

**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, and (c) the equilibrium constant  $K_m$ . [ $k_f = 1.860$  K kg mol $^{-1}$ ]
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, and (c) the activity  $a_A$ .
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 .  
(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.