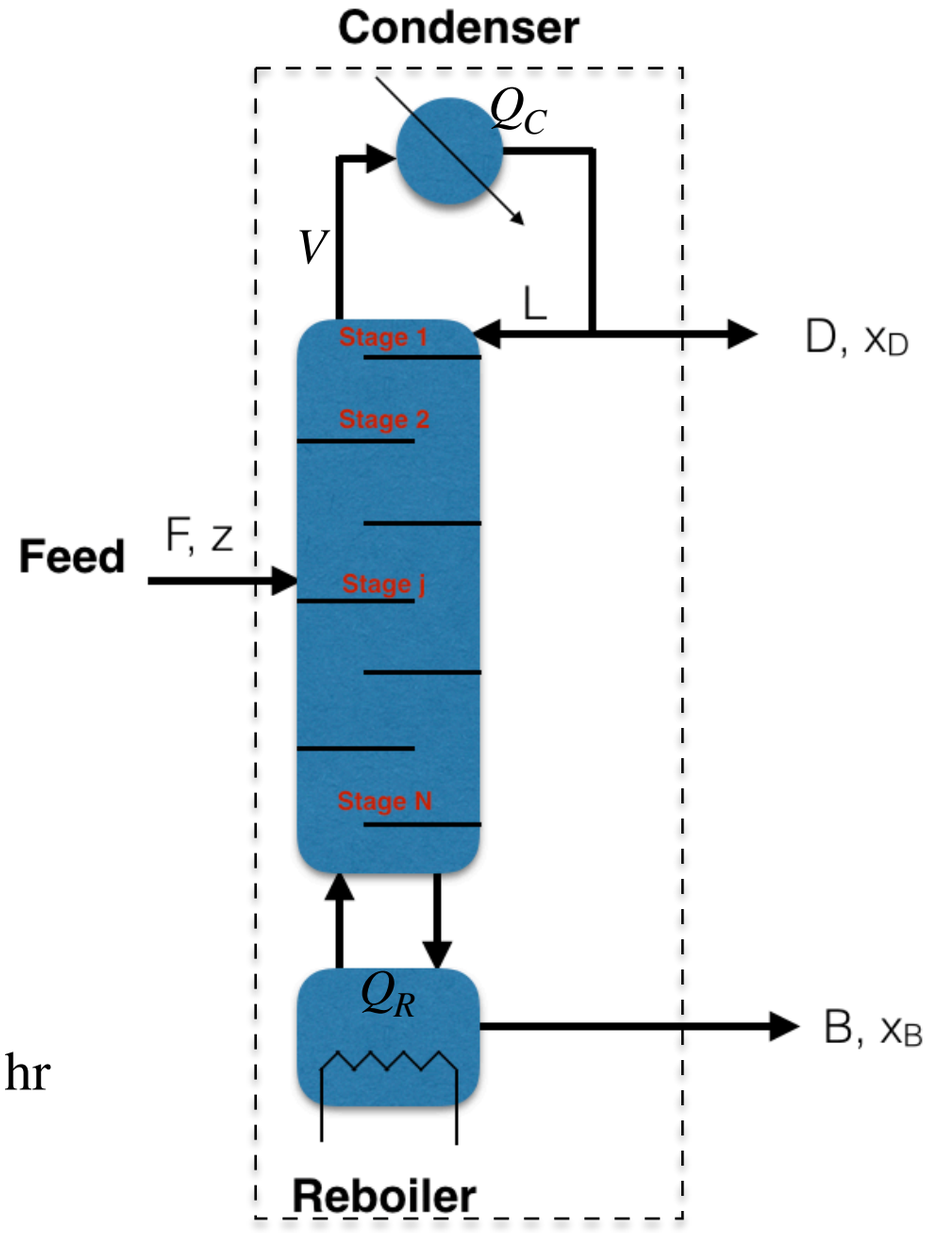


$$D = F\frac{z - x_B}{x_D - x_B} = 100\frac{0.5 - 0.1}{0.9 - 0.1} = 50 \text{ mole/hr}$$

$$B = F - D = 50 \text{ mole/hr}$$

$$L = R * D = 50 \text{ mole/hr} \qquad V = L + D = 100 \text{ mole/hr}$$

$$Q_c = V(\Delta h_{latent}) = 100 * 1500 = 150000 \text{ Joule/hr}$$

EPFL

Exercise problem 2: Solution

Calculate number of stages and label composition from the column

$x_D = 0.8$,

$x_B = 0.2$,

$z = 0.5$,

$R = 1$,

$V_B = 1$.

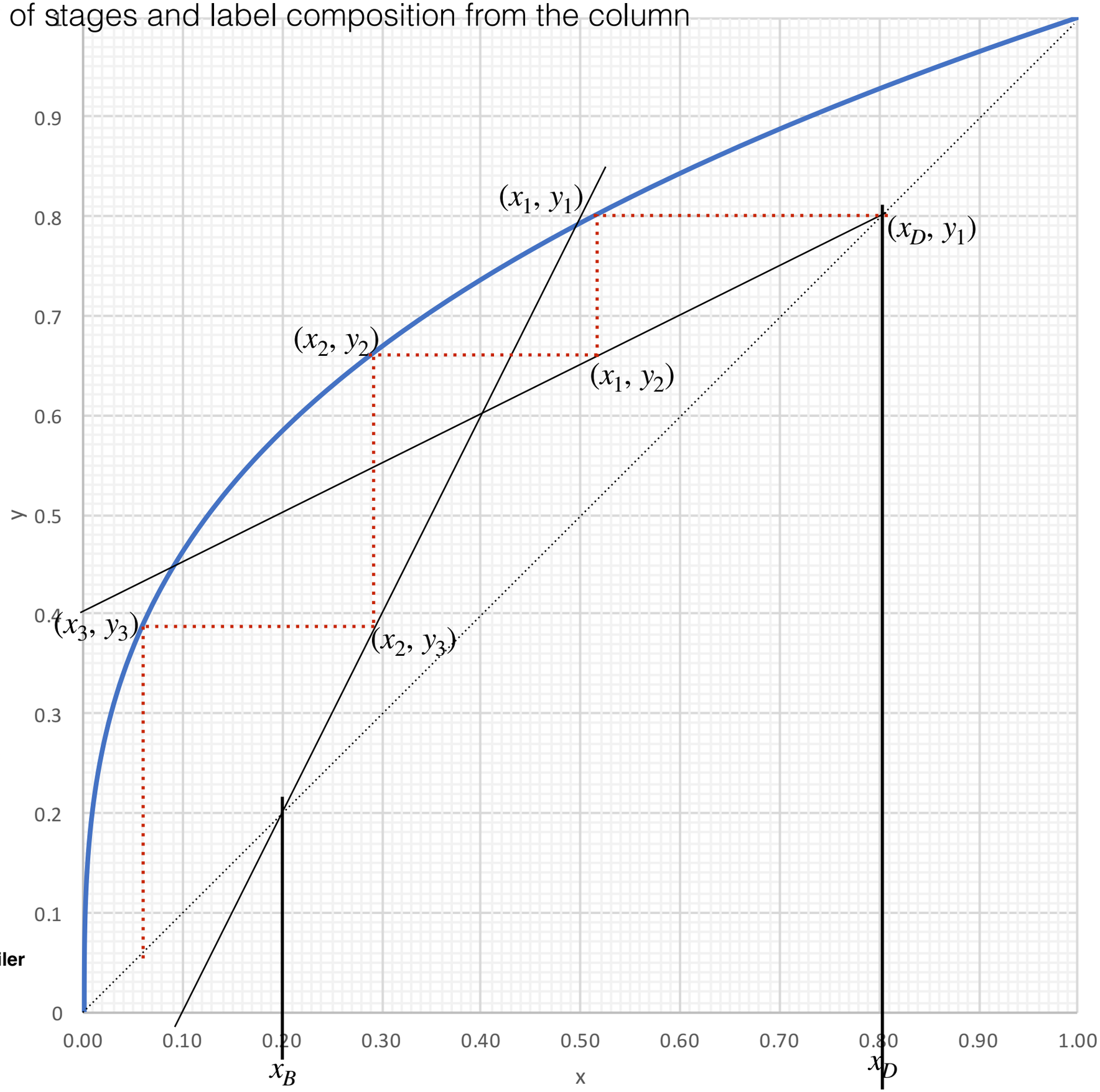
$$y_{m+1} = \frac{V_B + 1}{V_B} x_m - \frac{1}{V_B} x_B$$

$$y = 2x - 0.2$$

$$y_j = \frac{R}{(R+1)} x_{j-1} + \frac{1}{(R+1)} x_D$$

$$y = 0.5x + 0.4$$

Total 3 stages including reboiler



Exercise problem 3 : Solution

Consider the separation of ideal mixture with constant relative volatility of 10. Feed flow rate (z_1 = 0.5) is 100 liter/hr and distillate flow rates is 60 liter/hr. Calculate the number of stages to obtain distillate purity of 80% if both reflux and reboiler ratios are 1.

$$F = 100 \text{ mole/hr}$$

$$z = 0.5$$

$$B = 40$$

$$B = F\frac{x_D - z}{x_D - x_B}$$

$$x_B = 0.05$$

Constant relative volatility

$$y_1 = \frac{\alpha_{12}x_1}{(1 - x_1 + \alpha_{12}x_1)}$$

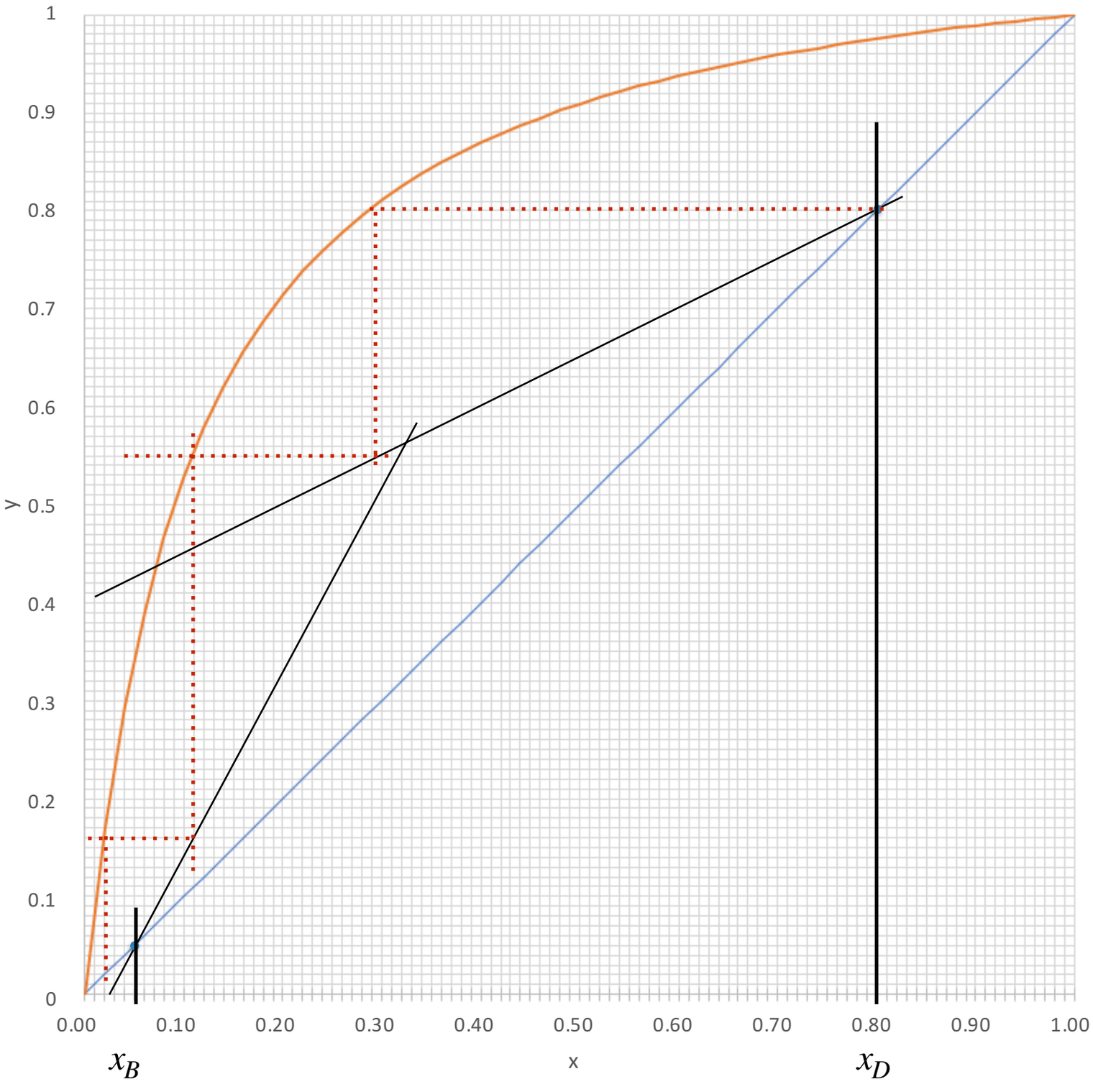
Generate equilibrium cuver y1 vs x1

$$y_j = \frac{R}{(R+1)}x_{j-1} + \frac{1}{(R+1)}x_D$$

$$y = 0.5x + 0.4$$

$$y_{m+1} = \frac{V_B + 1}{V_B}x_m - \frac{1}{V_B}x_B$$

$$y = 2x - 0.05$$



Number of stages = 3