Honors Chemistry
Summer Assignment 2012-2013

Welcome to Honors Chemistry. This next year, we will begin a journey into the exciting world of Chemistry, its nuances, its applications, and effects on history.

As Honors Chemistry students, this course is designed to be a rigorous course that provides relevant connections to prepare you for future education in the sciences. This course is demanding and will require your full commitment. It is expected that students spend at least 3-4 hours per week completing homework assignments and studying. Nothing can be forgotten in Chemistry, so a regular study session to refresh skills is very important. If you cannot commit to this course, please consider taking a regular Chemistry course.

To prepare for the year ahead, this summer you will begin thoroughly reviewing your Physical Science chemistry content and learning the basics of how to speak "Chemistry". This assignment will cover all of the background material required. Please pay close attention to the assignment details to ensure all work is completed and turned in on-time. I have also attached a guide to writing in Chemistry. This should provide a clear expectation of the level of writing that is required for the course.

I'm very excited about working with each and everyone one of you to find great success in Honors Chemistry. If at any time you have a question regarding the assignments or the content itself, please feel free to email me at Justin.lambert@cmcss.net.

Mr. Justin W. Lambert
Honors Chemistry Teacher

Summer Assignment:

1. Read "The Invention of Air" by Steven Johnson and write a three to six page paper that detail the following: (Please make sure that you use contextual details from the book and cite them properly.)
   a. Explain his:
      i. Scientific discoveries
      ii. Political philosophies
   b. Describe how this relates to the political aspects of the time (mid 1800's)
   c. Analyze his contribution to modern science and chemistry
   d. Deconstruct the context in which his curiosity lead his discoveries
2. After completing this analysis of the "The Invention of Air", write one to two pages on the following:
   a. How does Priestley's example lead you to investigate your own questions?
   b. What questions do you have that arose out of Priestley's research?
   c. What are possible areas that you would like to investigate for your future research project?
3. Both of these papers will be due on the first day of class. Please make sure to use 12-pt font and double spacing.
4. It is important to be able to speak the language of Chemistry. In order to become versed in this language, make flashcards of ALL of the compounds, ions, acids and prefixes on the attached pages. There will be a quiz over these in the first week of school.
   a. Please also include the first 40 elements on the Periodic Table.
   b. These flashcards will be collected for a grade.
5. From your text, read Chapters 1, 2, and 3. It is your responsibility to take notes that are effective for your learning. I WILL NOT be collecting them. Once you have read and feel comfortable with the material, complete the attached review worksheets. These will be due when you return from summer break.

APPENDIX 2:

A BRIEF GUIDE TO
WRITING IN CHEMISTRY

This document is a guide to assist students in chemistry courses with writing and formatting laboratory reports and research reports. An important goal of the Department is for our students to organize and communicate research results effectively and to write with acceptable scientific style. We hope that by providing many of the common stylistic, grammatical and organizational points in this single document, student can use this advice throughout their study of chemistry.

A. Formatting a Report

Layout. Use 12 point Times New Roman font and double spacing to allow space for comments and corrections. Number all pages, including those in appendices.

Organization. A standard lab report or research paper should be formatted with sections.

1. TITLE. List the title of the experiment or meaningful name for your research report. This is followed by your name and the date submitted. If you worked with partners, list their names next to yours, but put an asterisk after your name* to indicate that you wrote the report.

2. ABSTRACT. The abstract should be able to "stand alone." This means that someone should be able to read *only* your abstract and understand the basic nature of your report. For this reason, a good abstract clearly identifies the purpose of the experiment and the important results. Repeat: *a good abstract contains a summary of your results.*

Avoid pedagogical comments such as "this experiment helped us learn about the nature of chemical reactions" or "the goal of this experiment was to learn about dyes." Although those ARE important aspects and goals of the lab experience, the lab/research report should focus only on the data and results. Avoid starting your abstract with "The purpose of this experiment was..."

Background information on the theory or applications of your experiment belongs in the Introduction section. Avoid referencing any other sources or parts of the report, because the abstract should be able to "stand alone."

Be specific about what was done: name the reagents or types (not models) of instruments that were used, the products of a reaction, numerical values that were measured or calculated, etc. Avoid vague statements such as "a metal complex was prepared and the percent yield was calculated." A better abstract would read "hexaammine cobalt(III) chloride was prepared from cobalt (II) chloride, ammonia, ammonium chloride and hydrogen peroxide. The yield was 8.45 g (64 % based on cobalt)."

The best way to learn how to write a good abstract is to READ some published abstracts. These can be found in chemistry journals (for example, *The Journal of the American Chemical Society*) which are in the library.

TIP: When writing a full report, write the Abstract last.

3. INTRODUCTION. The introduction section explains to the reader what basic scientific question is being addressed. It includes general background material or a brief historical perspective on the topic being investigated. It presents brief summaries, with references, of previous work. An effective introduction funnels the reader from a larger area of research, through examples of progress in the field to a clear statement of the research problem or approach being addressed in the current report.

4. EXPERIMENTAL. This section includes a description of your experimental procedure, and names of instruments used. For lab courses, the procedure can simply reference the lab manual, listing any changes to the published procedure. DO NOT REWRITE THE LAB MANUAL. For advanced labs or independent research, the experimental section should provide all the necessary detail for someone to be able to reproduce your work. Often, an Experimental section is subdivided into **Materials** (sources and purity of reagents used), **Preparation of Compounds** (with procedure, and summary of characterization by NMR, IR, UV-Vis spectroscopy, melting point, chromatography, or elemental analysis) and **Instrumentation** (manufacturer, description of any adaptation or sample preparation) sections. Consult *JACS* to see examples of Experimental sections for various types of reports.

TIP: a good experimental section should allow another person, using what you have written and a lab manual, to completely reproduce what you did in the lab.

5. RESULTS & DISCUSSION. (may be single or separate sections) The Results should include a summary of your raw data (preferably in tabular form) and important observations. Do NOT include long tables of raw data; for those experiments simply present the results of your calculations. Calculations may be included in this section or in an Appendix, and a description of equations used in your calculations must be presented. Handwritten calculations are acceptable for lab reports.

A Discussion section should take the form of an analysis of your results. Comment on the purpose of the experiment. What do the results indicate? What are sources of error (experimental uncertainty/precision)? What additional experiments could help address any dangling ends? Do the results agree with what others have found? Do the results support a model or hypothesis? For some lab courses, you can use this section to answer any questions presented in the manual or in class. Although you should answer the questions in the lab manual, this section should have the style of flowing prose, not simply answers to numbered questions.

6. CONCLUSION. Summarize your results and discussion with a short conclusion that is more than simply a reiteration of your results. Phrase it in terms of the broader questions addressed in the Introduction.

7. REFERENCES. Citations of the literature used in the previous sections (see section F)

8. APPENDIX. Graphics may appear here, along with lengthy calculations or additional material not needed when reading through the report.

Graphics. Graphics include Tables, Figures, Schemes and chemical structures. Tables are columns of measured and/or calculated values or observations. All quantities should have units and be expressed using proper significant figures and scientific notation. Important experimental conditions should be listed as footnotes, especially when the table includes data obtained under different experimental conditions. Figures include: spectra, graphs, cartoons of experimental set-up or other drawings intended to show an *object*. Schemes include: reaction mechanisms, experimental flow charts or other drawings that are intended to show a *process*. All Tables, Figures and Schemes should be numbered sequentially and must be mentioned in the text. All graphics should be a full page in size and included at the end of the manuscript in the Appendix. Chemical structures can appear in the text and should be labeled with the same name, formula or compound number that appears in the text.

B. Sentence Structure and Writing Style

1. Beginning a sentence. Avoid beginning a sentence with a symbol, numeric value or equation.

incorrect:	315.6 mg of ammonium chloride was added to the solution, which was then heated to 50 °C.
correct:	After the addition of 315.6 mg of ammonium chloride, the solution was heated to 50 °C.
incorrect:	ν is both the vibrational frequency and the IR radiation frequency.
correct:	The frequency ν refers to both the vibrational frequency and the frequency of IR radiation.

2. Dangling Modifiers and Illogical Construction. Check that a modifier phrase or the pronoun "it" actually refers to the intended subject. (see also: subject-verb agreement.)

incorrect: Being coated with grease, I cleaned the flask before adding reagents
was I coated with grease or was the flask?
correct: Because the flask was coated with grease, it was cleaned before...

incorrect: After transferring to a larger flask, the solution was heated to a boil.
did the solution transfer itself?
correct: The solution was transferred to a larger flask and heated to a boil.

incorrect: A diagram of the influenza virus is now available. To obtain it, contact the instructor. *The instructor is making the influenza virus available?*
correct: A diagram of the influenza virus is now available from the instructor.

incorrect: To prevent decomposition, the reaction flask must be purged of air.
does the flask want to prevent decomposition?
correct: To prevent decomposition, purge all air from the reaction flask.

3. Equations. Equations typically appear as a separate line from the text and are numbered sequentially throughout the manuscript. Equations can then be referred to by number.

example:
"The quenching rate constant can be calculated using the Stern-Volmer equation:

$$\Phi_0/\Phi_q = 1 + k_q\tau_0[Q] \qquad (2)$$

4. Hyphens. Hyphenate compound adjectives.

5-mL aliquots were added but, aliquots of 5 mL were added
crystal deposited from the slowly-cooled solution.

5. Spaces. There should be a space between a quantity and its units and between a quantity or word and subsequent parenthetical phrase.

6.626 J s
25.15 K = 298.15 °C
45 mL
456 nm (34,000 M^{-1} cm^{-1})

6. Personal Pronouns. By tradition, scientists avoid using the personal pronouns "I" and "we" and "you" in most technical communications. The use of third person instead of first person is preferred when reporting results. (see also: active voice)

first person: I heated the solution at 100 °C for 1 h. and I noticed that it turned blue.
third person: When heated at 100 °C for 1 h., the solution turned blue.

7. Pedagogical comments. Avoid including pedagogical comments in a report or scientific communication. Phrases such as "this experiment helped us learn about the nature of chemical reactions" or "the goal of this experiment was to learn about dyes" are addressing the process of learning not the science of the experiment. Although those ARE important aspects and goals of the lab experience, the lab report should focus only on the data and results.

Also, try to avoid starting your abstract with "The purpose of this experiment was..."

8. Personification. Molecules and equipment are not people, so do not personify them in your writing.

incorrect: Sugar really wants to dissolve in water.

correct: Sugar is very soluble in water.

incorrect: Sodium wants to lose one electron to form Na^+.
correct: Oxidation of Na to Na^+ is thermodynamically favorable.

incorrect: The spectrum shows two bands of equal intensity
correct: Two bands of equal intensity appear in the spectrum.

9. Plural nouns. "Data" is plural for "datum," "spectra" is plural for "spectrum," "phenomena" is plural for "phenomenon," and "formulae" is plural of "formula." The amount of chemical reagent is singular, so use the correct verb tense.

incorrect: Data was acquired and a spectra is in the appendix.
correct: Data were acquired and a spectrum is in the appendix

incorrect: While the solution boiled, 5.0 g of KBr were added.
correct: While the solution boiled, 5.0 g of KBr was added.

10. Prepositions. Don't forget "of" between quantities and substance name.

incorrect: "... and 10 mL MeOH was added."
correct: "... and 10 mL of MeOH was added."

11. Redundant or unnecessary phrases (pleonasm).

incorrect: A photon of light having a wavelength of 530 nm...
if not "of light," what was the photon made of?
correct: Light having a wavelength of 530 nm...

incorrect: In this experiment, aspirin was prepared from oil of wintergreen.
If not this experiment, then in which experiment?
correct: Aspirin was prepared from oil of wintergreen.

12. Subject-verb agreement. Are you stating that an inanimate object is drawing a conclusion, or suggesting a strange cause and effect? (see also: dangling modifers)

incorrect: The IR spectrum implies that water is in the aspirin sample. *(spectra don't imply, people do)*
correct: The presence of water in the aspirin sample is inferred from the IR spectrum.

incorrect: Water was present in the aspirin product because of the peak at 3200 cm^{-1} in the IR spectrum. (*the peak in the spectrum didn't cause water to be present*)
correct: The peak at 3200 cm^{-1} in the IR spectrum indicates that water was present in the aspirin product. (*water caused the peak in the spectrum)*

C. Verbs

1. Active voice. By avoiding personal pronouns, scientists often depend excessively on the passive voice, which can weaken the writing style. *When possible,* replace passive voice with active voice.

passive voice:	A vapor was observed when the solution was heated.
active voice:	A vapor formed above the hot solution.

passive voice:	There was some solid that did not dissolve.
active voice:	Some solid did not dissolve.

2. Subject-verb agreement. Based on whether the subject is singular or plural, use the correct verb tense. A quantity used is a singular subject, even when that quantity is in a plural form of units.

incorrect:	12 g **were** added
correct:	12 g **was** added

3. Verb tense. Past tense is used to describe a procedure that you followed in an experiment. Present tense is used to describe a scientific fact, such as the properties of a molecule.

examples: Hydrochloric acid was added to the flask slowly in order to prevent decomposition of the product. Hydrochloric acid is a caustic substance that must be used with caution.

4. "Verbing" a Noun. Don't turn nouns into verbs.

incorrect: ammonia complexes to cobalt ions
correct: ammonia forms complexes with cobalt ions.

incorrect: the mixture was centrifuged to separate the solid.
correct: The solid was separated from the mixture using a centrifuge.

incorrect: The solution was rotovapped to dryness
correct: The solvent was removed by rotary evaporation

D. Abbreviations, Formulae and Numerals

1. Standard Abbreviations. Use standard *JACS* abbreviations (note: not all journals use exactly the same abbreviations:

examples: mL = milliliter; μg = microgram; nM = nanomolar
h = hour; min = minute; s = second
K = degrees Kelvin, °C = degrees Celsius

2. Chemical Formulae. Use subscripts, superscripts, parentheses, and symbols appropriately in chemical formulae.

examples: Cr^{3+}(*aq*)
$K_2[PtCl_4]$
$[Ru(bpy)_3{}^{2+}](PF_6)_2$

3. Compound Numbers. Compounds can be numbered if repeated long compounds names become cumbersome. The number should be defined (usually in bold or underlined) somewhere early in the manuscript, often when it is first presented. The numbers should appear in parenthesizes when used as adjectives, but not when used as nouns.

example:

"Investigations into the fluorescence of 8-hydroxyquinoline (**1**), 4-iodo-8-hydroxyquinoline (**2**) and 2-methyl-4-iodo-8-hydroxyquinoline (**3**) are described in this paper. Recrystallization of **1** and **2** afforded analytically pure samples, but vacuum sublimation of the methyl derivative (**3**) was necessary to remove fluorescent impurities."

4. Decimal Places. For values less than unity, use a leading zero. Avoid writing values having too many zero; use scientific notation.

examples:	"0.15 μL"	not ".15 μL"
	"2.3×10^{-5} M"	not "0.000024 M"

5. Defining Abbreviations. Abbreviations for chemical compounds, ligand, instruments or methods should be defined in the text before using throughout the manuscript.

examples:

"The complex cation $Ru(bpy)_3{}^{2+}$, where bpy = 2,2'-bipyridine, is luminescent . . ."
"Surfactants such as sodium dodecyl sulfate (SDS) lead to lower drag . . ."
"Peptide structures were minimized using the empirical force filed (EFF) method."
"The American Chemical Society (ACS) sponsors two annual national meetings."

6. Organic Abbreviations. Standard organic abbreviations can be used in text and formulae.

examples:

Me = methyl
Et = ethyl
iPr = *iso*-propyl
tBu = *tert*-butyl
Ch – cyclohexyl

7. Reagents and Solvents. Use chemical formulae for standard reagents and solvents, but not when the name is shorter or more precise

<u>examples:</u>	NaOH (*aq*)	in place of "sodium hydroxide"
	H_2SO_4 (*aq*)	in place of "sulfuric acid"
	CH_2Cl_2	in place of "dichloromethane"
	"caffeine"	in place of $C_8H_{10}N_4O_2$

E. Chemical Terms and Expressions

1. Chemical names. The names of chemicals are not capitalized, unless they are trade names such as "Tylenol" or "Viagra."

> incorrect: The reaction of aqueous Cobalt(II) with Aspirin was investigated.
> correct: The reaction of aqueous cobalt(II) with aspirin was investigated.

2. Create. Chemistry involves "synthesizing" new compounds, "preparing" solutions, "characterizing" products. Avoid using phrases such as "products were *created.*" Too divine.

3. Measurements. Spectra are measured "with" or "using" a spectrometer, not "on" a spectrometer (ouch!)

4. Machines. Spectrometers (UV-Vis, IR, NMR, etc.) are "instruments," not "machines."

5. React. As an intransitive verb, "react" should not have an object and should not have a passive voice. Chemical reagents react with each other, they are not reacted.

> <u>incorrect:</u> "Potassium hydroxide and hydrochloric acid were reacted to produce water and potassium chloride."
> <u>correct:</u> "The reaction of potassium hydroxide and hydrochloric acid produced water and potassium chloride."

6. Tested. A hypothesis can be "tested" and a student can be "tested." For most laboratory work, the terms "measured," "investigated," "determined," "calculated" or "obtained" often work better.

> <u>incorrect:</u> The absorbance of the solution was tested using the UV-vis machine.
> <u>correct:</u> The absorbance of the solution was measured using a UV-vis spectrophotometer.

F. References

There are numerous styles for formatting references. Unless otherwise instructed, citations should be formatted in the *JACS* style and appear as endnotes. Alternatively, article titles can also be included. Most important is to prepare citations with a uniform style.

Last name, initials; Last name, initials *Journal Title* **year**, *volume (issue)*, starting page.
or
Last name, initials; Last name, initials "Article Title" *Journal Title* **year**, *volume (issue)*, starting page.

<u>examples:</u>

Schlabach, M.; Limbach, H.-H.; Shu, A.; Bunnenberg, E.; Tolf, B.; Djerassi, C. *J. Am. Chem. Soc.* **1993**, *115*, 4554.

Additional Materials for Writing Lab/Research Reports

Davis, Martha *Scientific papers and presentations* San Diego : Academic Press, **1997**

Dodd, Janet S. (ed.)*The ACS style guide : a manual for authors and editors* ACS, **1997**.

Eisenberg, Anne "Strategies five productive chemists use to handle the writing process." *J. Chem. Educ.* **1982,** *59*, 566.

Potera, Carol "The Basic Elements of Writing a Scientific Paper: The Art of Scientific Style" *J. Chem. Educ.* **1984,** *61*, 247.

Spector, Thomas "Writing a Scientific Manuscript: Highlights for Success" *J. Chem. Educ.* **1994,** *71*, 47.

> "To avoid criticism, do nothing, say nothing, be nothing."
> *-Elbert Hubbard*

Names of Common Polyatomic Ions

Ion	Name	Ion	Name
NH_4^+	Ammonium	CO_3^{2-}	Carbonate
NO_2^-	Nitrite	HCO_3^-	Hydrogen Carbonate
NO_3^-	Nitrate	H_3O^+	Hydronium
SO_3^{2-}	Sulfite	ClO^-	Hypochlorite
SO_4^{2-}	Sulfate	ClO_2^-	Chlorite
$S_2O_3^{2-}$	ThioSulfate	ClO_3^-	Chlorate
OH^-	Hydroxide	ClO_4^-	Perchlorate
CN^-	Cyanide	$C_2H_3O_2^-$	Acetate
PO_4^{3-}	Phosphate	MnO_4^-	Permanganate
HPO_4^{2-}	Hydrogen Phosphate	$C_2O_4^{2-}$	Oxalate
$H_2PO_4^-$	Dihydrogen Phosphate	O_2^{2-}	Peroxide
CrO_4^{2-}	Chromate	BrO_2^-	Bromite
$Cr_2O_7^{2-}$	Dichromate	BrO_3^-	Bromate

Common Type II Cations

Ion	Systematic Name	Older Name
Fe^{3+}	Iron (III)	Ferric
Fe^{2+}	Iron (II)	Ferrous
Cu^{2+}	Copper (II)	Cupric
Cu^+	Copper (I)	Cuprous
Co^{3+}	Cobalt (III)	Cobaltic
Co^{2+}	Cobalt (II)	Cobaltous
Sn^{4+}	Tin (IV)	Stannic
Sn^{2+}	Tin (II)	Stannous
Pb^{4+}	Lead (IV)	Plumbic
Pb^{2+}	Lead (II)	Pumbous
Hg^{2+}	Mercury (II)	Mercuric
Hg_2^{2+}*	Mercury (I)	Mercurous
Zn^{2+}	Zinc (II)	
Au^{3+}	Gold(III)	

*Mercury (I) ions always occur bound together in pairs to form Hg_2^{2+}

Common Simple Cations and Anions

Cation	Name	Anion	Name
H^+	Hydrogen	H^-	Hydride
Li^+	Lithium	F^-	Fluoride
Na^+	Sodium	Cl^-	Chloride

K^+	Potassium	Br^-	Bromide
Cs^+	Cesium	I^-	Iodide
Be^{2+}	Beryllium	O^{2-}	Oxide
Mg^{2+}	Magnesium	S^{2-}	Sulfide
Ca^{2+}	Calcium		
Ba^{2+}	Barium		
Al^{3+}	Aluminum		
Ag^+	Silver		

Prefixes Used to Indicate Numbers in Chemical Names

Prefix	Number Indicated
Mono-	*1*
di-	*2*
tri-	*3*
tetra-	*4*
penta-	*5*
hexa-	*6*
hepta-	*7*
octa-	*8*
nona-	*9*
deca-	*10*

Names of Acids That Do Not Contain Oxygen

Acids	Names
HF	Hydrofluoric Acid
HCl	Hydrochloric Acid
HBr	Hydrobromic Acid
HI	Hydroiodic Acid
HCN	Hydrocyanic Acid
H_2S	Hydorsulfuric Acid

Names of Some Oxygen-Containing Acids

Acid	Name
HNO_3	Nitric Acid
HNO_2	Nitrous Acid
H_2SO_4	Sulfuric Acid
H_2SO_3	Sulfurous Acid
H_3PO_4	Phosphoric Acid
$HC_2H_3O_2$	Acetic Acid

WORKSHEET ON CHEMICAL VS PHYSICAL PROPERTIES AND CHANGES

Keep this in your binder as a study guide! You will have a quiz on this next class!

Background: Keeping the difference between physical and chemical properties as well as changes can be a challenge! This worksheet will help you do this. First, use the book to define the following terms.

VOCABULARY WORD	DEFINITION
Physical Property	
Physical Change	Change in which the identity of the substance does NOT change
Chemical Property	
Chemical Change	

Part One: Physical or Chemical Property? Fill in the chart using the vocabulary words or phrases provided.

Vocabulary words

Boiling point	**Ability to rust**	**Melting point**	**Brittleness**	**Reactivity with vinegar**
elasticity	**Flammability**	**Density**	**Transparency**	**ductility**

Each word is used once. Define the word when done!

Chemical Property↓	**Definition**
	• **The ability to burn**
	• **Reacts with oxygen to produce rust**

Physical Property↓	**Definition**
	• **The property of letting light pass through something**

Part Two: Physical or Chemical Change? Indicate with a 'P' or a 'C' which type of change is taking place.

1. ______________ glass breaking
2. ______________ hammering wood together
3. ______________ a rusting bicycle
4. ______________ melting butter
5. ______________ separate sand from gravel
6. ______________ bleaching your hair
7. ______________ frying an egg
8. ______________ squeeze oranges for juice
9. ______________ melting ice
10. ______________ mixing salt and water
11. ______________ mixing oil and water
12. ______________ water evaporating
13. ______________ cutting grass
14. ______________ burning leaves
15. ______________ fireworks exploding
16. ______________ cutting your hair
17. ______________ crushing a can
18. ______________ boiling water

NAME:________________ PERIOD:________

THE STATES OF MATTER WORKSHEET

Matter is anything that takes up space and has mass. All matter is made up of atoms—the smallest unit of each element. Matter can exist as a solid, liquid, and gas (and also plasma). Remember that:

- **Solid**- has a fixed shape and volume
- **Liquid**- has a definite volume, but takes the shape of the part of the container which it occupies
- **Gas**- does not have a fixed shape or volume and will take the volume and shape of the container that holds it

1. a. What do you expect will happen when you put the balloon into ice water?
b. Explain *why* you think this will happen.

2. Instructions:
a. Measure the balloon circumference and calculate its volume at room temperature.
b. Put the balloon in ice water for 3 minutes. Measure its circumference and calculate its volume. Record your data measurements in the table below.

Balloon Measurements:

a. Room Temperature		b. Ice		c. Hot water	
Circumference	Volume	Circumference	Volume	Circumference	Volume

Hint for calculating volume: $d=c/\pi$, $r=d/2$, $V=4/3\pi r^3$

3. a. Did the *volume* of the balloon change in the cold water?________
b. Did the *mass* change in the cold water? ______
c. Do your results match your predictions?

4. What do you think will happen if you put the balloon into hot water?
(If you have time, you can test this by putting the balloon into hot water. Measure the circumference again and calculate its volume. Record your measurements in the table.)

Worksheet - Mixed Gas Law Worksheet   Name: ______________________

SHOW ALL WORK FOR ALL PROBLEMS

I. 1.0 atm = 101.3 kPa = 760 mmHg   And 0°C = 273 K

Change the following units: 359 kPa = ________ atm   10°C = ________ K

6.2 atm = ________ kPa   10K = ________ °C

For the rest of the problems: **First** identify each number with **P, V, or T**. **Second** state **whose** law you are using, **Third** – show the equation, **Fourth** solve the problem, and **Fifth** - circle your final answer - and make sure you don't forget your units!!!

1. The gas in a sealed can is at a pressure of 3.00 atm at 25°C. A warning on the can tells the user not to store the can in a place where the temperature will exceed 52°C. What would the gas pressure in the can be at 52°C?

2. A sample of hydrogen exerts a pressure of 0.329 atm at 47°C. The gas is heated 77°C at constant volume. What will its new pressure be?

3. A sample of neon gas occupies a volume of 752 mL at 25°C. What volume will the gas occupy at standard temperature if the pressure remains constant?

4. A sample of oxygen gas has a volume of 150 mL when its pressure is 440 mmHg. If the pressure is increased to standard pressure and the temperature remains constant, what will the new gas volume be?

5. Ral3ph had a helium balloon with a volume of 4.88 liters at 150 kPa of pressure. If the volume is changed to 3.15 liters, what would be the new pressure in atm?

6. 5.36 liters of nitrogen gas are at -25°C and 733 mm Hg. What would be the volume at 128°C and 1.5atm?

7. At constant temperature, 2 L of a gas at 4 atm of pressure is expanded to 6 L. What is the new pressure? (Do this one conceptually and not algebraically.)

Basic Atomic Structure Worksheet

1. The 3 particles of the atom are:

   a. ____________________
   b. ____________________
   c. ____________________

   Their respective charges are:

   a. ____________________
   b. ____________________
   c. ____________________

2. The number of protons in one atom of an element determines the atom's ____________________, and the number of electrons determines the ____________________ of the element.

3. The atomic number tells you the number of ____________________ in one atom of an element. It also tells you the number of ____________________ in a neutral atom of that element. The atomic number gives the "identity" of an element as well as its location on the periodic table. No two different elements will have the ____________________ atomic number.

4. The ____________________ of an element is the average mass of an element's naturally occurring atom, or isotopes, taking into account the ____________________ of each isotope.

5. The ____________________ of an element is the total number of protons and neutrons in the ____________________ of the atom.

6. The mass number is used to calculate the number of ____________________ in one atom of an element. In order to calculate the number of neutrons you must subtract the ____________________ from the ____________________.

7. Give the symbol of and the number of protons in one atom of:

   Lithium ____________________ Bromine ____________________
   Iron ____________________ Copper ____________________
   Oxygen ____________________ Mercury ____________________
   Krypton ____________________ Helium ____________________

8. Give the symbol of and the number of electrons in a neutral atom of:

   Uranium ____________________ Iodine ____________________
   Boron ____________________ Xenon ____________________
   Chlorine ____________________

9. Give the symbol of and the number of neutrons in one atom of:

   (Mass numbers are ALWAYS whole numbers...show your calculations)

   Barium ____________________ Bismuth ____________________
   Carbon ____________________ Hydrogen ____________________
   Fluorine ____________________ Magnesium ____________________
   Europium ____________________ Mercury ____________________

10. Name the element which has the following numbers of particles:

   a. 26 electrons, 29 neutrons, 26 protons ________________________

   b. 53 protons, 74 neutrons ________________________

   c. 2 electrons (neutral atoms) ________________________

   d. 20 protons ________________________

   e. 86 electrons, 125 neutrons, 82 protons ________________________

   f. 0 neutrons ________________________

11. If you know ONLY the following information can you ALWAYS determine what the element is? (Yes/No)

   a. Number of protons ________________________

   b. Number of neutrons ________________________

   c. Number of electrons in a neutral atom ________________________

   d. Number of electrons ________________________

12. Fill in the missing items in the table below.

NAME	SYMBOL	Z	A	# PROTONS	# ELECTRONS	# NEUTRONS	ISOTOPIC SYMBOL
a.	Na						
b.		17			18		
c. Potassium							
d.	P						
e. Iron					24		
f.				53			
g. Silver							
h.		36					
i.	W						
j.		29					
k.				49			
l.				79	78		
m.		16			18		

Periodic Table Worksheet

Use the following clues to determine the elements being described and fill in the missing information.

1. Each atom of this element has 9 protons and 10 neutrons. The atomic number of the element is _(1)_. The mass number is _(2)_. The number of valence electrons is _(3)_. This element can be found in the _(4)_ family on the periodic table. The valence configuration of this atom is _(5)_. This element is classified as a(n) _(6)_. This element is _(7)_, with a symbol of _(8)_.

2. This element is a metalloid of Group IV. It has _(9)_ valence electrons on the third energy level. Its name is _(10)_, symbol _(11)_. Its atomic number is _(12)_ and its mass number is _(13)_. This element has _(14)_ neutrons.

3. This is a Halogen and is found in Group _(15)_. It has _(16)_ valence electrons. It has 17 electrons in a neutral atom. The element is _(17)_, symbol _(18)_. It has _(19)_ protons and a mass number of 35. How many neutrons does it have? _(20)_

4. This element is the largest of period three. It is _(21)_, symbol _(22)_. Its atomic number is _(23)_ and it is found in the family _(24)_.

5. Each atom of this element has 56 protons and 81 neutrons. The atomic number is _(25)_ and the atomic mass number is _(26)_. The number of valence electrons this atom has is _(27)_ because it is found in Group _(28)_. The element is _(29)_, symbol _(30)_.

1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________
6. ______________________
7. ______________________
8. ______________________
9. ______________________
10. ______________________
11. ______________________
12. ______________________
13. ______________________
14. ______________________
15. ______________________
16. ______________________
17. ______________________
18. ______________________
19. ______________________
20. ______________________
21. ______________________
22. ______________________
23. ______________________
24. ______________________
25. ______________________
26. ______________________
27. ______________________
28. ______________________
29. ______________________
30. ______________________

6. This is a Group II element with 12 protons. The number of electrons in a neutral atom of this element is _(31)_. It has _(32)_ valence electrons on the _(33)_ energy level. The family name of this element is _(34)_. The mass number is _(35)_ and there are _(36)_ neutrons in an atom of this element.

7. This element has the maximum number of valence electrons in period 4. It is _(37)_, symbol _(38)_, atomic number _(39)_, mass number _(40)_ and it has _(41)_ neutrons. Its family name is _(42)_.

8. This element is a transition metal. It has _(43)_ valence electrons and is found in period 5. It has a nuclear charge of +47. The element is _(44)_, symbol _(45)_ and atomic number _(46)_. Its mass number is _(47)_ and it has _(48)_ neutrons in its nucleus.

9. This element has a mass number of 40 but it only has 2 valence electrons. It is not a transition metal. It is found in Group _(49)_ and has electrons in _(50)_ energy levels. The element is _(51)_, symbol _(52)_ and atomic number _(53)_.

10. This element has the largest atoms of Period 4. The atomic number of this element is _(54)_. The number of protons in one atom of this element is _(55)_. An atom of this element has _(56)_ valence electrons and has _(57)_ completely filled quantum levels. The element is a member of the _(58)_ family. The element is _(59)_, symbol _(60)_.

31. ____________________
32. ____________________
33. ____________________
34. ____________________
35. ____________________
36. ____________________
37. ____________________
38. ____________________
39. ____________________
40. ____________________
41. ____________________
42. ____________________
43. ____________________
44. ____________________
45. ____________________
46. ____________________
47. ____________________
48. ____________________
49. ____________________
50. ____________________
51. ____________________
52. ____________________
53. ____________________
54. ____________________
55. ____________________
56. ____________________
57. ____________________
58. ____________________
59. ____________________
60. ____________________

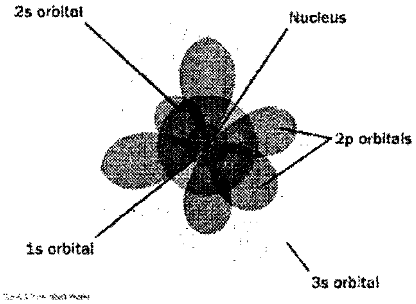
Name ____ date _______________ period_____

Chemical Bonding Worksheet

Fill in the blanks with the word that best completes the sentence or answers the question.

General Information

The smallest particle of matter that retains its chemical properties is called an (1.) ____________________.
Atoms are composed of three atomic particles. These are called protons, (2.) ________________________, and (3.) __________________________.
Neutral atoms have equal numbers of (4.) ______________________ and (5.) ______________________.
Look at the diagram of an atom below. Each of the orbitals can contain 2 electrons. The 1s orbital is the only orbital in the first electron shell so the first shell can only hold 2 electrons. In the second electron shell there is one 2s and three 2p orbitals so the second electron shell can hold a total of 8 electrons. **Label** on the diagram shown below where you would find the (6.) electrons, (7.) protons, and (8.) neutrons.

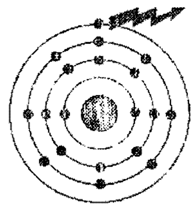


Metallic Bonds

One chemical bonding mechanism is the *metallic bond.* In the metallic bond, an atom achieves a more stable configuration by sharing the electrons in its outer shell with many other atoms. Metallic bonds prevail in elements in which the valence electrons are not tightly bound with the nucleus, namely metals. In this type of bond, each atom in a metal crystal contributes all the (9.) ________________________ in its valence shell to all other atoms in the crystal.

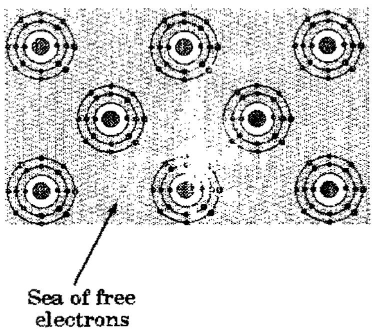
Another way of looking at this mechanism is to imagine that the valence electrons are not closely associated with individual (10.) ______________________, but instead move around amongst the atoms within the crystal. Therefore, the individual atoms can "slip" over one another yet remain firmly held together by the electrostatic forces exerted by the electrons. (Electrostatic forces are those due to the charges on the nucleus and the surrounding electrons.) Note this configuration in the diagrams below. This is why most metals can be hammered into thin sheets which is the property called (11.) ______________________ or drawn into thin wires (12.) ________________________. When an electrical potential difference (electrical potential is the difference in electrical charge that allows electricity to flow) is applied, the electrons move freely between atoms, and causes a flow of electrical (13.) ________________________.

Other simple examples include potassium (K).



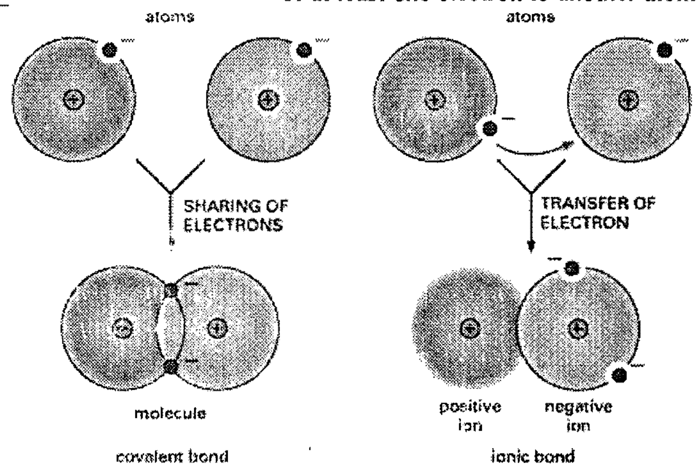
Potassium (2:8:8:1)

Potassium atoms lose the outermost electron and form a metallic bond.



Covalent Bonds vs Ionic Bonds

Ionic and Covalent bonds are often compared and contrasted. Below is a diagram showing examples of each of these type of bonds. The main difference is that in covalent bonds there is a (14.) ________________________ of the electrons whereas in ionic bonds there has been a (15.) _____ of at least one electron to another atom.



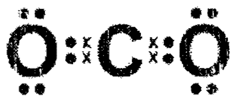
Covalent Bonds

Covalent chemical bonds involve the (16.) _________________________ of a pair of valence electrons by two atoms, in contrast to the transfer of electrons in ionic bonds. Such bonds lead to stable molecules if they share electrons in such a way as to create a noble gas configuration for each atom.

Hydrogen gas forms the simplest covalent bond. The halogens such as chlorine also exist as diatomic gases by forming covalent bonds. The nitrogen and oxygen which makes up the bulk of the atmosphere also exhibits covalent bonding in forming diatomic molecules.

Covalent bonding can be visualized with the aid of Lewis (dot) diagrams. Lewis diagrams show only the valence electrons around the chemical symbol for an element. There is an example of a Lewis (dot) diagram below in the diagram showing a hydrogen molecule and a water molecule. Note the (17.) ________________________ electrons are the only ones shown in the dot diagrams.

Drawing the Dot Structure for Carbon Dioxide



The carbon atom starts out with 4 outer shell electrons, and each oxygen atom starts out with 6 (as shown above). In order for each atom to end up with an octet (8 electrons in the outer shell), those 16 electrons must arrange themselves as shown in the Lewis dot structure above, resulting in two double bonds around the central carbon atom.

H· + |C̄l· ——→ H—C̄l| or H:C̈l:

Drawing the Dot Structure for Hydrogen Chloride

The electrons spend more time around the Chlorine atom than the Hydrogen atom making the Chlorine side of the molecule have a negative charge and the Hydrogen side of the atom have a positive charge.

Polar vs Nonpolar Covalent Bonds

Covalent bonds in which the sharing of the electron pair is (18.) ____________________, with the electrons spending more time around the more nonmetallic atom, are called polar covalent bonds. In such a bond there is a charge separation with one atom being slightly more positive and the other more negative.

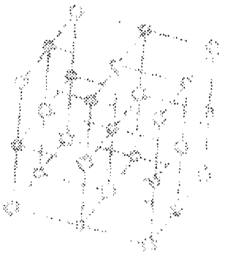
Ionic Bonds

In case where one or more atoms lose electrons and other atoms gain them in order to produce a noble gas electron configuration, the bond is called an ionic bond.

Some atoms, such as metals tend to (19.) ____________________ electrons to make the outside ring or rings of electrons more stable and other atoms tend to gain electrons to complete the outside ring. An (20.) ____________________ is a charged particle. Electrons are negative. The negative charge of the electrons can be offset by the positive charge of the protons. When an atom loses electrons it becomes a (21.) ____________________ ion because the number of protons exceeds the number of electrons. Nonmetal ions and most of the polyatomic ions have a negative charge. The nonmetal ions tend to (22.) ____________________ electrons to fill out the outer shell. When the number of electrons exceeds the number of protons, the ion is negative. The attraction between a positive ion and a negative ion is an ionic bond. Any positive ion will bond with any (23.) ____________________ ion. They are not fussy. An ionic compound is a group of atoms attached by an ionic bond that is a major unifying portion of the compound. A positive ion, whether it is a single atom or a group of atoms all with the same charge, is called a (24.) ____________________. A negative ion is called an (25.) ____________________. The name of an ionic compound is the name of the positive ion (cation) first and the negative (anion) ion second.

The names of the ions of nonmetal elements (anions) develop an -ide on the end of the name of the element. For instance, fluorine ion is fluoride, oxygen ion is (26.) ____________________, and iodine ion is (27.) ____________________. There are a number of elements, usually the (28.) ____________________ metals that having more than one valence, that have a name for each ion, for instance ferric ion is an iron ion with a positive three charge. Ferrous ion is an iron ion with a charge of plus two. There are some ion which are called polyatomic ions. These are covalently bonded groupings that act all together as ions. Examples of polyatomic ions are phosphate, cyanide, ammonium, and hydroxide.

Below is a diagram of a sodium chloride crystal. Note how the ions are arranged in a regular pattern. Also note that there is a line indicating the attraction between each of the ions in each of the molecules. This attraction between molecules allows for the ionic compound to have a (29.) ____________________ melting point. Properties of ionic compounds include that they are (30.) ____________________ at room temperature, will (31.) ____________________ electricity when melted or dissolved, and will not conduct electricity when in the (32.) ____________________ form.



Naming Ionic and Covalent Compounds

The naming of ionic compounds is different from the naming of covalent compounds. Ionic compounds are named according to the directions in the "Math Skills" box on p. 125 of your text book. Go over these directions with your teacher. After you go through the directions, attempt the practice problems #1 - #4 on the bottom of p. 125 and write your answers below. You will need your periodic table and the polyatomic packet. It will be useful to use the ion cards to help figure out the **formulas** for these compounds.

1.) lithium oxide ____________________ 3.) titanium (III) nitride is____________________

2.) beryllium chloride ____________________ 4.) cobalt (III) hydroxide is____________________

Now you need to think in reverse. You are given the formula and need to figure out the **name** of the ionic compounds for the molecules in the "Check Your Understanding" section on p. 128 of your text book.

1. a.) $Ni_3(PO_4)_2$ ____________________ d.) $CrCl_2$ ____________________

b.) FeI_2 ____________________ e.) NaCN ____________________

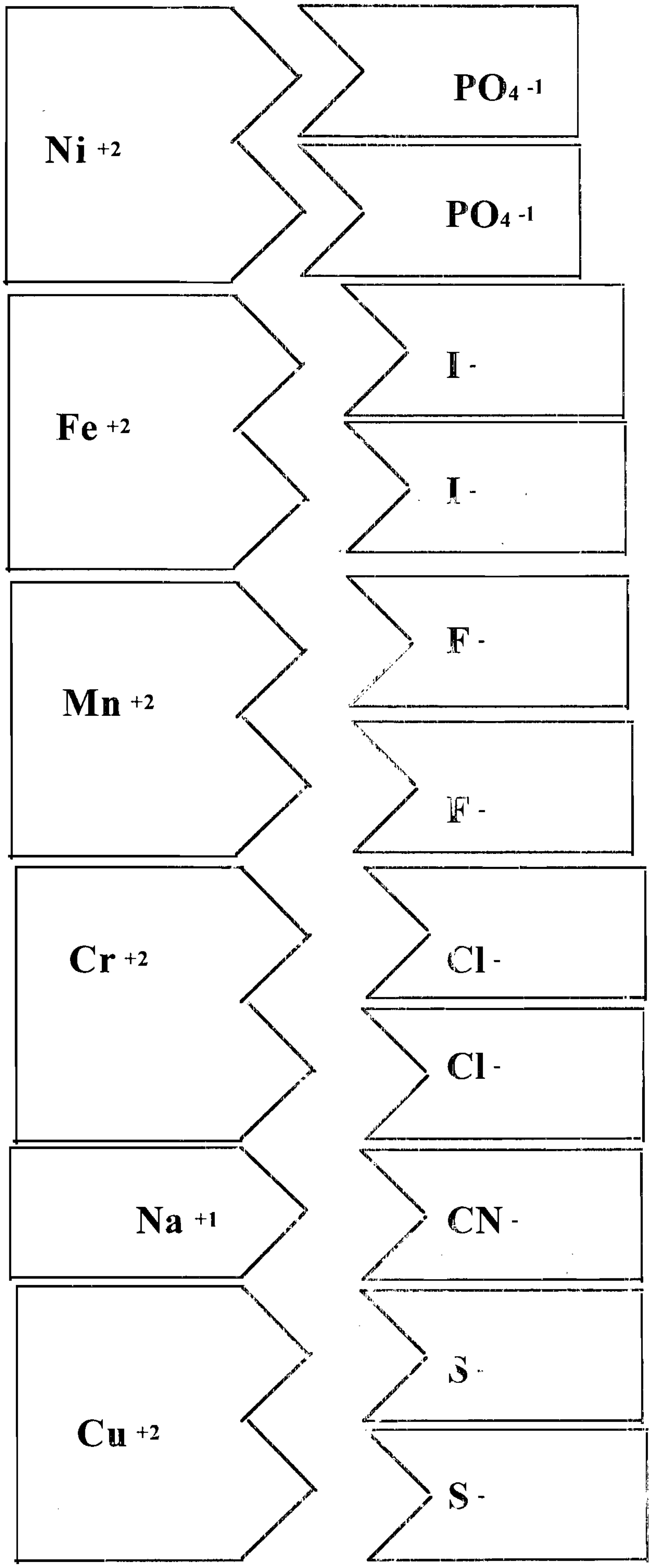
c.) MnF_2 ____________________ f.) CuS ____________________

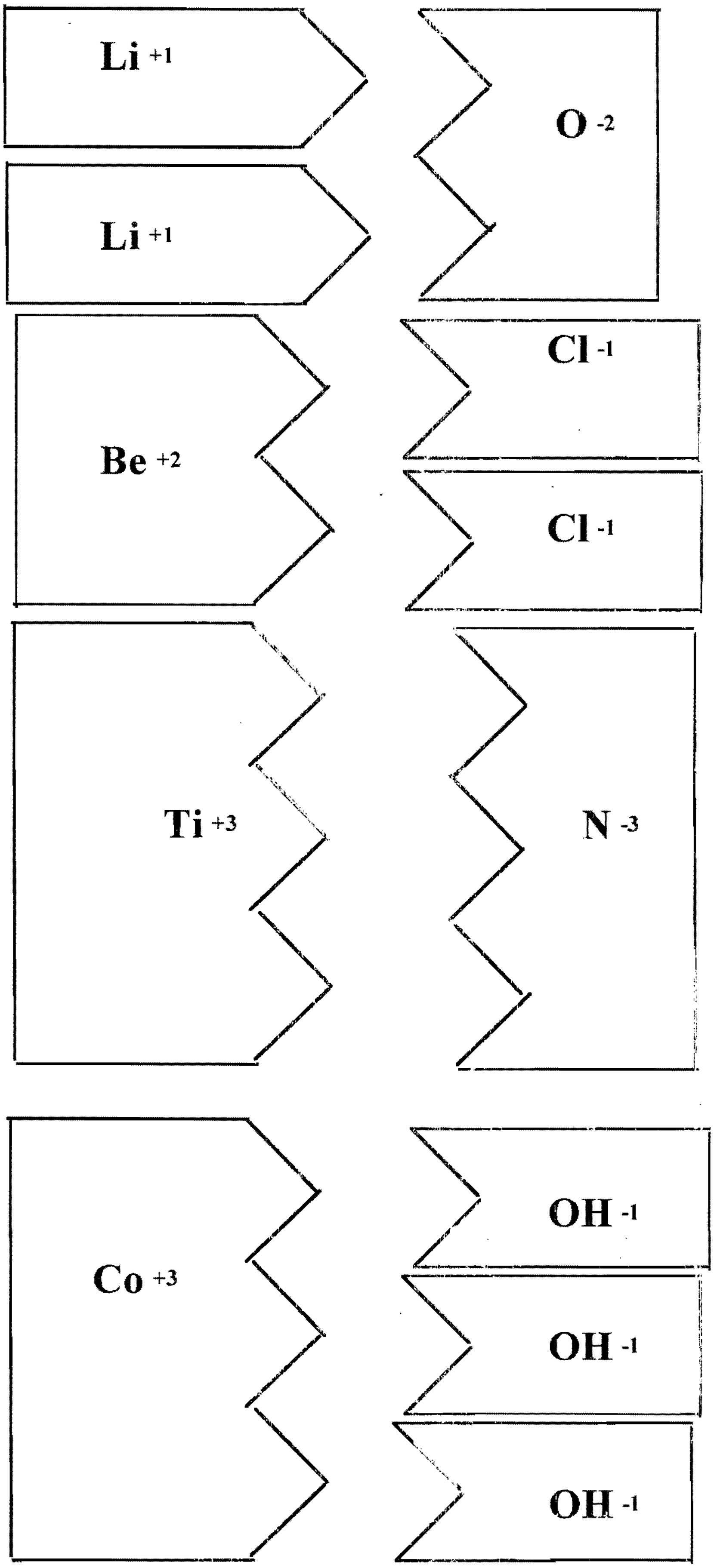
2. a.)You are now being given the formula for several covalent compounds. These problems are also on p. 128 of your text book. Use the prefixes related to numbers of atoms from p. 126 to name the following covalent compounds.

a.) As_2O_5 ____________________ d.) P_4O_{10} ____________________

b.) SiI_4 ____________________ e.) SeO_2 ____________________

c.) P_4S_3 ____________________ f.) PCl_3 ____________________


Ni +2
PO4 -1
PO4 -1
Fe +2
I -
I -
Mn +2
F -
F -
Cr +2
Cl -
Cl -
Na +1
CN -
Cu +2
S -
S -


Li +1
O -2
Li +1
Be +2
Cl -1
Cl -1
Ti +3
N -3
Co +3
OH -1
OH -1
OH -1

Name________________________Period #___

Chemical Reactions Worksheet

Use the word bank to complete the following statements. Some words may be used twice or not at all.

1. A process in which one or more ___________________________ change to make one or more new substances with different physical and chemical ______________________ is called a _______________________________________.

2. Chemical ____________________ are a shorthand way of representing substances by using ________________ and numbers to represent the _____________ in a molecule.

3. A chemical ___________________ uses chemical symbols and formulas to describe a chemical ________________________.

4. In order for a chemical reaction to occur, the chemical ________________ must be broken and replaced by new ________________. When this happens, new substances are formed.

5. A _____________________ is a solid substance formed in a solution.

6. Symbols, formulas, and equations are ___________________. Anyone from any country can read them – like music.

7. ____________________ is very important when writing chemical formulas and equations. You must pay close attention to ___________ and ___________ cases.

8. The Law of _________________________ of _____________ states that mass cannot be _______________________ or destroyed.

upper

Conservation

accuracy

properties

atoms

reaction

created

bonds

lower

substances

formulas

Mass

chemical reaction

equation

symbols

reaction

precipitate

universal

Indicate whether the following changes are chemical or physical by writing a P or C in the blank.

9 ._____leaves changing color 10._____sugar dissolving in tea 11._____rusting nail

12._____melting ice cream 13._____muffins baking 14._____broken pencil

15._____vinegar and baking soda 16._____penny turning green 17._____fireworks

18. Circle the one that is NOT a common sign that a chemical change is taking place:

bubbles light heat melting odor color change

Refer to the following chemical equation for the next few questions:

$$6\ CO_2 + 6\ H_2O + \text{energy} \rightarrow C_6H_{12}O_6 + 6\ O_2$$

19. Circle all the subscripts in this chemical equation.
20. Draw a box around each molecule in this equation.
21. Underline the coefficients in the equation.
22. How many atoms are on the left side of the equations? __________
23. How many atoms are on the right side of the equation? __________
24. How many total Carbon atoms are there?_______ Oxygen?______ Hydrogen? _______
25. Does the arrow point to the products or the reactants in the equation? ____________________
26. Does this equation follow the Law of Conservation of Mass? ______________

Explain:____

27. What chemical reaction so you think this equation represents? ____________________________

28. Try to balance the following equation by putting in the appropriate coefficients:

$$\_\_\_\_\ Na + \_\_\_\_\ Cl_2 \rightarrow \_\_\_\_\ NaCl$$

Name: ____________________
Period: ______ Date: _______

Nuclear Chemistry Worksheet

Directions: Identify the following as alpha, beta, gamma, or neutron.

1. $^{1}_{0}n$ ____________ 2. $^{0}_{-1}e$ ____________ 3. $^{4}_{2}He$ ____________ 4. $^{0}_{0}\gamma$ ____________

5. Nuclear decay with no mass and no charge ____________

6. An electron ____________

7. Least penetrating nuclear decay ____________

8. Most damaging nuclear decay to the human body ____________

9. Nuclear decay that can be stopped by skin or paper. ____________

10. Nuclear decay that can be stopped by aluminum. ____________

Complete the following nuclear equations.

11. $^{42}_{19}K \rightarrow ^{0}_{-1}e +$ __________

12. $^{239}_{94}Pu \rightarrow ^{4}_{2}He +$ __________

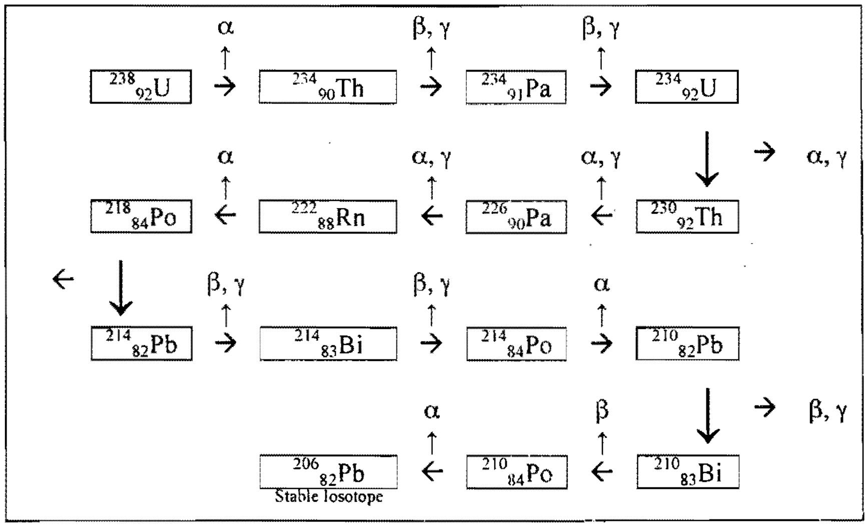
13. $^{9}_{4}Be \rightarrow ^{9}_{4}Be +$ __________

14. $^{235}_{92}U \rightarrow$ __________ $+ ^{231}_{90}Th$

15. $^{6}_{3}Li \rightarrow ^{4}_{2}He +$ __________

16. __________ $\rightarrow ^{142}_{56}Ba + ^{91}_{36}Kr + 3\,^{1}_{0}n$

Nuclear Decay Series



The figure maps the radioactive decay of uranium-238 to lead-206. Use the figure to answer the following questions.

17. How many alpha particles are produced as one atom of uranium-238 decays to an atom of lead-206?

____

18. How many beta particles?

____

19. Explain why lead-206 is a stable isotope. ________________

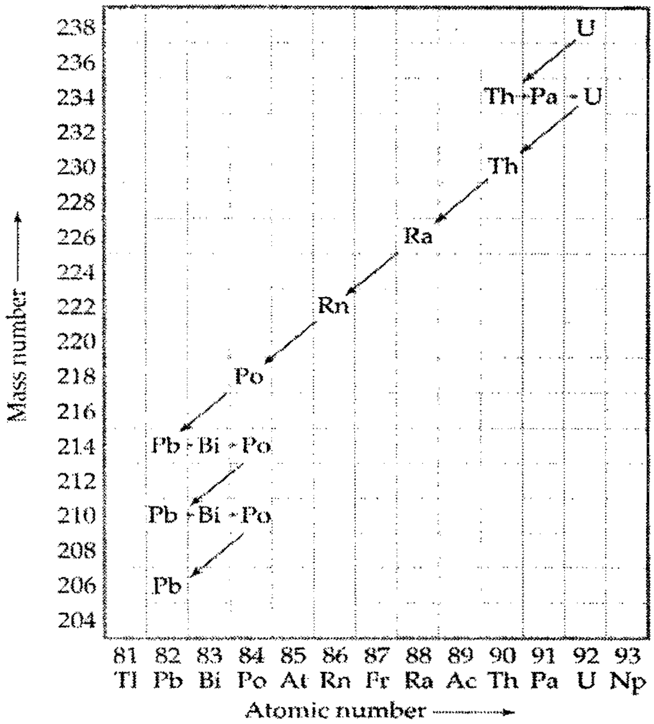
____

____

20. When protactinium-229 goes through two alpha decays, francium-221 is formed.

21. Write the nuclear equation for the decay of Po-210 if it undergoes 2 consecutive alpha decay followed by a beta decay followed by another alpha decay.

22. The decay chain (or series) of uranium-238 is shown in the following figure. What is the ***final product*** in this decay series?



23. Using the figure to the right, list each type of decay that uranium-238 goes through to become lead-206.

24. Thorium-232 undergoes radioactive decay until a stable isotope is reached. Write the reactions for the decay of Th-238. There are eleven steps beginning with Alpha decay with each product becoming the reactant of the next decay. Circle the final Stable isotope.

- Alpha: ______________________________
- Beta: ______________________________
- Beta: ______________________________
- Alpha: ______________________________
- Alpha: ______________________________
- Alpha: ______________________________
- Alpha: ______________________________
- Beta: ______________________________
- Beta: ______________________________
- Alpha: ______________________________
- Beta: ______________________________

Acids and Bases 

The degree of **acidity** or **alkalinity (basic)** is important in organisms. The body must constantly maintain a near neutral pH (7) in the blood and body tissues. To do this, the body produces **buffers** that can **neutralize** acids. Acidic and basic conditions in the body occur due to different **metabolic (chemical) reactions** taking place throughout the body.

1. What does alkalinity mean?

2. What pH must organisms maintain?

3. What characteristic of life would maintaining this balance be? (See textbook)

4. What chemicals does the body produce to keep neutral pH?

5. Buffers _____________ acids in the body.

6. Acidic and basic conditions occur due to ______________ reactions in the body.

Water is one of the most important molecules in the body. Cells are made mostly of water and water is required for almost every metabolic reaction in the body. The force of attraction between water molecules is so strong that the oxygen atom of one molecule can actually remove the hydrogen from other water molecules. This reaction is known as **dissociation**, and it takes place in our cells. Water (**H_2O**) **dissociates** into H^+ and OH^- **ions**. A charged atom or molecule is called an **ion**. The OH^- **ion is** called the **hydroxide ion**, while the H^+ **ion** is called the **hydrogen ion**. **Free** H^+ **ions** can react with another water molecule to form the H_3O^+ or **hydronium ion**. The human body requires a **neutral pH** for many reasons. One reason cells like a neutral pH is for proteins. **Basic or acidic solutions denature proteins (change their shape) so they no longer work.**

7. What is dissociation?

8. What is the chemical formula for water?

9. What is an ion?

10. Name the 2 ions form when water dissociates.

11. What is the hydroxide ion?

12. What is a hydrogen ion?

13. What is the hydronium ion and its formula?

Acidity or alkalinity is a measure of the relative amount of **H^+ and OH^- ions** dissolved in a solution. **Neutral solutions** have an equal number of **H^+ and OH^- ions. Acids** have more **H_3O^+ ions** (H+) than **OH^- ions. Acids** taste **sour** and can be **corrosive. Digestive fluids** in the body are acidic and must be neutralized by buffers. **Bases** contain more **OH^- ions** than **H_3O^+ ions. Bases** taste **bitter** and **feel slippery.**

When an acid is combined with a base, **neutralization** occurs. The result of neutralization is a **salt** and **water.** Neutralization helps return our body **pH** to **neutral.** The process of our bodies maintaining neutral pH so that proteins can work properly without being denaturated (unfolded) is known as **homeostasis.**

14. How do you measure for acidity or alkalinity?

15. What is a neutral solution?

16. Acids have more ____________ ions and taste ______________. And can be __________________.

17. Bases contain more ______________ ions than _____________ ions.

18. _______________ fluids are acid in the body and must be ___________________ by __________________.

19. Bases taste _________________ and feel ____________________.

20. What is neutralization?

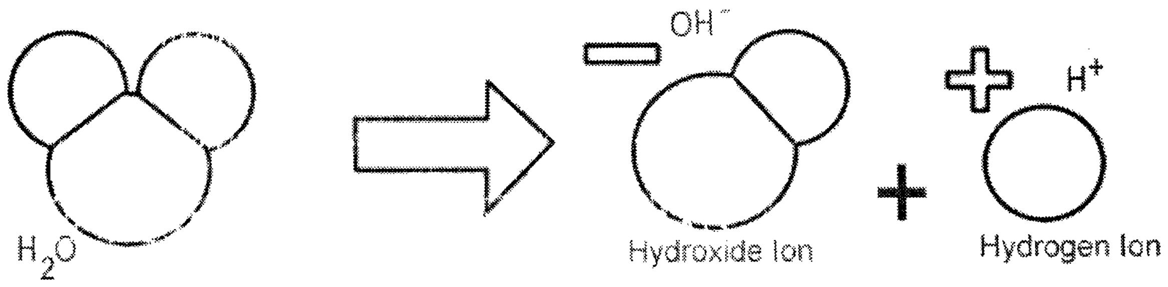
21. What 2 things are produced by neutralization?

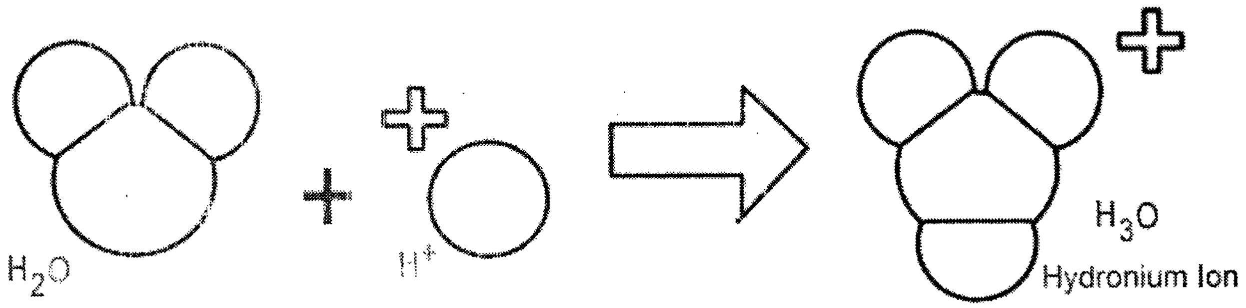
22. Neutralization keeps our pH at _________________ and is an example of maintaining ________________________.

Color the following diagrams according to the key.

DISSOCIATION OF WATER

HYDROGEN (yellow)
OXYGEN (red)

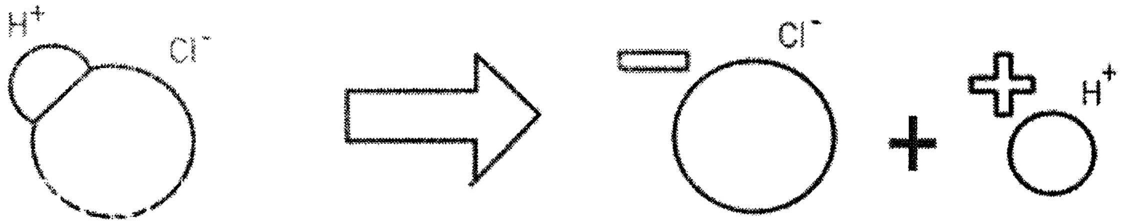




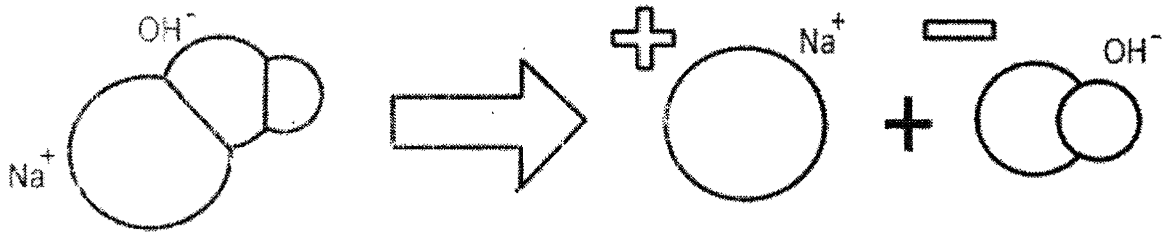
ACIDS & BASES

Chlorine (green)
Sodium (blue)

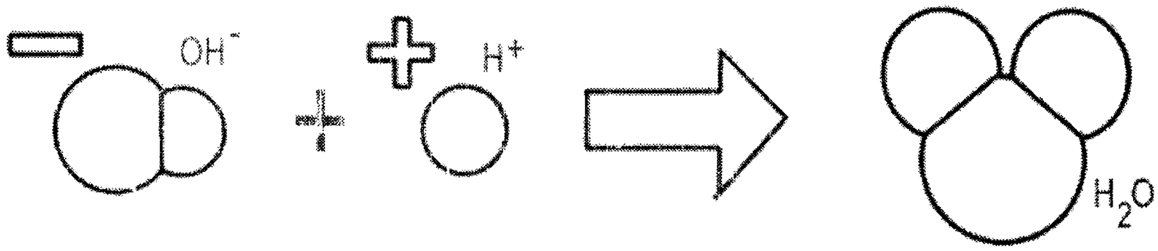
Hydrochloric Acid



Sodium Hydroxide



NEUTRALIZATION



Questions:

1. Why is the water molecule so important to organisms?

2. What ions form when water dissociates?

3. What is meant by the term alkalinity?

4. What is produced by the body to help neutralize acidic conditions?

5. What is the name for the **OH^- ions**?

____

6. What is the name for the **H^+ ion**?

____

7. How does the hydronium ion form? What is its formula?

____

____

8. Why do most proteins need near a neutral pH?

____

9. What two substances form from an acid-base neutralization?

____

10. Acids have an excess of ____________ ions.