



Physico-Chemical Analysis Techniques

Exam (S1) 19/01/2025

Course Question: (3 pts)

1. List three (03) methods for separating homogeneous mixtures.
2. The selection of an extraction solvent is based on several parameters. What are they?

Exercise 1: (6 pts)

15 mL of a substance (A) in an aqueous solution with a concentration of 60 mg/L is extracted using 3 mL of diethyl ether. The partition coefficient of diethyl ether/water is 10.

1. What are the necessary conditions for a good-quality extraction?
2. With which instrument is this extraction performed?
3. Calculate the amount of substance (A) extracted by the solvent.
4. Determine the amount remaining in the aqueous phase.
5. Calculate the extraction yield.
6. If the volume of solvent is doubled, what will the new extraction yield be?

Exercise: (7 pts)

A mixture is separated by gas chromatography. The column parameters are as follows:

- $L = 150 \text{ cm}$, $T = 140 \text{ }^{\circ}\text{C}$, Carrier gas: He, Flow rate: $20 \text{ cm}^3/\text{min}$, Detector: FID.

The table above presents the results recorded from the chromatogram.

Pic	A	B	C	D	E	F
$t_R \text{ (s)}$	$(t_m = 25)$	177	750	1029	1222	1775
$\omega \text{ (s)}$	1,70	11,80	54,50	68,60	81,50	118,30
Aire (cm^2)	0,01	18,10	101,10	26,50	98,90	61,00

1. Deduce the dead time.
2. Calculate the reduced volumes for compounds B, C, D, E, and F.
3. Identify the component that represents the largest quantity in the mixture.
4. Calculate the resolution between peaks B-C, C-D, D-E, and E-F. Comment on the values of R_s .
5. Determine the theoretical plate number N for peaks B, C, D, and E.
6. What is the minimum column length required for peaks D and E to be resolved with minimal overlap?
7. Determine the retention times of compounds D and E on this new column.

Exercise 3: (4 pts)

A container is divided into two compartments, C1 and C2, by a semi-permeable membrane. In compartment C1, the following compounds are placed: 5.8 g of NaCl, 0.71 g of Na₂SO₄, 1.8 g of glucose, 17 g of proteins (non-dissociable), and 1.5 g of urea. A quantity of water is added to obtain a volume of 1 liter in each compartment.

- Molar masses (g/mol): NaCl = 58, Na₂SO₄ = 142, glucose = 180, proteins = 6.8×10^4 , urea = 60.
 - $R = 8.31 \text{ J/mol K}$
1. Calculate the osmotic pressure exerted on the membrane at 27°C.