

Answer on Question #54271 – Chemistry – Physical Chemistry

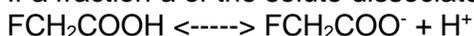
Question:

On dissolving 19.5 g of CH_2FCOOH in 500 g of water a depression of 1c in freezing point of water is observed calculate vant hoff factor and dissociation constant of fluoroacetic acid given $k_f=1,86 \text{ Kkg mol}^{-1}$

Answer:

The van't Hoff factor i is the ratio between the actual concentration of particles produced when the substance is dissolved, and the concentration of a substance as calculated from its mass.

If a fraction a of the solute dissociates into n ions, then $i=1+a(n-1)$.



The dissociation of fluoroacetic acid yields $n=2$ particles, so that $i=1+a$.

1) Calculation of van't Hoff factor:

Molar mass of fluoroacetic acid is

$$M(\text{FCH}_2\text{COOH})=78 \text{ g/mol}$$

Number of moles of fluoroacetic acid is

$$n(\text{FCH}_2\text{COOH}) = m(\text{FCH}_2\text{COOH}) / M(\text{FCH}_2\text{COOH}) = 19.5 \text{ g} / 78 \text{ g/mol} = 0.25 \text{ mol}$$

$$\text{Molality, } m = (\text{number of moles fluoroacetic acid}) / (\text{mass of water in kg}) = 0.25 \text{ mol} / 0.5 \text{ kg} = 0.5 \text{ mol/kg}$$

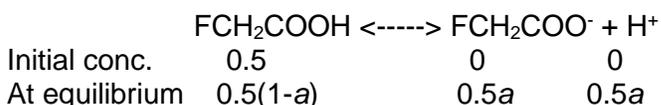
$$\Delta T_f = i \times K_f \times m$$

$$i = \Delta T_f / (K_f \times m)$$

$$\text{Here, } \Delta T_f = 1.0 \text{ K; } K_f = 1.86 \text{ K}\cdot\text{kg/mol; } m = 0.5 \text{ mol/kg}$$

$$i = 1.0 / (1.86 \times 0.5) = 1.0753$$

2) Calculation of dissociation constant, K_a



$$K_a = 0.5a^2 / (1-a) = 0.5 \times (0.0753)^2 / (1 - 0.0753) = 3.07 \times 10^{-3}$$