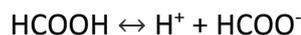# Answer on Question #53088 – Chemistry – General chemistry

**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.

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

We have:

$$\Delta T = [1+\alpha·(p+q-1)]·K·m$$

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

$$\Delta T=m·K(1+\alpha)$$

where K - cryoscopic constant (for water =1.86)

   α -  degree of dissociation

   m - molality [mol/kg]

Formic acid is binary electrolyte, that means:

$$\Delta T =m·K(1+\alpha)$$

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

$$\alpha=0.751/(400 · 1.86)-1=0.998$$

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

**Answer: 19.92 · 10⁴**