Into 150 mL of the 0.50 M KNO_3 (aq) solution was added 2.0 g of KHTart (solid).

Calculate the concentration of $HTart^-$ anion in this solution.

1. Calculating mass of KNO_3 solution:

$m_{sol} = V \cdot \rho$, where V – volume of solution, ρ = 1.029 g/mL – density of 0.5 M KNO_3 (aq) solution (from the chemical handbook); $m_{sol} = 150 \cdot 1.029 = 154.35\,\text{g}$;

2. Calculating mass of solid KNO_3, dissolved in water:

$m_{KNO3} = V \cdot C \cdot M_{KNO3} / 1000$, where C – molar concentration of KNO_3 in solution, M_{KNO3} = 101 g/mol;

$m_{KNO3} = 150 \cdot 0.5 \cdot 101 / 1000 = 7.58\,\text{g}$;

3. Calculating mass of pure water:

$m_{H2O} = m_{sol} - m_{KNO3} = 154.35 - 7.58 = 146.77\,\text{g}$;

4. Calculating mass of KHTart, which will dissolve in such amount of water:

$m_{KHTart} = m_{H2O} \cdot S_{KHTart} / 100$, where S_{KHTart} = 0.54 g – solubility of KHTart in 100 g of water at 20°C (from the chemical handbook); $m_{KHTart} = 146.77 \cdot 0.54 / 100 = 0.793\,\text{g}$

5. Calculating the molar concentration of $HTart^-$ anion in this solution, it will be the same as the molar concentration of dissolved salt KHTart, because that is a strong electrolyte, which fully dissociates:

$$C_{HTart^-} = C_{KHTart} = \frac{m_{KHTart} \cdot 1000}{V \cdot M_{KHTart}} = \frac{0.793 \cdot 1000}{150 \cdot 188} = 0.0281\,\text{M}$$

Answer: 0.0281 mol/L