Tutorial N° 1

Exercise 1

A commercial phosphoric acid solution contains 75% by mass of H_3PO_4, and its density is 1.57 g/mL. Determine the molar concentration, normality, molality, mole fraction, and molar percentage of H_3PO_4 in this commercial solution.

Exercise 2

The measurement of the conductivity of a potassium chloride ($K^+ + Cl^-$) solution with concentration C gives 1.224 mS·cm^{-1} at 21°C.

1. Express **σ**, the conductivity, in S·m^{-1}.
2. The following values are provided :
   $\lambda_{Cl^-} = 7{,}63\ mS.m^2.mol^{-1}$; $\lambda_{K^+} = 7{,}35\ mS.m^2.mol^{-1}$
   2.1. What does the letter λ represent?
   2.2. Convert these values to S.$m^2.mol^{-1}$.
   2.3. Determine the concentration C in $mol.L^{-1}$.

Exercise 3

An unknown amount m_{LiCl} of lithium chloride was dissolved in a 200 mL volumetric flask.

Given: Molar conductivities at 25°C: λ_{Li^+}= 3,86 mS.m^2/mol^{-1}; λ_{Cl^-}= 7,63 mS.m^2.mol^{-1}

Molar masses: M_{Li} = 6,9 g.mol^{-1}, M_{Cl} = 35,5 g.mol^{-1}

1. Determine the concentration C in mol.L^{-1} of this solution, knowing that its conductivity is σ = 34,5 mS.cm^{-1} (we previously calibrated the conductometer).
2. What mass m_{LiCl} of lithium chloride was placed in the volumetric flask?

Exercise 4

A potassium chloride (KCl) solution has a concentration C= 5.10^{-3} mol.L^{-1}.

1. Write the equation for the dissolution reaction of potassium chloride in water.
2. The dissolution is complete. Calculate, in mol.m^{-3}, the concentrations of the ions K^+ and Cl^- in the solution. Justify your answer clearly.
3. Calculate the conductivity of the solution.

Given :

Ionic molar conductivities: λ_{Cl^-}= 7,63.10^{-3} S.m^2.mol^{-1}, λ_{K^+}= 7,4.10^{-3} S.m^2.mol^{-1}

Exercise 5

We mix a volume $V_1 = 200\ mL$ of a potassium chloride ($K^+ + Cl^-$) solution with concentration $C_1 = 5{,}0.10^{-3}\ mol/L$ with a volume $V_2 = 800\ mL$ of a sodium chloride ($Na^+ + Cl^-$) solution with concentration $C_2 = 1{,}25.10^{-3}\ mol/L$.

1. What is the conductivity of the resulting solution?
2. In the previous mixture, a conductometer cell is placed. The surface area of the electrodes is 11,0cm^2 and the distance between them is 1,1 cm.
   2.1. What is the value of the conductance?

Given:

$\lambda_{Na^+} = 5{,}01.10^{-3}\ S.m^2/mol$; $\lambda_{Cl^-} = 7{,}63.10^{-3}\ S.m^2/mol$; $\lambda_{K^+} = 7{,}35.10^{-3}\ S.m^2/mol$

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Exercise 6

In a beaker, 50 mL of hydrochloric acid (HCl) with an unknown concentration, and this solution is titrated with a 0.1 mol/L sodium hydroxide (NaOH) solution. The results obtained are summarized in the table below. Based on this data:

1. Write the chemical equation for this titration.
2. Plot the conductivity curve as a function of the volume of NaOH added.
3. Explain the different parts of the curve.
4. Calculate the concentration of HCl.

Table

V_{NaOH} (mL)	0	5	10	15	20	25	30	35	40
σ (µ.S/cm)	180	175	170	160	140	120	100	80	50
V_{NaOH} (mL)	45	50	55	60	65	70	75		
σ (µ.S/cm)	30	15	35	60	90	120	150		

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