Chemistry 20 Unit 2a: Solutions (Chapter 16)

I. Properties

A. Definitions

1. *Mixtures:*

Solution/ *Homogenous mixture*:

Solvent:
Solute:
Alloy:

Mechanical mixture/ Heterogenous mixture:

2. *Suspension*:
3. *Colloid*:
4. *Miscible*:
5. *Immiscible*:
6. *Electrolyte:*

B. *Solubility*: ***amount***

ie) NaCl: 31.6 g/100 mL dissolves at O C (in water)
36.2 g/100 mL dissolves at 25 C
39.2 g/100 mL dissolves at 100 C

Rate Depends on:

1. ________: shaking brings solvent into contact with solute. (Does not affect amount that dissolves)
2. __________: the larger the _______ (powder vs solid) the faster the dissolving.
3. __________: the higher the __________ the faster the dissolving

Amount Depends on:

1. __________: the higher the temperature the greater the solubility for most substances.
NOTE: Most _______ decrease in solubility with higher temperature.
Ie) At 100 C oxygen is insoluble. Water, pop left overnight will not have any gases.
2. __________: the greater the pressure the greater the solubility.
Ie) $CO_{2(g)}$ dissolves in carbonated beverages when under pressure
NOTE:

_____________: separates compounds in solution depending on:

a) size of molecules - smallest particles on top
b) solubility (Lab) - most soluble on top(picture)

C. Saturation

1. __________: a solution that contains the ________ amount of solute for a given amount of solvent at a constant temperature.
2. ___________: a solution that does not contain the ________ amount of solute of a given solvent at a constant temperature.
3. ____________: a solution that contains _____ solute than it can hold at a constant temperature. HOW? By ______________

D. Dissolving process

1. Molecular substances with oxygen in them.
   $C_6H_{12}O_{6(s)}$ -->
   How?

2. Ionic substances
   $NaCl_{(s)}$ -->
   How?

II. Molar Concentration

A. Definition-

* Symbol is ___ or _____
* Unit is _______ (moles of solute/Litres of solution)
* Formula ____________________________

B. Example of concentration conversions

1. Calculating Concentration from moles and Volume
   $C = n/V$
   Eg)

2. Calculating Concentration from mass and Volume
   Step 1. $n = m/M$
   Step 2. $C = n/V$
   Eg)

3. Other forms of expressing concentration
   a) ppm =
   b) % by mass =
   c) % by volume =

4. Steps to prepare a solution

   STEP 1:

   STEP 2:

   STEP 3:

   STEP 4:

   STEP 5:

EXAMPLE:

How do I prepare a 100 mL 0.400 mol/L solution of magnesium sulphate solution in the lab?

III. Dilutions

A. Definitions

1. *Dilution*:

2. *Concentrated*:

3. *Dilute*:

B. Mathematical expression: ____________________ $_1$ = initial & $_2$ = final

NOTE: $V_2 = V_1 + V_{water}$

Helpful Hints:

C. Example of dilution problems

1)***How do you prepare 100 mL 0.40M magnesium sulphate solution from 100 mL of 2.0 M magnesium sulphate solution***.

Step 1:

Step 2:

Step 3.

Step 4.

2) ***If a student begins with 1000 mL of 1.00 mol/L solution and dilutes it to 0.100 mol/L, what volume of water did the student add to dilute the solution?***

3) If 100 mL of 1.0 moL/L solution is added to 900 mL of 0.10 mol/L solution what is the resulting concentration?

4) Challenge: If 100 mL of water is added to a 1.00 mol/L solution and the resulting solution is 0.250 mol/L what was the volume of the original solution used.

D. Pipetting Techniques

1. Definition: technique used to measure out a ____________ of liquid (25 mL or less) to _______________ (0.1 mL to 0.01 mL).
2. Types of pipets (Draw two diagrams)
   a. <u>*graduated pipet*</u>:

   b. <u>*volumetric pipet*</u>:

3. Technique

Step 1: Rinse with ______ water to remove any residue or liquid
Step 2: Rinse with the ______. **Why**? ____________________
Step 3: Hold the pipet near the top with one (left) hand. Leave your index finger free. **Why**? _______________________
Step 4. Place the pipet into the sample, resting the tip on the __________ of the container.
Step 5: Squeeze the _____ with your other (right) hand and place the ______ firmly and squarely on the end of the pipet.
Step 6: Release the bulb until the liquid has risen ______ the desired calibration line. (May have to do in stages.)
Step 7: Remove the bulb and quickly put your _____ finger of your left hand over the top. (Some have dispensing bulbs)
Step 8. Remove from solution and wipe ___________ **Why**?
Step 9. While touching the tip of the pipet to the inside of a waste beaker, gently_____ your index finger off to allow the liquid level to drop. Stop by placing your index finger on top when the ________ reaches the ***calibration*** line. (at eye level)
Step 10. Touch the tip of the pipet to the inside wall of the receiving container and remove your finger to allow the liquid to flow freely. A small volume is expected to remain in the ____.

IV. Biomagnification & other risks (OPTIONAL)

V. Dissociation

A. Solubility & Precipitation reactions

1. Look for the ions in your compound in row I of your solubility table

a. If the other ion is in row II it is soluble and is ________ in the presence of water. (dissolves) (high solubility)

b. If the other ion is in row III it is not soluble and will form a ___________. (solid) (low solubility)

c. If it is not found on the table, assume that it also forms a precipitate.

2. Other terminology

- *Hydronium ion*:
- *Solvation*:
- *Hydration*:

B. *Dissociation*:

ie) Water dissociates into its ions.

1. More Definitions

- *Electrolyte*:

- *Non-electrolyte*:

* *Dissociation equations*:

- *Ionization equations:*

2. CAUTIONS: Write a Balanced equation. Remember all ions are aqueous. Show correct ionic charges.

3. EXAMPLES

a) Ionic compounds

$KCl_{(s)}$

$Cu(NO_3)_{2(s)}$

$Al_2(SO_4)_{3(s)}$

b) Molecular gases

$HI_{(g)}$

c) Bases

$NH_{3(g)} + H_2O_{(g)}$

d) Acids

$HCl_{(aq)}$

or $HCl_{(aq)} + H_2O_{(g)}$

NOTE: most hydrogen compounds dissolve but don=t completely dissociate except six listed below: These are all strong acids.

$HClO_{4(aq)}$, $HI_{(aq)}$, $HBr_{(aq)}$, $HCl_{(aq)}$, $HNO_{3(aq)}$, $N_2SO_{4(aq)}$

C. *Equilibrium*:

There is a *dynamic* (happening all the time) equilibrium that exists in a saturated solution since the rate of ________ is equal to the rate of ______________. You observe no change.

Ie)

VI. Net Ionic equations

Soluble compounds such as lead (II) nitrate dissociate upon dissolving in water. When this compounds reacts with another substance, some of the ions react while some ions do not react. Chemists write net ionic equations to show only the ions and compounds that do react in the reaction.

A. Definitions

1) *Non ionic equation*

2) *Total ionic equation*

3) *Net ionic equation*

B. Steps involved

1) Write out a nonionic equation
2) Change all aqueous compounds into their ions and write out the total ionic equation.
3) Cross off any ions that appear as reactants and products. Make sure that they appear as ions on both sides of the equation and that their coefficients are the same. Write out your new net ionic compound.

VII. Solution Stoichiometry

STEP 1:

STEP 2:

STEP 3:

STEP 4:

STEP 5:

EXAMPLES

1) If 200 mL of sodium hydroxide reacts with 100 mL of 0.150 mol/L hydrochloric acid, what is the concentration of the sodium hydroxide?

2) In the question above what is the concentration of the aqueous solution produced?

3) What is the concentration of ammonium ions if there is 100 g of ammonium sulfate solid is placed in 100 mL of water?

4) Lead nitrate solution reacts with sodium hydroxide. Using a net ionic equation, how many grams of solid forms if 6.02×10^{23} particles of hydroxide ion are present.

Chemistry 20 Acid & Bases Notes

I. Definitions

Acid:

#1) Arrhenius's definition: substance that ionizes to form ______________ ions.
Modified Arrhenius definition: substance that ionizes for form _________ ions.

#2) Operational definition: Turns____ litmus paper ______ & has a pH __________

Base(Alkaline):

#1) Arrhenius's definition: substance that dissociates to form ___________ ions.

#2) Operational definition: Turns ____ litmus paper ______ & has a pH _________

Neutral:

#1) Arrhenius's definition:

#2) Operational definition:

Acid solution: A solution where the _________ concentration is greater than the __________ concentration

Basic solution: A solution where the _________ concentration is greater than the __________ concentration

Indicator: a chemical substance that changes _________ when an acid or base is added. (Look at pg. 10 in your data books)

pH: _______of ____________ (hydronium ion/proton) measured as a negative ____________ of the ____________ concentration.(   )

pOH: parts of _______________ measured as a negative ____________ of the ___________ concentration (   ).

pH meter:

dynamic equalibrium: a balance between forward and reverse process so as to achieve a steady state.

self-ionization of water: when two water molecules react & break up into ions(dissociation)

#1) H_2O <--->

#2) $H_2O + H_2O$ <--->

NOTE: Fewer than two water molecules in one billion ionize at STP conditions.

NOTE: Only 7 acids completely ionize. See pg 8 & 9 in your databook.

Neutralization reaction:

WHMIS symbol:

SAFETY practices:

1. ***Report all ____________ to a supervisor***
2. ***Wash off acids and bases with __________________***
3. ***Neutralize an acid with _______________ and a base with _________________***
4. Always add ________________ to ________________________

II. Properties of acids and bases

	ACIDS	BASES
Feel		
Touch		
Electrolytic in solution (Y/N)		
State at room temperature		
Neutralization with:		
Concentration of [H_3O^+] ions		
Concentration of [OH^-] ions		
Common examples		
Reacts with __ to produce __		
Turns bromothymol blue __		
Turns phenolphthalein ___		
Turns litmus paper _____		

III. Formula's

1) Ion-product constant for water

* The product of the concentrations of _________ ions and ________ ions is ______ or K_w

* Formula:

Calculation example:

1) What is the concentration of the hydroxide ions in a 0.15 mol/L solution of hydrochloric acid ?

Step 1: Write out a balanced dissociation or ionization equation

Step 2: Determine know concentration

Step 3: Multiply by mole ratio to determine the concentration of hydronium or hydroxide ions.

Step 4: Use the ion concentrations determined in step 3 and plug these values into the ion product formula. Kw

[H3O+] [OH-]

2) Calculate the hydrogen concentration in a 0.25 mol/L solution of barium hydroxide.

3) Determine the hydronium and hydroxide ion concentrations in 500 mL of water that has 2.6 g of sodium hydroxide dissolved into it.

2) Converting concentration to pH or pOH

* pH calculations use the negative log
* Formulas: $pH = -(\log [H_3O])$
  $pOH = -(\log [OH^-])$
* Significant digits: Only the number of digits following the decimal in the pH value are significant and used to determine the ion concentrations. The digits before the decimal are NOT significant and are used to determine the exponent.

EXAMPLES

1) What is the pH of a 4.7×10^{-11} mol/L concentration of hydronium ions?
   * Simple Calculators: pH of 4.7×10^{-11} mol/L ----> 4.7E11-log -
   * Programable calculators: ----> -(log 4.7E-11)

2) What is the pOH of ________________ concentration of hydroxide ions?

3) Converting pH or pOH into ion concentrations

* Formulas: $[H_3O] = \text{antilog}(-pH) = 10^{-pH}$
  $[OH-] = \text{antilog}(-pOH) = 10^{-pOH}$

EXAMPLES

1) Calculate the hydrogen ion concentration if the pH is 10.33. (How many sig digs? ____)
   * Simple calculators: 10.33-Shift log
   * Programable calculators: 10^x -10.33

2) Calculate the hydroxide ion concentration if the pOH is _______

4) Relationship between pH and pOH

Formula: pH + pOH = 14.00 (at STP)

EXAMPLES

1) What is the pOH in the example 1) above?
2) What is the pH in the example 2) above?

SUMMARY:

pOH

pH

$[H_3O]$

[OH]

1.

2.

3.

4.

ACID – BASE STOICIOMETRY

1. Balanced reaction with _______________
2. Change the given to moles:
   You may first have to find the _____________ using one of the four pH formulas
3. Multiply by the ______________
4. Convert into _____________

◆ EXAMPLE: A 200 mL solution of hydrochloric acid (HClaq) with a pH of 1.45 neutralizes 300 mL of barium hydroxide ($Ba(OH)_{2\,(aq)}$). Determine the concentration of salt formed.

1.

2. The [H3O+] = [HCl]

3

4.

TITRATION:

Purpose: : a method used to determine the ______________ of a sample (Acid or Base)

Setup: This will demonstrated in class or a lab done on it only if we have time. It is retaught in Chemistry 30.

1. _______ the buret and flask; _______ them with solution
2. A __________ solution (known concentration) is added to the ________ and becomes the _________
3. A _________ of sample is measured and placed in a _________. Several drops of an ideal __________ are added.
4. The titrant is slowly added to the flask until a _______ change occurs. The ________ of titrant is measured.
5. The _________________ of sample is calculated using ________________.

Graph: Sketch the graph for a titration between a strong acid and strong base. The equivalency point is the volume of titrant added to cause a color change or end point. (This is just an introduction.)