Key

Chemistry in Context
In-Class Worksheet for Chapter 5
Spring 2009

1. Things that dissolve in water are soluble. Based on your experience, classify the following as very soluble, partially soluble, or insoluble.

   a. table salt very soluble
   b. vegetable oil insoluble
   c. aspirin partially soluble

2. a. A student add 78 mg of calcium to a liter of deionized water. What is the concentration of the solution in ppm?

   ☆ ppm ≈ mg/L ≈ 78 ppm

   (or $ppm = \frac{g\ solute}{10^6\ g\ solution} = \frac{0.078\ g}{(1000\ g + 0.078\ g) \times 10^6} = 77.99\ ppm$)

   b. 56 µg of Fe were detected in 7 L of water. What is the concentration of Fe in ppb and ppm?

   $ppb \approx \mu g/L\ water = \frac{56\ \mu g}{7\ L} = 8\ \mu g/L = 8\ ppb$

   8 ppb = 8000 ppm
   (multiply by 1000)

3. a. Describe how you would make 250 mL of a 0.1 M KCl solution. = 0.25 L ← molar mass = 74.55 g/mol

   $0.1\ \frac{mol}{L} \times 0.25\ L = 0.025\ mol \times 74.55\ \frac{g}{mol}$
   $= 1.864\ g$

   Add 1.864 g KCl to a 250 mL volumetric flask.
   Fill to the mark with water.

   b. For a 3 M and a 0.3 M LiF solution, how many moles are of solute are present in 500 mL? ← 0.5 L

   $0.3\ \frac{mol}{L} \times 0.5\ L = 0.15\ mol$

   $3\ \frac{mol}{L} \times 0.5\ L = 1.5\ mol$

4. A ppb is the same as a µg per liter of solution

   Molarity is defined as moles per liter of solution

O 3.5
H 2.1
C 2.5
Cl 3.0
Li 1.0

5. Here are four sets of atoms: O and H, O and C, H and Cl, Li and Cl
   a. What is the difference in electronegativity between the atoms in each set?

O-H : 1.4 H-Cl : 0.9
O-C : 0.4 Li-Cl : 2.0

   b. Arrange the bonds in order of increasing polarity.

O-C , H-Cl , O-H , Li-Cl
polar covalent Ionic

   c. Label each pair as forming an ionic, polar covalent, or nonpolar covalent bond.

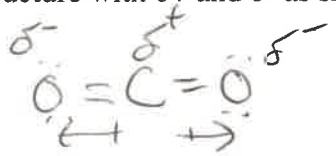
   d. For those you labeled as polar covalent, which atom in each pair attracts the electrons more strongly? (circled)

O-C H-Cl O-H

6. The H_2O molecule contains polar bonds and is a polar molecule. What about CO_2?
   a. Are the covalent bonds in CO_2 polar or nonpolar? Hint: Use the electronegativity values given in Table 5.3.

Yes C-O : 0.4 difference

   b. Draw a Lewis structure for CO_2. Be sure to use the right bond angles. Label the structure with δ+ and δ- as shown in Figure 5.9 for H_2O.



   c. Explain why H_2O is a polar molecule and CO_2 is not.

because CO_2 is linear, the dipoles cancel out
this doesn't happen in water

7. Explain why the boiling point of H_2O is so much greater than the boiling point of CH_4. Do you expect NH_3 is more like H_2O or CH_4? Why?

H_2O has a high boiling point because it can hydrogen bond. CH_4 can't hydrogen bond. It takes a lot of energy to break the intermolecular bonds. NH_3 can hydrogen bond so it will be like H_2O.

Key

TWO SIDES!!!

Chemistry in Context
In-Class Worksheet for Chapter 6
Spring 2009

Important Equations/Information

$pH = -\log[H^+]$ $\quad [H^+] = 10^{-pH}$

$pOH = -\log[OH^-]$ $\quad [OH^-] = 10^{-pOH}$

$[H^+][OH^-] = 1 \times 10^{-14}$ $\quad pH + pOH = 14$

$[H^+] = [OH^-]$ a neutral solution (pH = 7)
$[H^+] > [OH^-]$ an acidic solution (pH < 7)
$[H^+] < [OH^-]$ a basic solution (pH > 7)

1. Show how the following acids will dissociate when added to water.
   a. H_2SO_4 $H_2SO_4 \rightarrow 2H^+ + SO_4^{2-}$
   b. HNO_3 $HNO_3 \rightarrow H^+ + NO_3^-$
   c. $HClO_4$ $HClO_4 \rightarrow H^+ + ClO_4^-$

2. Show how the following bases will dissociate when added to water.
   a. KOH $KOH \rightarrow K^+ + OH^-$
   b. $Mg(OH)_2$ $Mg(OH)_2 \rightarrow Mg^{2+} + 2OH^-$

3. Label the acid, base, and salt (ionic compound) in the following neutralization reactions.
   a. $Sr(OH)_2\,(aq) + 2HClO_4\,(aq) \rightarrow Sr(ClO_4)_2\,(aq) + H_2O\,(l)$
      base acid salt
   b. $NaHCO_3\,(aq) + CH_3COOH\,(aq) \rightarrow CH_3COONa\,(aq) + CO_2\,(g) + H_2O\,(l)$
      base acid salt

4. Write out the products (and balance!) for the following neutralization reactions and then label the acid, base, and salt (ionic compound) for each reaction.
   a. $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$
      acid base salt
   b. $HBr + KOH \rightarrow H_2O + KBr$
      acid base salt
   c. Potassium hydroxide neutralized by hydrochloric acid
      $KOH + HCl \rightarrow H_2O + KCl$
      base acid salt

TWO SIDES!!!

5. Write the following reactions as molecular, ionic, and net ionic reactions. Label spectator ions

a. $2HCl_{(aq)} + Ca(OH)_{2(aq)} \rightarrow 2H_2O_{(l)} + CaCl_{2(aq)}$

$2H^+ + 2Cl^- + Ca^{2+} + 2OH^- \rightarrow 2H_2O + Ca^{2+} + 2Cl^-$

spectator ions

$2H^+ + 2OH^- \rightarrow 2H_2O$ or $H^+ + OH^- \rightarrow H_2O$

b. $Ba(OH)_2 + H_2SO_4$ (note: $BaSO_4$ is insoluble – forms a solid!)

$Ba(OH)_{2(aq)} + H_2SO_{4(aq)} \rightarrow BaSO_{4(s)} + 2H_2O$

- this is ionic + net ionic
- no spectator ions

$Ba^{2+} + 2OH^- + 2H^+ + SO_4^{2-} \rightarrow BaSO_{4(s)} + 2H_2O$

6. Label the following solutions as acidic, basic, or neutral. Find the pH where possible (i.e., parts c and d).

a. HCl acidic

b. NaBr neutral

c. $[H^+] = 1 \times 10^{-9}$ M basic $pH = 9 = -\log(1 \times 10^{-9})$

d. $[OH^-] = 1 \times 10^{-4}$ M basic $pOH = 4 = -\log(1 \times 10^{-4})$ $pH = 14 - 4 = 10$

7. Find the $[OH^-]$ in solutions with the following $[H^+]$

a. $[H^+] = 5 \times 10^{-8}$ M $[OH^-] = 1 \times 10^{-14} / 5 \times 10^{-8} = 2 \times 10^{-7}$ M

b. $[H^+] = 3 \times 10^{-4}$ M $[OH^-] = 1 \times 10^{-14} / 3 \times 10^{-4} = 3.3 \times 10^{-11}$ M

8. Find the $[H^+]$ in solutions with the following $[OH^-]$

a. $[OH^-] = 1 \times 10^{-7}$ M $[H^+] = 1 \times 10^{-14} / 1 \times 10^{-7} = 1 \times 10^{-7}$ M

b. $[OH^-] = 9 \times 10^{-12}$ M $[H^+] = 1 \times 10^{-14} / 9 \times 10^{-12} = 1.1 \times 10^{-3}$ M

9. What is the pH and pOH for the four solutions in Questions 7 and 8? Label the solutions as acidic, basic or neutral.

7a. pH = 7.3, pOH = 6.7 basic

8a pH = 7, pOH = 7 neutral

b. pH = 3.5, pOH = 10.5 acidic 0.025

pH = 3.0, pOH = 11.0 acidic