Chemistry 236 -- Quiz 10

Lab Day ___

November 7, 2007 — Freezing Point Depression

Pledge and signature:

Note: If you want your paper returned folded (*i.e.*, score concealed), please print your name on the back.

1. (9) A 10.00-g sample of a weak acid (M = 76.0 g/mol) in water is titrated to neutrality with 19.7 mL of 0.122 M NaOH. The freezing point of this mixture is found to be –0.504 °C. Calculate (a) the molality of the acid (from titration), (b) the fraction dissociated α, and (c) the equilibrium constant K_m. [k_f = 1.860 K kg mol^{-1}]

(a) 0.245 $m°$ [See Study Problem 15.]

(b) α = 0.107 [See CP eqns 11 & 12 and surrounding text; also SP 13.]

(c) K_m = 0.0031 $m°$

2. (5) A 1.500% solution of $CaCl_2$ (110.99 g/mol) in water (18.015 g/mol) has a freezing point of –0.661°C. Calculate (a) the predicted (simple theory) freezing point, (b) the practical osmotic coefficient φ, and (c) the activity a_A.

(a) –0.766°C (b) 0.863 (c) 0.9936

[See Study Problem 14.]

3. (2) (a) Suppose the freezing point given just above is uncertain by 0.005°C. Assuming that this is the only source of experimental uncertainty, calculate the resulting uncertainty in φ.
(b) Suppose the titration volume in (1) is uncertain by 0.3 mL. Again assuming that this is the only source of uncertainty, calculate the resulting uncertainty in the acid molality.

In both cases the relative error in the measured quantity is the relative error in the computed property. These relative errors are 0.00756 and 0.0152, giving

$\Delta\varphi$ = 0.0065 and Δm = 0.0037 $m°$