Chem 1020 Sample Challenge Questions for Exam 4 (Modules 11A, 11B, & 13) 5/02
You should study your drill quizzes, study your Handbook modules, and review your drill quizzes BEFORE working these problems. When working them you should do so under exam conditions, i.e. alone, using only a calculator and periodic table, and waiting until you have completely finished before checking your answers.

1. **CHALLENGE:** If water (a polar solvent), CCl_4 (a nonpolar solvent), and a A (a nonpolar solute with a molecular weight of 126) are placed in a container and shaken, the three initially mix together during the shaking but then separate into two layers. One is primarily water with a small amount of A dissolved and the other is primarily CCl_4 with most of the A dissolved ("like dissolves like"). Since the substance A can easily move from the water to the CCl_4 layers, the A in the two layers rapidly reaches an equilibrium which might be expressed as [A](aq) = [A](CCl_4) with an equilibrium constant of 8.0. If 10 grams of A are added to 200 mL of water and 100 mL of CCl_4, how many grams of the A will be in the water layer at equilibrium?

   A. 1.1 g B. 5.0 g C. 2.0 g D. 0.59 g E. 9.1 g

2. A certain weak electrolyte is found to dissociate into $M^+$and N^-. What is the % dissociation of the substance if 0.90 molal solution of the substance has a boiling point of 100.67°C? (K_f for water = 1.86°C/m and K_b for water = 0.51°C/m) **(11B-Challenge)**

   A. 46% B. 100% C. 0% D. 15% E. 41%

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3. **CHALLENGE:** Given that X reacts to produce Y according to the equation 1 X = 1 Y , how many moles of X would be present in a 10 liter container at equilibrium if 5 moles of both of the substances were placed in the container initially and the equilibrium constant for the reaction is 100?

   A. 0.99 B. 0.010 C. 5.1 D. 0.10 E. 0.50

4. **CHALLENGE:** When AB dissolves in water, some of the solute particles break into ions A^+ and B^-. What is the percent dissociation of a 0.426 m solution of AB if the freezing point of the solution is -0.943°C? (K_f for water = 1.86°C/m and K_b for water = 0.51°C/m)

   A. 19.0% B. 8.1% C. 100% D. 1.81% E. 6.3%

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C

$K = \frac{[A](CCl_4)}{[A](aq)} = 8.0$ | $K = 8.0 = \frac{\left[\frac{(10-x)/126}{100}\right]}{\left[\frac{x/126}{200}\right]} = \frac{(10-x)(200)}{x(100)}$

$[A] = \frac{\text{moles A}}{L} = \frac{g/MW}{L}$

let x = g in aq

$\therefore 10 - x$ = g in CCl_4

$8x = 20 - 2x$ $\quad 10x = 20$ $\quad \therefore \boxed{x = 2 = \text{g in aq}}$

2. A certain weak electrolyte is found to dissociate into M^+ and N^-. What is the % dissociation of the substance if 0.90 molal solution of the substance has a boiling point of 100.67°C? (K_f for water = 1.86°C/m and K_b for water = 0.51°C/m) **(11B-Challenge)**

A

A. 46% B. 100% C. 0% D. 15% E. 41%

	$MN \rightleftharpoons M^+ + N^-$		
i	0.90	0	0
Δ	$-x$	$+x$	$+x$
f	$0.90 - x$	x	x

particle conc

$m = (0.90 - x) + x + x$

$m = 0.90 + x$

$\Delta T_B = T_B - 100.0°C$

$= 0.67°C$

$\Delta T_B = K_B m$

$0.67 = 0.51\ °C/m\ (0.90 + x)$

$0.67 = 0.459 + 0.51x$

$0.211 = 0.51x$

$0.414 = x$

$\%\ \text{dissoc} = \frac{x}{0.90} \times 100\%$

$= \frac{0.414}{90} \times 100\%$

$= 46\%$

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D

	X	⇌	Y
i	5		5
Δ	-a		+a
f	5-a		5+a

$K = 100 = \frac{[Y]}{[X]}$

$100 = \frac{(5+a)/10}{(5-a)/10} = \frac{5+a}{5-a}$

$500 - 100a = 5 + a$

$495 = 101a$

$a = 4.90$

$\therefore$ moles X = 5 - a = 5. - 4.90 = **0.10**

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   A. 19.0% B. 8.1% C. 100% D. 1.81% E. 6.3%

A

$AB \rightleftharpoons A^+ + B^-$

0.426 - x x x

particle conc = m

$m = (0.426 - x) + x + x$

$m = 0.426 + x$

$\Delta T_{f.p} = K_f m$

$0.943 = 1.86(0.426 + x)$

$0.943 = 0.792 + 1.86x$

$1.86x = 0.151$

$x = 0.081$

$\%\ \text{dissoc.} = \frac{0.081}{0.426} \times 100\%$

$= 19\%$