CHEM 1050 Homework
Exam #4 Assignment-Solutions
Alan D. Earhart

9.2 a. solute=acetic acid, solvent=water b. solute=water, solvent=ethanol
c. solute=oxygen, solvent=nitrogen

9.5 a. ionic is more soluble in water b. nonpolar is more soluble in CCl_4
c. polar is more soluble in water d. nonpolar is more soluble in CCl_4

9.9 a. $KCl(aq) \rightarrow K^+(aq) + Cl^-(aq)$

b. $CaCl_2(aq) \rightarrow Ca^{2+}(aq) + 2Cl^-(aq)$

c. $K_3PO_4(aq) \rightarrow 3K^+(aq) + PO_4^{3-}(aq)$

d. $Fe(NO_3)_3(aq) \rightarrow Fe^{3+}(aq) + 3NO_3^-(aq)$

9.12 a. mainly ions b. mainly molecules c. some ions, mainly molecules

9.22 a. unknown, possibly saturated
b. saturated

9.24 You need to adjust the solute and solvent to 100 g of water to use the table.
a. saturated (50. g KCl will not dissolve in 100. g water)
b. saturated (200. g $NaNO_3$ will not dissolve in 100. g water)
c. saturated (320. g sugar will not dissolve in 100. g water)

9.27 a. The solubility of sugar increases as the temperature increases.
b. Gases tend to be less soluble as the temperature increases.
c. Same as b.

9.31 5% (m/m) has 5 grams of solute per 100 g of solution while 5% (m/v) has 5 grams of solute per 100 mL of solution.

9.34 a. $\left(\frac{75\ g}{325\ g}\right)(100\%) = 23\%\ (m/m)$

b. $\left(\frac{2.0\ g}{22.0\ g}\right)(100\%) = 9.1\%\ (m/m)$ (remember, mass of **solution**)

c. $\left(\frac{48.5\ g}{250.0\ g}\right)(100\%) = 19.4\%\ (m/m)$

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9.37 a. $\left(\frac{5.0\text{ g}}{100\text{ g}}\right)\left(\frac{50.\text{ g}}{1}\right) = 25\text{ g}$

b. $\left(\frac{4.0\text{ g}}{100\text{ mL}}\right)\left(\frac{1250\text{ mL}}{1}\right) = 50.\text{ g}$

9.41 a. $\left(\frac{20.\text{ g}}{100\text{ mL}}\right)\left(\frac{100.\text{ mL}}{1}\right) = 20.\text{ g}$

b. $\left(\frac{20.\text{ g}}{100\text{ mL}}\right)\left(\frac{100.\text{ mL}}{1\text{ hr}}\right)\left(\frac{12\text{ hr}}{1}\right) = 2.4\times10^{2}\text{ g}$

9.47 a. $\left(\frac{2.00\text{ mol glucose}}{4.00\text{ L solution}}\right) = 0.500\text{ M glucose}$

b. $\left(\frac{4.00\text{ g KOH}}{1}\right)\left(\frac{1\text{ mol}}{56.1\text{ g}}\right)\left(\frac{1}{2.00\text{ L solution}}\right) = 0.0357\text{ M KOH}$

c. $\left(\frac{5.85\text{ g NaCl}}{1}\right)\left(\frac{1\text{ mol}}{58.5\text{ g}}\right)\left(\frac{1\text{ ml}}{0.001\text{ L}}\right)\left(\frac{1}{400.\text{ mL solution}}\right) = 0.250\text{ M NaCl}$

9.55 a. $(6.0\text{ M})(2.0\text{ L}) = (C_2)(6.0\text{ L})$ $\quad C_2 = \frac{(6.0\text{ M})(2.0\text{ L})}{(6.0\text{ L})} = 2.0\text{ M}$

b. $(12\text{ M})(0.50\text{ L}) = (C_2)(3.0\text{ L})$ $\quad C_2 = \frac{(12\text{ M})(0.50\text{ L})}{(3.0\text{ L})} = 2.0\text{ M}$

c. $(25\text{ \% m/v})(10.0\text{ mL}) = (C_2)(100.0\text{ mL})$

$$C_2 = \frac{(25\text{ \% m/v})(10.0\text{ mL})}{(100.0\text{ mL})} = 2.5\text{ \% (m/v)}$$

d. $(15\text{ \% m/v})(50.0\text{ mL}) = (C_2)(250\text{ mL})$

$$C_2 = \frac{(15\text{ \% m/v})(50.0\text{ mL})}{(250\text{ mL})} = 3.0\text{ \% (m/v)}$$

9.66 a. A b. A c. B

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10.1 a. acid b. acid c. acid d. base e. both

10.8 a. $CO_3^{2-}(aq) + H_2O(\ell) \rightleftharpoons HCO_3^-(aq) + OH^-(aq)$
base acid acid base

b. $H_2SO_4(aq) + H_2O(\ell) \rightarrow HSO_4^-(aq) + H_3O^+(aq)$
acid base base acid

10.9 a. F^- b. OH^- c. HCO_3^- d. SO_4^{2-}

10.12 a. HSO_4^- b. HCN c. H_2O d. $HClO_2$

10.13 a. $H_2CO_3(aq) + H_2O(\ell) \rightleftharpoons HCO_3^-(aq) + H_3O^+(aq)$
acid base

conjugate base of $H_2CO_3 = HCO_3^-$
conjugate acid of $H_2O = H_3O^+$

b. $NH_4^+(aq) + H_2O(\ell) \rightleftharpoons NH_3(aq) + H_3O^+(aq)$
acid base

conjugate base of $NH_4^+ = NH_3$
conjugate acid of $H_2O = H_3O^+$

c. $HCN(aq) + NO_2^-(aq) \rightleftharpoons CN^-(aq) + HNO_2(aq)$
acid base

conjugate base of $HCN = CN^-$
conjugate acid of $NO_2^- = HNO_2$

10.18 a. HCO_3^- b. H_2O c. H_2CO_3

10.25 In pure water, any water molecules that dissociate will produce **one** hydronium and **one** hydroxide ion.

10.26 It's the ion-product of hydronium and hydroxide ions concentrations in the solution. At 25 °C it's 1.0×10^{-14}.

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10.30 a. basic, $\left[H_3O^{1+}\right] < 1.0 \times 10^{-7}$ M

b. acidic, $\left[H_3O^{1+}\right] > 1.0 \times 10^{-7}$ M

c. acidic, $\left[H_3O^{1+}\right] = 2.0 \times 10^{-3}$ M , $\left[H_3O^{1+}\right] > 1.0 \times 10^{-7}$ M

d. basic, $\left[H_3O^{1+}\right] = 2.2 \times 10^{-13}$ M , $\left[H_3O^{1+}\right] < 1.0 \times 10^{-7}$ M

10.32 Plug into $K_w = [H_3O^+][OH^-]$ and solve for $[H_3O^+]$

a. $\left[H_3O^+\right] = 1.0 \times 10^{-8}$ M b. $\left[H_3O^+\right] = 2.0 \times 10^{-4}$ M

c. $\left[H_3O^+\right] = 5.0 \times 10^{-7}$ M d. $\left[H_3O^+\right] = 4.8 \times 10^{-12}$ M

10.34 Plug into $K_w = [H_3O^+][OH^-]$ and solve for $[OH^-]$

a. $\left[OH^-\right] = 1.0 \times 10^{-2}$ M b. $\left[OH^-\right] = 1.7 \times 10^{-11}$ M

c. $\left[OH^-\right] = 1.0 \times 10^{-5}$ M d. $\left[OH^-\right] = 1.9 \times 10^{-13}$ M

10.39 a. pH=4.0 b. 8.5 c. pH=9.0 d. pH=3.4
e. pH=7.2 f. pH=10.9

10.54 a. No. It's just an acid.
b. No. It's just a neutral salt.
c. Yes. Acetic acid ($HC_2H_3O_2$, acid) and sodium acetate ($C_2H_3O_2^-$, acetate is the conjugate base of acetic acid)
d. No. Both are strong and you need a **weak** acid and its conjugate base or a **weak** base and it's conjugate acid.

10.55 a. (3) A buffer solution maintains the pH. So if a small amount of an acidic or basic solution is added to the buffer, the pH is not expected to change much.
b. (1, 2) An acid added to this buffer solution will convert the base, F^-, to its conjugate acid, HF. A base added to this buffer solution will convert the acid, HF, to its conjugate base, F^{1-}. You need to have **both** present because the product is the conjugate of either the acid or the base.
c. The best answer for the given choices is (3). However, HF is also present.