A liquid stream flows into a distillation column. It contains 60.0 mole % of A (Mw = 20.0, SG = 1.00) and the rest is species B (Mw = 50.0, SG = 2.00). The production rate of bottom product is 100.0 mole / s, and the mole fraction of B in the bottom product is (0.82). Of the A fed to the column, 10% emerges in the bottom product.

1) Draw and completely label a flow chart of the process.

2) Carry out the degree of freedom analysis.

3) What is the basis of calculation that you will choose?

4) Find the molar flowrates of the feed and overhead (top) product stream.

5) Find the composition of the overhead product stream.

6) Find the fraction of B in the feed stream emerges in the overhead product.

7) What is the volumetric flowrates of the feed stream (cm^3/s)?

A mixture of sugar and water contains 71 wt %. The mixture is heated to remove water from the mixture and produce a concentrated sugar solution. The operation is called drying. After drying it is found that 60 wt % of the original water has been removed.

1) Draw and fully label a flowchart of the process.

2) How many material balances can be written for this system? How many are independent?

3) Perform a degree of freedom analysis for this system.

4) What is the composition in mass fractions of the concentrated sugar solution after drying?

A liquid stream flows into a distillation column. It contains 30.0 mole % of benzene and the balance of toluene. The production rate of the bottom product is 100.0 mole/s and the mass fraction of toluene in the bottom product stream is 0.82 g toluene/g. Of the benzene fed to the column 10% emerges in the bottom product.

1) Draw and completely label a flow chart of the process.

2) Carry out the degree of freedom analysis.

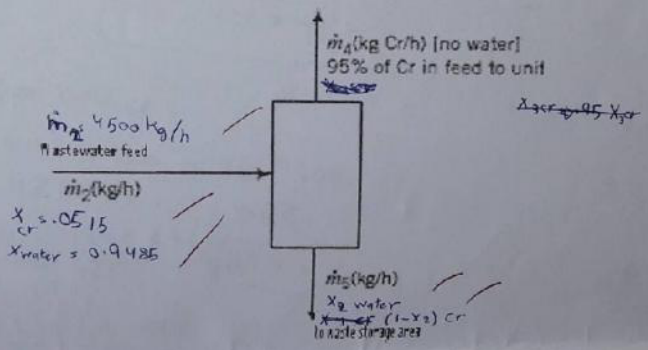
3) What is the basis of calculation that you will choose?

4) Find the molar flowrates of the feed and overhead (top) product stream.

5) Find the composition of the overhead product stream.

Question 3: [30 points]

A wastewater (مياه صناعية) feed stream containing **5.15 wt% chromium** (كروم), Cr, is fed to a treatment unit that removes 95% of the chromium in the feed. The residual liquid stream leaving the bottom of the treatment unit is sent a waste storage area. The treatment unit has a feed capacity of **4500 kg wastewater/h**.



1. Draw and *completely* label a flow chart of the process.
2. How many material balances can be written for this system? How many are independent?
3. Perform a degree of freedom analysis for this system.
4. Calculate the flow rates and mass fractions of the streams leaving the treatment unit?
5. What is the concentration in (mol/L) of Cr in the wastewater feed stream (**SG of the feed =1, Atomic weight of Cr = 52**)

(2) 3 material balances, 2 independent