# AP Chemistry



# Summer Assignment

- Read the letter on the next page.
- Complete the worksheets in this packet.
- THEY ARE DUE ON THE FIRST DAY OF SCHOOL!
- Buy an AP Chemistry Test Prep book (like from the Princeton Review) and start looking through it.



I'm glad that after taking one year of Chemistry, you have decided it's a subject that you'd like to learn more about. The class will be challenging, but the biggest factor in determining your success will be the amount of effort you put into the class. If you do the reading assignments and homework, you can definitely be successful in the class and ultimately on the AP exam.

We have a lot of material to cover in this class, so we will start off by making sure that we all have the basics down. Over the summer, you are responsible for doing the worksheets in this review packet. They are due on the first day of school and will be your first grade! You will have a test on this material at the end of the first week of school. The material in this packet should be mostly review from your first year of Chemistry. You will find that much of the AP Chemistry curriculum consists of the same topics that you covered last year, but in more depth.

If you get stuck on a problem or a certain type of problem, try moving on to the next part. These problems cover a wide variety of topics, so you might be able to do the next part and then go back to the previous ones later. I am also including a copy of your new periodic table. This is the version that is provided on the AP exam, so you should start getting used to it. You might notice that there is no list of polyatomic ions on the back. That is because you are expected to know them!

I would also recommend that you buy an AP Chemistry test prep book. There are several available, and they are all good. (Last year's class recommended the <u>Princeton Review</u> or <u>Barron's</u>.) Read the introduction, and take the diagnostic test in it. This will give you an idea of where you are starting. You could also read and highlight the chapters on the basics and stoichiometry. These books are valuable because they provide many sample questions to get you read for the exam.

I hope that you will work on this homework assignment throughout the summer, and not put it all off until the last minute!

Sadjia Droueche AP Chemistry



	Nan	ne:		
AP Chemistry Worksheet 1: Significant Figures and Dimensional Analysis				
For eac	ch problem below, write the equation and show your work. Always use uni	ts and box your final answer.		
1.	Round each of the following numbers to four significant figures, and expre	ess the result in scientific notation:		
a.	300.235800			
b.	456,500			
C.	0.006543210			
d.	0.000957830			
e.	- 0.035000			
2. figures: a.	Carry out the following operations, and express the answers with the app : 1.24056 + 75.80	propriate number of significant		
b.	23/67 - 75			
C.	890,000 x 112.3			
d.	78,132 / 2.50			
3. metric a a.	Perform the following conversions: (You need to go online to look up son and English units.) 8.60 mi to m	ne conversion factors between		
b.	3.00 days to s			
C.	\$1.55/gal to dollars per liter			
d.	75.00 mi/hr to m/s			
e.	55.35 ft <sup>3</sup> to cm <sup>3</sup>			

4. The density of pure silver is 10.5 g/cm<sup>3</sup> at 20°C. If 5.25 g of pure silver pellets are added to a graduated cylinder containing 11.2 mL of water, to what volume level will the water in the cylinder rise?

5. The density of air at ordinary atmospheric pressure and  $25^{\circ}$ C is 1.19 g/L. What is the mass, in kilograms, of the air in a room that measures  $12.5 \times 15.5 \times 8.0$  ft?

#### AP Chemistry Worksheet 2: Structure of the Atom and the Periodic Table

For each problem below, write the equation and show your work. Always use units and box in your final answer.

1. What were the main points of Dalton's Atomic Theory? Which of these points are still accepted today? Which ones do we no longer accept, and why?

2. Summarize the evidence used by J.J. Thomson to argue that cathode rays consist of negatively charged particles.

3. Let's pretend you are holding two atoms of carbon that are isotopes. Describe what the two atoms have in common and what they have different.

Symbol	<sup>39</sup> 19 <b>K</b>				
Protons		25			82
Neutrons		30	64		
Electrons			48	56	
Mass #				137	207

4. Fill in the gaps in the following table, assuming each column represents a neutral atom:

5. Write the correct symbol, with both superscripts and subscripts, for each of the following :

- (a) the isotope of sodium with mass 23
- (b) the atom of vanadium that contains 28 neutrons
- (c) the isotope of chlorine with mass 37
- (d) an atom of magnesium that has an equal number of protons and neutrons

<sup>6.</sup> Give the name and the common charge for elements 7. Describe where each type of element found in each of these groups of the Periodic Table: is found on the Periodic Table.

- (a) Group 1
- (b) Group 2
- (c) Group 17
- (d) Group 18
- (e) Actinides

- (a) Metals
- (b) Non-metals
- (c) Transition metals
- (d) Lanthanides

#### AP Chemistry Worksheet 3: Naming Inorganic Compounds

For each problem below, write the equation and show your work. Always use units and box in your final answer.

- 1. Give the name for each of the following ionic compounds:
- a. AIF<sub>3</sub>
- b. Fe(OH)<sub>2</sub>
- c. Cu(NO<sub>3</sub>)<sub>2</sub>
- d. Ba(ClO<sub>4</sub>)<sub>2</sub>
- e. Li<sub>3</sub>PO<sub>4</sub>
- f. Hg<sub>2</sub>S
- g.  $Ca(C_2H_3O_2)_2$
- h.  $Cr_2(CO_3)_3$
- i. K<sub>2</sub>CrO<sub>4</sub>
- j. (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>
- 2. Write the chemical formula for each of the following compounds:
- a. copper (I) oxide
- b. potassium peroxide
- c. aluminum hydroxide
- d. zinc nitrate
- e. mercury (I) bromide
- f. iron (III) carbonate
- g. sodium hypobromite
- 3. Give the name or chemical formula, as appropriate, for each of the following acids:
- a. HBrO<sub>3</sub>
- b. HBr
- c.  $H_3PO_4$
- d. hypochlorous acid
- e. iodic acid
- f. sulfurous acid
- 4. Give the name or chemical formula, as appropriate, for each of the following molecular substances:
- a. SF<sub>6</sub>
- b. IF<sub>5</sub>
- c. XeO<sub>3</sub>
- d. dinitrogen tetroxide
- e. hydrogen cyanide
- f. tetraphosphorous hexasulfide
- 5. Write the balanced chemical equation for each reaction given below.

- a. Zinc carbonate can be heated to form zinc oxide and carbon dioxide
- b. On treatment with hydrofluoric acid, silicon dioxide forms silicon tetrafluoride and water.
- c. Sulfur dioxide reacts with water to form sulfurous acid.
- d. Liquid butane fuel  $(C_4H_{10})$  burns in the presence of oxygen gas.
- e. Perchloric acid reacts with cadmium to form cadmium perchlorate and a gas.

f. A solution of sodium bromide reactions with a solution of vanadium (III) nitrate to form a brightly colored precipitate.

#### AP Chemistry Worksheet 4: Atomic and Molecular Masses

For each problem below, write the equation and show your work. Always use units and box in your final answer.

1. What isotope is used as the standard in establishing the atomic mass scale?

2. The atomic weight of magnesium is reported as 24.3, yet no atom of magnesium has the mass of 24.3 amu. Explain.

3. Only two isotopes of copper occur naturally, Cu-63 (abundance 69.09 percent) and Cu-65 (abundance 30.91 percent). Calculate the average atomic mass of copper.

- 4. Determine the molar mass of each of the following compounds:
- a. N<sub>2</sub>O<sub>5</sub>
- b. FeCO<sub>3</sub>
- c. Ca(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>
- d. (NH<sub>4</sub>)<sub>3</sub>PO<sub>4</sub>
- e. sodium nitrate
- f. copper (II) sulfate
- g. disilicon hexabromide
- 5. Calculate the percentage by mass of oxygen in the following compounds:
- a. NO<sub>2</sub>
- b. CH<sub>3</sub>COOCH<sub>3</sub>
- c. Cr(NO<sub>3</sub>)<sub>3</sub>
- d. (NH<sub>4</sub>) <sub>2</sub>CO<sub>3</sub>

This page intentionally left blank. You can draw a pretty chemistry picture below! ⓒ

#### AP Chemistry Worksheet 5: Balancing Equations & Patterns of Reactivity

For each problem below, write the equation and show your work. Always use units and box in your final answer.

1. Balance the following equations:

a. 
$$CO(g) + O_2(g) --> CO_2(g)$$

b. 
$$N_2O_5(g) + H_2O(I) --> HNO_3(aq)$$

c. 
$$PCI_5(I)$$
 +  $H_2O(I)$  -->  $H_3PO_4(aq)$  +  $HCI(aq)$ 

d. 
$$CH_4(g) + Br_2(g) --> CBr_4(I) + HBr(g)$$

e. 
$$C_5H_{10}O_2(I)$$
 +  $O_2(g)$  -->  $CO_2(g)$  +  $H_2O(I)$ 

f.  $Cr(OH)_{3}(s) + HCIO_{4}(aq) --> Cr(CIO_{4})_{3}(aq) + H_{2}O(I)$ 

2. Write balanced chemical equations to correspond to each of the following descriptions:

a. Solid calcium carbide,  $CaC_2$ , reacts with water to form an aqueous solution of calcium hydroxide and acetylene gas,  $C_2H_2$ .

b. When solid potassium chlorate is heated, it decomposes to form solid potassium chloride and oxygen gas.

c. Solid zinc metal reacts with sulfuric acid to form hydrogen gas and an aqueous solution of zinc sulfate.

d. When liquid phosphorous trichloride is added to water, it reacts to form a solution of phosphorous acid and hydrochloric acid.

e. When hydrogen sulfide gas is passes over solid hot iron (III) hydroxide, the reaction produces solid iron (III) sulfide and gaseous water.

3. a. What products form when a hydrocarbon is completely combusted in air?

- b. Write a balanced chemical equation for the combustion of octane,  $C_8H_{18}$  (I), in air.
- c. How can you determine the chemical formula of the product formed when the metallic element calcium combines with the nonmetallic element oxygen, O<sub>2</sub>?
- d. Write the balanced chemical equation for the reaction described in (c).

- 4. Write a balanced chemical equation for the reaction that occurs when
- a. the hydrocarbon heptane, C<sub>7</sub>H<sub>16</sub> (I), is combusted in air
- b. the gasoline additive MTBE (methyl tertiary-butyl ether), C<sub>5</sub>H<sub>12</sub>O (I), burns in air
- c. Rb (s) reacts with water
- d. Mg(s) reacts with Cl<sub>2</sub> (g)
- 5. Balance the following equations, and indicate what type of reaction each one is: a. Al (s) +  $Cl_2(g)$  -->  $AlCl_3(s)$
- b.  $C_2H_4(g) + O_2(g) --> CO_2(g) + H_2O(I)$
- c.  $Li(s) + N_2(g) --> Li_3N(s)$
- d.  $PbCO_3(s) \longrightarrow PbO(s) + CO_2(g)$
- e.  $C_7H_8O_2(I) + O_2(g) --> CO_2(g) + H_2O(I)$

#### AP Chemistry Worksheet 6: The Mole

For each problem below, write the equation and show your work. Always use units and box in your final answer.

- 1. The molecular formula of aspartame, the artificial sweetener marketed as NutraSweet, is C<sub>14</sub>H<sub>18</sub>N<sub>2</sub>O<sub>5</sub>.
- a. What is the molar mass of aspartame?
- b. How many moles of aspartame are present in 1.00 mg of aspartame?
- c. How many molecules of aspartame are present in 1.00 mg of aspartame?
- d. How many hydrogen atoms are present in 1.00 mg of aspartame?

- 2. A sample of glucose,  $C_6H_{12}O_6$ , contains 2.03 x  $10^{21}$  atoms of carbon.
- a. How many atoms of hydrogen does it contain?
- b. How many molecules of glucose does it contain?
- c. How many moles of glucose does it contain?
- d. What is the mass of the sample in grams?

a. How many moles of chloride ions are in 0.0750 g of magnesium chloride?

b. What is the mass, in grams, of  $3.50 \times 10^{-3}$  mol of aluminum sulfate?

c. What is the mass, in grams, of  $1.75 \times 10^{20}$  molecules of caffeine,  $C_8H_{10}N_4O_2$ ?

- d. What is the molar mass of cholesterol if 0.00105 mol weigh 0.406 g?
- 4. Calculate the number of molecules in:
- a.  $0.0666 \text{ mol propane}, C_3H_8$ , a hydrocarbon fuel
- b. A 50.0 mg tablet of acetaminophen,  $C_8H_9O_2N$ , an analgesic solid under the name of Tylenol
- c. A tablespoon of table sugar,  $C_{12}H_{22}O_{11}$ , weighing 10.5 g

- a. How many moles of vinyl chloride in each liter does this represent?
- b. How many molecules per liter is this?

<sup>5.</sup> The allowable concentration level of vinyl chloride,  $C_2H_3CI$ , in the atmosphere in a chemical plant is 2.0 x  $10^{-6}$  g/L.

#### AP Chemistry Worksheet 7: Empirical and Molecular Formulas

For each problem below, write the equation and show your work. Always use units and box in your final answer.

- 1. Determine the empirical formula of each of the following compounds if a sample contains
- a. 0.104 mol K, 0.052 mol C, and 0.156 mol O
- b. 5.28 g Sn and 3.37 g F
- c. 87.5 percent N and 12.5 percent H by mass

- 2. Determine the empirical formulas of the compounds with the following compositions by mass
- a. 10.4 percent C, 27.8 percent S, and 61.7 percent Cl

b. 21.7 percent C, 9.6 percent O, and 68.7 percent F

- 3. What is the molecular formula of each of the following compounds?
- a. empirical formula  $CH_2$ , molar mass = 84 g/mol
- b. empirical formula  $NH_2CI$ , molar mass = 51.5 g/mol
- 4. Determine the empirical and molecular formulas of each of the following substances:

a. Ibuprofen, a headache remedy contains 75.69 percent C, 8.80 percent H, and 15.51 percent O by mass; molar mass about 206 g

b. Benzene contains only carbon and hydrogen and is 7.74% hydrogen by mass. The molar mass of benzene is 78.1 g/mol.

5. Many homes in rural America are heated by propane gas, a compound that contains only carbon and hydrogen. Complete combustion of a sample of propane produced 2.641 g of carbon dioxide and 1.442 g of water as the only products. Find the empirical formula of propane. (Hint: Figure out how many moles of C and H were produced. They all came from the fuel.)

6. (This is probably the hardest problem in the whole packet!) Menthol, the substance we can smell in mentholated cough drops, is composed of C, H, and O. A 0.1005 g sample of menthol is combusted, producing 0.2829 g of  $CO_2$  and 0.1159 g of  $H_2O$ .

a. What is the empirical formula for menthol?

b. If the compound has a molar mass of 156 g/mol, what is its molecular formula?

#### AP Chemistry Worksheet 8: Chemical Equations and Calculations

For each problem below, write the equation and show your work. Always use units and box in your final answer.

- 1. Why is it essential to use balanced chemical equations in solving stoichiometry problems?
- 2. The fermentation of glucose, C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>, produces ethyl alcohol, C<sub>2</sub>H<sub>5</sub>OH, and CO<sub>2</sub> as shown here:

 $C_6H_{12}O_6(aq) --> 2 C_2H_5OH(aq) + 2 CO_2(g)$ 

a. How many moles of  $CO_2$  are produced when 0.300 mol of  $C_6H_{12}O_6$  reacts in this fashion?

b. How many grams of  $C_6H_{12}O_6$  are needed to form 2.00 g of  $C_2H_5OH$ ?

c. How many molecules of  $CO_2$  form when 2.00 g of  $C_2H_5OH$  are produced?

- 3. Aluminum sulfide reacts with water to form aluminum hydroxide and hydrogen sulfide.
- a. Write the balanced chemical equation for this reaction.

b. How many grams of aluminum hydroxide are obtained from 10.5 g of aluminum sulfide?

#### $2 \text{ NaN}_3(s) \longrightarrow Na(s) + 3 N_2(g)$

a. How many moles of N<sub>2</sub> are produced by the decomposition of 1.50 moles of NaN<sub>3</sub>?

b. How many grams of NaN<sub>3</sub> are required to form 5.00 g of nitrogen gas?

c. How many grams of NaN $_3$  are required to produce 10.0 L of nitrogen gas if the gas has a density of 1.25 g/L?

5. A piece of aluminum foil 0.550 mm thick and 1.00 cm square is allowed to react with bromine to form aluminum bromide.

a. How many moles of aluminum were used? (The density of aluminum is 2.699 g/cm<sup>3</sup>.)

b. How many grams of aluminum bromide form, assuming that the aluminum reacts completely?

In the decomposition of sodium hydroxide, how many moles of sodium hydroxide are needed to produce
 30.0 moles of water?

In the single replacement reaction of lithium and magnesium nitrate, what mass of lithium combines with
 75.0 grams of magnesium nitrate

8. How many grams of lead(II)nitrate are needed to produce 60.0 grams of potassium nitrate in the double replacement reaction of potassium iodide and lead(II)nitrate.

9. When methane and oxygen react (complete combustion reaction) how many grams of water would be

produced from 25.0 grams of methane?

10. If 7.40 grams of calcium hydroxide react with nitric acid to produce 2.01 grams of water, what is the percent yield?

#### AP Chemistry Worksheet 9: Limiting Reactants & Theoretical Yield

For each problem below, write the equation and show your work. Always use units and box in your final answer.

- 1. A manufacturer of bicycles has 50 wheels, 30 frames, and 24 seats.
- a. How many bicycles can be manufactured using these parts?
- b. How many parts of each kind are left over?
- c. Which part is like a limiting reactant in that it limits the production of bicycles?

2. The fizz produced when an Alka-Seltzer tablet is dissolved in water is due to the reaction between sodium bicarbonate, NaHCO<sub>3</sub>, and citric acid, H<sub>3</sub>C<sub>6</sub>H<sub>5</sub>O<sub>7</sub>:

 $3 \text{ NaHCO}_3 (aq) + H_3C_6H_5O_7 (aq) --> 3 CO_2 (g) + 3 H_2O(I) + Na_3C_6H_5O_7 (aq)$ 

In a certain experiment 1.00 g of sodium bicarbonate and 1.00 g of citric acid are allowed to react.

a. Which reactant is the limiting reactant? You must show work to support your answer.

- b. How many grams of carbon dioxide form?
- c. How much of the limiting reactant is left when the reaction is complete?
- d. How much of the excess reactant remains after the reaction is complete?

3. When hydrogen sulfide gas is bubbled into a solution of sodium hydroxide, the reaction forms sodium sulfide and water. How many grams of sodium sulfide are formed if 2.50 g of hydrogen sulfide is bubbled into a solution containing 1.85 g of sodium hydroxide, assuming that the limiting reagent is completely consumed?

4. Solutions of sulfuric acid and lead (II) acetate react to form solid lead (II) sulfate and a solution of acetic acid. If 10.0 g of sulfuric acid and 10.0 g of lead (II) acetate are mixed, calculate the number of grams of sulfuric acid, lead (II) acetate, lead (II) sulfate, and acetic acid present in the mixture after the reaction is complete.

5. A student reacts benzene,  $C_6H_6$ , with bromine,  $Br_2$ , to prepare bromobenzene,  $C_6H_5Br$ , and HBr.

a. What is the theoretical yield of bromobenzene in this reaction when 30.0 g of benzene reacts with 65.0 g of bromine?

b. If the actual yield of bromobenzene was 56.7 g, what was the percent yield?

#### **AP Chemistry Worksheet 10:**

1. Nitrogen gas has a pressure of 452 mmHg. What is this pressure in atmospheres? In kilopascals?

2. A sample of a certain gas has a volume of 452 mL at 711 mmHg and 26oC. What would be the volume of this same sample of gas if it were measured at STP?

3. What is the pressure exerted by 0.981 grams of sulfur dioxide gas placed in a 250. mL container at a temperature of 25oC?

4. What is the molar mass of an unknown gas if the density of that gas is 0.762 g/L at a pressure of 0.634 atm and a temperature of 25oC?

5. For a given sample of gas molecules, the average kinetic energy depends only on the value of the a. pressure b. volume c. moles d. temperature

6. Van der Waal's equation includes terms that are intended to correct for which of the following aspects for non-ideal behavior? (Choose the best possible answer.)

a. The volume of real gas molecules is small but not negligible.

b. There are intermolecular attractions in real gases.

c. Van der Waals' equation corrects for both volume of gas molecules and intermolecular attractions.

d. Van der Waals' equation corrects for neither the volume of gas molecules nor intermolecular attractions.

7. A sample of an unknown gas is found to effuse at the rate of 17.7 mmol/hr. Under comparable conditions, gaseous iodine effuses at the rate of 15.0 mmol/hr. What Is the molar mass of the unknown gas?

8. What is the rms speed of argon molecules at 0oC?

9. Diborane reacts with oxygen to give boric oxide and water vapor:  $B2H6 + 3 O2 \rightarrow B2O3 + 3H2O$ If you mix diborane and oxygen in the correct stoichiometric ratio (note the balanced equation above), and if the total pressure of the mixture is 200. mmHg, what are the partial pressures of the two gases?

10. To determine the molecular formula for a boron hydrogen compound, you place 0.325 g of the gaseous compound in a 0.346-L flask. It exerts a pressure of 325 mmHg at 22oC. What is the correct molecular formula of the compound?

#### a. B2H6 b. B2H5 c. B4H10 d. B5H7 e. B2H3

11. Whose law describes the following:

\*The relationship between volume and temperature \_\_\_\_\_\_

\*The relationship between temperature and pressure \_\_\_\_\_

\*The relationship between pressure and volume \_\_\_\_\_

12. A container with 50. grams of hydrogen and 50. grams of oxygen has a pressure of 1050 mmHg. What is the partial pressure of each gas?

13. Equal masses of helium and neon are placed in separate containers of equal volume at the same temperature.

\*Pressure of the gases:

- a. The pressure of helium is greater than the pressure of neon.
- b. The pressure of neon is greater than the pressure of helium
- c. The pressures of the gases are the same.

\*Numbers of atoms:

- a. There are more atoms of helium than of neon.
- b. There are more atoms of neon than of helium.
- c. There are as many atoms of helium as there are of neon.

\*Energies of the atoms:

a. The average energy of the helium atoms is greater than that of the neon atoms.

- b. The average energy of the neon atoms is greater than that of the helium atoms.
- c. The average energy of the helium atoms is the same as that of the neon atoms.

14. Magnesium metal is reacted with excess HI to produce hydrogen gas. The gas is collected over water. 45.82 ml of the wet hydrogen gas is collected at 30.0  $^{\circ}$ C. The water level in the eudiometer is equalized with the water in another vessel before the volume of H2 gas is determined. The atmospheric pressure in the laboratory is 0.972 atm.

Mg (s)+2HI (aq) \_\_\_\_\_ H2(g)+ MgI2 (aq)

a. What is the vapor pressure of water under these conditions?

- b. What is the partial pressure of H2 gas (i.e., the pressure of the dry H2 gas) in the eudiometer?
- c. What mass of Mg metal was consumed in the reaction (assume 100% yield)?

# **AP Chemistry Worksheet 11: Acid-base**

An Arrhenius acid is defined as any compound that dissociates in aqueous solution to form • \_\_\_\_\_ions.

HNO3\_\_\_\_\_ H+ + NO3

HCl (aq)

An Arrhenius base is defined as any compound that dissociates in aqueous solution to form • \_\_\_\_\_ions.

KOH (aq) \_\_\_\_\_ K+ (aq) + OH- (aq)

NaOH (aq)\_\_\_\_\_

Salts are compounds that dissociate in aqueous solution releasing neither \_\_\_\_\_\_ ions nor • \_\_\_\_\_ions.

KCl (aq) K+(aq) + Cl-(aq)NaCl (aq) \_\_\_\_\_

Using the Arrhenius definition, classify the following examples as acids, bases, or salts:

HBr	_KCl
Mg(OH)2	H3PO4
HCI	_ HClO
KNO2	Al(OH)3
HFO4	KC2H3O2
Ba(OH)2	NaCl

Acids and bases can also be identified using an operational definition. Operational definitions are simply a list of properties.

ACIDS:

- taste is a characteristic property of all acids in aqueous solution. ♦ A
- ♦ Acids react with some metals to produce gas.
- ♦ Because aqueous acid solutions conduct electricity, they are identified as \_\_\_\_\_.

♦ Acids react with bases to produce a \_\_\_\_\_\_ and water.

♦ Acids turn \_\_\_\_\_ different colors.

**BASES:** 

- ♦ Bases tend to taste \_\_\_\_\_\_ and feel \_\_\_\_\_\_.
- ♦ Like acids, aqueous basic solutions conduct \_\_\_\_\_\_, and are identified as
- Bases react with \_\_\_\_\_\_ to produce a salt and \_\_\_\_\_.
- ♦ Bases turn \_\_\_\_\_ different colors.

Naming Acids

- ٠
- Binary acids consist of \_\_\_\_\_\_ elements, the first being \_\_\_\_\_\_. Ternary acids consist of \_\_\_\_\_\_ elements. Do NOT use a prefix. ٠

-ate becomes \_\_\_\_\_ and -ite becomes \_\_\_\_\_

Give the word equation for the neutralization reaction of an acid and a base.

#### **REACTIONS OF ACIDS AND BASES**

The definitions of a Brønsted-Lowry acid is: 1.

Identify the Brønsted-Lowry Acid & Base, and also the conjugate acid and conjugate base in each reaction:

H2O(l) ≓	NH4+(aq)	+	OH–(aq)
H2O(l) ≓	H3O+(aq)	+	ClO3–(aq)
HSO3–(aq) ≓	F–(aq)	+	H2SO3(aq)
	H2O(1) <i>≓</i> H2O(1) <i>≓</i> HSO3–(aq) <i>≓</i>	H2O(1) $\rightleftharpoons$ NH4+(aq)H2O(1) $\rightleftharpoons$ H3O+(aq)HSO3-(aq) $\rightleftharpoons$ F-(aq)	H2O(1) $\rightleftharpoons$ NH4+(aq)+H2O(1) $\rightleftharpoons$ H3O+(aq)+HSO3-(aq) $\rightleftharpoons$ F-(aq)+

8. The product of an Arrhenius acid and base neutralization are a/an \_\_\_\_\_ and \_\_\_\_

Complete and balance the following reactions:



10. \_\_\_\_\_H2SO4 + \_\_\_\_\_KOH \_\_\_\_\_\_\_+ \_\_\_\_\_\_

11. \_\_\_\_HCl + \_\_\_\_Ca(OH)2 \_\_\_\_\_ + \_\_\_\_

12. \_\_\_\_ Fe(OH)3 + \_\_\_\_ H2SO4\_\_\_\_\_ + \_\_\_\_

#### NAMING ACIDS & BASES:

13. What is the correct formula for nitrous acid?

14. What is the correct formula for hydrobromic acid?

15. What is the correct name for H3PO3? \_\_\_\_\_

16. What is the correct name for HNO3?

17. What is the correct formula for bromic acid?

18. What is the correct name for H2SO4?

19. What is the formula for aluminum hydroxide? \_\_\_\_

20. What is the correct name for Sr(OH)2? \_\_\_\_\_

21. What is the correct name for Cu(OH)2?

22. What is the formula for iron (III) hydroxide?

Acids/Bases & pH

Complete the following table by filling in the empty spaces. Indicate if the solution is acidic, basic or neutral.

[H3O]+	[OH]-	pН	рОН	Acidic/Basic/Neutral
2.35 × 10– 3				
	4.93 × 10– 8			
		8.320		
			10.270	
3.72 × 10- 10				
	*1.00 × 10- 7			
		2.580		
			5.260	
*1.00 × 10– 3				
	4.27 × 10− 2			
		*8.000		
			2.040	

Complete the following problems which require more than a single step. <u>SHOW YOUR WORK &</u> <u>STEPS</u>

35. Given a solution with a hydroxide ion concentration,  $[OH-] = 2.73 \times 10-5$ , what is the pH?

36. A solution is found to have a pH of 8.3. What is the hydroxide ion, [OH-], concentration?

37. The measured pOH of a solution is 5.5. What is the hydrogen ion, [H+], concentration?

**BONUS QUESTION:** (all work above must be complete before attempting the bonus) You are stuck with a problem. You need to measure pH of a solution known to be made from a metal hydroxide, but you don't have a meter or any indicators. You do happen to have some lead (II) nitrate that is soluble, and you remember that lead (II) hydroxide is insoluble. You add some to 1 liter of your unknown solution and a precipitate forms. You add more until the precipitate stops forming and then a bit more just in case. After you filter and dry the precipitate, you have 3.81 grams of it. <u>What was the</u> <u>approximate pH of the original solution?</u> SHOW YOUR STEPS AND YOUR WORK. E

# **AP** Chemistry Worksheet 12: Acid-base

1. What is the concentration (molarity) of a solution of NaCl if 40. mL of a 2.5 M NaCl solution is diluted to a total volume of 500. mL?

2. A stock solution of 1.00 M NaCl is available. How many mL are needed to make 100.0 mL of 0.750 M

3. What volume of 0.250 M KCl is needed to make 100.0 mL of 0.100 M solution?

4. To properly disposed of acid its concentration must be less than 1.00 x 10-5 M. How much water must be added to 25 mL of 6.0 M HCl before it can be disposed of safely? (This is why we don't pour it away).

5. 500. mL of a 6.00 M stock solution of NaCl is added to 2.00 L of water. How much of the solution must you pour away and replace with water to get exactly 2.00 L of 1.00 M NaCl?

6. How much solvent must be added to 200. mL 1.50 M NaNO3 to make a solution with a concentration of 0.800 M NaNO3 ?

7. Suppose you have just received a shipment of sodium carbonate, Na2CO3 . You weigh out 50.00 g of the material, dissolve it in water, and dilute the solution to 1.000 L. You remove 10.00 mL from the solution and dilute it to 50.00 mL. By measuring the amount of a second substance that reacts with Na2CO3 , you determine that the concentration of sodium carbonate in the diluted solution is 0.0890 M. Calculate the percentage of Na2CO3 in the original batch of material.

### **Periodic Trends Worksheet**

<ol> <li>Describe the cor</li> <li>Write the mehle</li> </ol>	itributions made by the following scien	tists: Mendeleev and Moseley
2. Write the noble	gas electron configuration for the follow	wing elements:
a. Be	b. Al	c. Mn
d. Y	e. Po	f. Hs
g. V in which that eleme	Vhat is the relationship between the electric ent appears in the periodic table?	ctron configuration of an element and the period
3. Write the noble	gas electron configuration for the follo	wing elements:
a. Be	b. Mg	c. Ca
d. Sr	e. Ba	f. Ra
3. H	Iow do the electron configurations with	in the same group of elements compare?
4. V	Vhat information is provided by the spe	cific block location of an element?
5. V	Vhich group of elements are the alkali r	netals? List four characteristic properties:
6. V	,,,,,, Vhich group of elements are the alkalin	e earth metals? List four characteristic
properties:		
	,,,	
7. V	Vhat name is used to refer to the entire	d-block elements?
8. V	Vhich group of elements are the halogen	ns? List three characteristic properties:
9. V	Which elements are the metalloids? List	t their characteristic properties:
10.	Which groups of elements are the main	group elements?
11.	Which group of elements are the noble	gases? List three characteristic properties:
	,,,	

12. Without looking at a periodic table, identify the period, block, and group in which the elements with the following electron configurations are located.

Period	Block	_Group	a.	[Ne]3s23p4
Period	Block	Group	b.	[Kr]5s24d105p2
Period	Block	_Group	c.	[Xe]6s24f145d106p5

13. Without looking at a periodic table, write the expected outer electron configuration for each of the following elements.

- \_\_\_\_\_a. Group 7, Period 4
- \_\_\_\_\_b. Group 3, Period 5 \_\_\_\_\_c. Group 12, Period 6

\_\_\_\_14. What are valence electrons?

\_\_\_\_\_15. Which main group elements have 1 valence electron?

16. Which main group elements have 6 valence electrons?

17. Write the n	clear symbol for an ion with a charge	e of +2, 20 protons, and 24
a. How many ele	ectrons are in this ion?	b. Is it an anion or cation?
18. Write the m	clear symbol for an ion with a charg	e of -2, 18 electrons, and 18
neutronsa. How many pro	otons are in this ion?	_b. Is it an anion or cation?
19 Write the m	clear symbol for an ion with a charge	$e \circ f + 3$ 13 protons and 15
neutrons.	acteur symbol for un fon whith a charge	5 of +5, 15 protons, and 15
a. How many ele Periodic Trends Worksheet #2	ectrons are in this ion?	b. Is it an anion or cation?
Trends-Atomic size, Shielding, Ior	ization Energy, Electron Affinity	
1. Circle the one from each pair th	at would be the larger in size:	
(A) F atom or O atom	(B) Ba atom or Ra atom # 88	(C) Hf atom #72 or Ti atom
(D) Cs ion or Ba ion	(E) Al ion or Al atom	(F) Po ion #84 or At ion #85
(G) I ion or I atom	(H) Dy atom #66 or Cf atom #98	(I) As #33 atom or Cl atom
(J) Ca atom or Ca ion	(K) W atom #74 or Gd atom #64	(L) Mg ion or Na ion
2. Circle the element that has more	e shielding:	
(A) B#5 or In #49	(B) Mg or S or neither	(C) Tl #81 or Y#39
(D) Cl#17 or I#53	(E) Ar#18 or Xe#54	(F) Ca#20 or Ga#31 or neither
3. Circle the element with the grea	ter first ionization energy (IE):	
(A) Pb or Sn	(B) B or C	(C) Ba or At #85
(D) Lr #103 or Ra #88	(E) Cs #55 or V #23	(F) Si # 14 or Ag
(G) F atom or O atom	(H) Ba atom or Ra atom	(I) S#16 and Te#52
4. Circle the element with the grea	ter electron affinity (EA):	
(A) F or Cl	(B) Sr #38 or Rb #37	(C) Os #76 or Co #27
(D) Am #95 or Eu #63	(E) Pb or Sn	(F) Ba or At #85
5. Circle the element with the low	er electronegativity (EN):	

(A) C or N	(B) Na or K	(C) Ta #73 or Cu		
(D) Pd #46 or Mo #42	(D) Lr #103 or Ra #88	(E) Cs #55 or V #23		
(F) Si # 14 or Ag	(G) F atom or O atom	(H) Ba atom or Ra atom		
<ul><li>6. Write the complete electron con</li><li>a. Mg 2+</li></ul>	nfiguration for the following ions f. Ca 2+	and state if it is an anion or cation:		
b. H 1+	g. H 1	_g. H 1		
c. S 2-	h. O 2			
d. Na 1+	i. F1			
e. Cl 1-	j. K 1+			

#### Periodic Trends Review

Read over notes, all homework problems, and the periodic table we drew in class. Be able to define the following: valence electrons, ion, atomic radius, ionization energy. Make sure you are able to label the group numbers, period numbers, alkali metals, alkaline earth metals, transition metals, inner transition metals, halogens, noble gases, s-block, p-block, d-block, f-block, metalloids, nonmetals, main group elements, atomic radii trends, ionization energy trends, electron affinity trends, ionic radii trends, electronegativity trends, and number of valence electrons found in each group. Be able to list the different characteristics of the various families found on the periodic table (ex. Alkali metals are the most reactive metals; they are all soft, silvery metals...)

\_\_\_\_\_1. Who and how was the first periodic table constructed and how has our present day periodic table changed from the original?

2. As you move across the periodic table, from left to right,

(A) do the atoms get smaller or larger?

(B) are the ionization energies increasing or decreasing?\_\_\_\_\_

(C) are the metals becoming more or less reactive?

(D) are the metals getting harder or softer?

3. Explain the trends involving ionization energy, atomic radii, electronegativity, electron affinity, and ionic radii that are evident in the various groups and periods of the periodic table.

4. Which main group elements have 1 valence electron? \_\_\_\_\_ 6 valence electrons?\_\_\_\_\_

5. Without looking at the periodic table determine the group, period, and block for the following elements:

6. Use their placement on the periodic table to arrange the following elements based on their size (atomic radii) from largest to smallest. a. Ca, Ge, Br, K, Kr b. Sr, Mg, Be, Ba, Ra c. F, Cl, Fr, Cs

7. Use their placement on the periodic table to arrange the following elements from highest ionization energy to lowest ionization energy. a. Ca, Ge, Br, K, Kr b. Sr, Mg, Be, Ba, Ra c. F, Cl, Fr, Cs

8. Use their placement on the periodic table to determine which of the following has a higher electron affinity.

a. F or Sn b. Si or Y c. Fe or K d. Bi or N e. Ho or Br f. Rb or Cl

9. Use their placement on the periodic table to determine which of the following has a lower electronegativity.

a. For Sn b. Si or Y c. Fe or K d. Bi or N e. Ho or Br f. Rb or Cl

10. Use their placement on the periodic table to determine which of the following is smaller. a. Ca atom or Ca ion b. Cl atom or Cl ion c. N ion or O ion Mg ion or Sr ion

11. Which of the following has the most shielding? a. Br or Fb. Al or Cl or neitherc. Ca or Ra

12. When sodium becomes an ion will it lose or gain electrons? \_\_\_\_\_ How many electrons? \_\_\_\_\_ Write the nuclear symbol for an ion of sodium (assume it has 11 neutrons). \_\_\_\_\_

13. When aluminum ionizes will it lose or gain electrons? \_\_\_\_\_ How many electrons? \_\_\_\_\_ Write the nuclear symbol for an ion of aluminum (assume it has 14 neutrons). \_\_\_\_\_

14. When nitrogen becomes an ion will it lose or gain electrons?\_\_\_\_\_ How many electrons?\_\_\_\_\_ Write the nuclear symbol for an ion of nitrogen (assume it has 7 neutrons).\_\_\_\_\_

\_\_\_\_\_15. Write the nuclear symbol for an ion with a charge of +2, 20 protons, and 24 neutrons.

\_\_\_\_\_a. How many electrons are in this ion? \_\_\_\_\_b. Is it an anion or cation?

\_\_\_\_\_16. Write the nuclear symbol for an ion with a charge of -2, 18 electrons, and 18

neutrons.

\_\_\_\_\_a. How many protons are in this ion? \_\_\_\_\_b. Is it an anion or cation?

\_\_\_\_\_17. Write the nuclear symbol for an ion with a charge of +3, 13 protons, and 15

neutrons. \_\_\_\_\_\_a. How many electrons are in this ion? \_\_\_\_\_\_b. Is it an anion or cation?

18. Describe the characteristics of metals, nonmetals, and metalloids.