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2024/2025

Serie No. 1

Exercice 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.

Exercice 2

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

1. Express **σ**, the conductivity, in $S \cdot m^{-1}$.
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 $m^2.mol^{-1}$.
   2.3. Determine the concentration C in $mol.L^{-1}$.

Exercice 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 $g.mol^{-1}$

a) 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).

b) What mass m_{LiCl} of lithium chloride was placed in the volumetric flask?

Exercice 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^+ et 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^+}= $7{,}4.10^{-3}$ $S.m^2.mol^{-1}$

Exercice 5

Dissolve 0.5 g of calcium nitrate $Ca(NO_3)_2$ in a 200 mL volumetric flask.

Given :

Molar mass of calcium nitrate : $M_{Ca(NO3)2}$ = 164 g/mol.

Ionic molar conductivities at 25°C: λ_{Ca2+} = 11,90 $mS.m^2.mol^{-1}$; λ_{NO3-} = 7,14 $mS.m^2.mol^{-1}$

Ionic molar conductivities at 20°C: λ_{Ca2+} = 7,44 $mS.m^2.mol^{-1}$; λ_{NO3-} = 6,43 $mS.m^2.mol^{-1}$

a) Indicate the ions present in the solution and calculate their concentrations.
b) Calculate the conductivity σ at 25°C and 20°C. Explain the difference in results.

Exercice 6

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 :

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

Exercice 7

Using a cell, the conductance G of a sodium chloride ($NaCl$) solution S_1 with concentration c = 5.10^{-3} $mol/\ L$ was measured, and it was found to be G = 5,45.10^{-3} S.

1.1. Write the equation for the dissociation reaction of sodium chloride in water.
1.2. The dissociation of $NaCl$ is complete. Determine the concentrations (in $mol/\ L$ and $mol/\ m^3$) of the ions Na^+ and Cl^-. Provide a clear justification for your answer.
1.3. Determine the conductivity **σ** of the solution.
1.4. The value $K = L/S$ (where L is the distance between the electrodes and S is the submerged surface area of an electrode) is called the "cell constant." Determine K.

Given :

Ionic molar conductivities : λ_{Na+} = 3,87.10^{-3} $S.\ m^2.\ mol$; λ_{Cl-} = 7,63.10^{-3} $S.\ m^2/\ mol$