# Answer on Question #53088 – Chemistry – General chemistry

**Question**

400 M of formic acid (HCOOH) solution freezes at -.751 degrees C. Calculate the Ka of the acid at that temperature

**Solution:**

$$HCOOH \leftrightarrow H^+ + HCOO^-$$

$$K_a=\frac{[H^+][HCOO^-]}{[HCOOH]}$$

$C_m$=400 mol/kg

ΔT=0.751 K

Electrolyte dissociates according to the scheme:

$$K_pA_q = pK^{q+} + qA^{p-}$$

i.e. from one molecul formed (p+q) ions. The degree of dissociation is denoted by α.

$$1-\alpha+\alpha\cdot p+ \alpha\cdot q = 1 + \alpha\cdot(p +q -1)$$

We have:

$$\Delta T = [1+\alpha\cdot(p+q-1)]\cdot K\cdot m$$

In this case formic acid is dissociated into 2 ion **(p=q=1)**

$$\Delta T=m\cdot K(1+\alpha)$$

where K - cryoscopic constant (for water =1.86)

α - degree of dissociation

m - molality [mol/kg]

Formic acid is binary electrolyte, that means:

$$\Delta T =m\cdot K(1+\alpha)$$

$$\alpha = \frac{\Delta T}{m \cdot K} - 1$$

$$\alpha=0.751/(400 \cdot 1.86)-1=0.998$$

$$K_a = (0.998 \cdot 400) \cdot (0.998 \cdot 400)/((1-0.998) \cdot 400) = \mathbf{19.92 \cdot 10^4}$$

**Answer: $19.92 \cdot 10^4$**