



In-Class Exercises n° 01

(Distillation – Introduction and Basic Principles)

Exercise 01: Bubble point at given temperature T.

Calculate the bubble point pressure and vapor phase composition of a binary liquid mixture at a given temperature $T = 350 \text{ K}$.

Given data:

- Mole fraction of the binary mixture in liquid phase: $x_1 = 0.6$; $x_2 = 0.4$;
- Antoine constants:

Component	A	B	C	T range (K)
1	8.07131	1730.63	233.426	Around 350 K
2	7.93173	1696.09	230.0	

Exercise 02: Bubble point at given pressure P.

Calculate the bubble point temperature and vapor phase composition of a binary liquid mixture at a given total pressure $P = 1.0 \text{ atm}$.

Given data:

- Mole fraction of the binary mixture in liquid phase: $x_1 = 0.5$; $x_2 = 0.5$;
- Antoine constants:

Component	A	B	C	T range (°C)
1	8.14019	1810.94	244.485	1 - 100
2	7.68117	1332.04	199.200	5 - 90

- Total pressure $P = 1.0 \text{ atm} = 1.01325 \text{ bar}$.

Exercise 03: Dew point at given pressure P.

Calculate the dew point temperature and liquid phase composition of a binary vapor mixture at a given total pressure $P = 1.0 \text{ atm}$.

Given data:

- Mole fraction of the binary mixture in vapor phase: $y_1 = 0.5$; $y_2 = 0.5$;
- Antoine constants:

Component	A	B	C	T range (°C)
1	8.08097	1582.271	239.726	0 - 100
2	7.68117	1332.04	199.200	5 - 90

Total pressure $P = 1.0 \text{ atm} = 1.01325 \text{ bar}$.

Exercise 04: Dew point at given temperature T.

Calculate the dew point pressure and liquid phase composition of a binary vapor mixture at a given temperature $T = 80^\circ\text{C}$.

Given data:

- Mole fraction of the binary mixture in liquid phase: $y_1 = 0.6$; $y_2 = 0.4$;
- Antoine constants:

Component	A	B	C	T range (°C)
1	8.20417	1642.89	230.3	20 - 120
2	7.93173	1696.09	230.0	10 - 100

Exercise 05: Bubble and dew point calculations.

- A gas mixture of **15 mol-%** benzene, **5 mol-%** toluene and the rest nitrogen is compressed isothermally at **100°C** until condensation occurs. What will be the composition of the initial condensate?
- Calculate the temperature and composition of a vapor in equilibrium with a liquid that is **25 mol-%** benzene and **75 mol-%** toluene at **1 atm**. Is this a bubble point or a dew point?
- Calculate the temperature and composition of a liquid in equilibrium with a gas mixture containing **15 mol-%** benzene, **25 mol-%** toluene and the rest nitrogen (which may be considered non-condensable) at **1 atm**. Is this a bubble point or a dew point?