Dear AP Chemistry Student,

I’m excited that you are taking AP Chemistry in the 2024-2025 school year with me. This is a hard class that requires dedication, a lot of work and a love for chemistry.

AP Chemistry is meant to be a second-year course….that is, there is a lot of new material to cover and very little time to go over topics we studied in 10th grade Chemistry. However, because Chemistry is comprehensive, we can’t forget about all the concepts learned. To that end, I’ve put together this notes and problems packet for you to complete during the summer. Don’t try to do it all at once – but practicing a little at a time every few days will help to flex those brain muscles over the summer. Please join my youtube channel (<https://youtube.com/playlist?list=PLvOP8Dfba2lSn0PiatFZj6e3ZzsgRG_G2>). Videos are posted on this playlist that will assist with your summer packet. Please email me ([Marissa.lehmann@k12.dc.gov](mailto:Marissa.lehmann@k12.dc.gov)) if you have any questions or need any additional support. I will be checking my email about once a week during the summer.

**This packet is due on August 30th. You will have an assessment (similar to the practice quiz that is part of this packet) on August 30th.**  If you make an effort to review this material, I don’t anticipate you having any difficulty with the first test.

In that spirit, enjoy your summer and I look forward to a new year of AP Chemistry AP Chemistry with you.

All the best,

Mrs. Lehmann

**Polyatomic Ions to Memorize**

|  |  |
| --- | --- |
| **Chemical Formula** | **Chemical Name** |
| C2H3O2- | Acetate |
| NO3- | Nitrate |
| NO2- | Nitrite |
| CO32- | Carbonate |
| HCO3- | Hydrogen Carbonate (bicarbonate) |
| PO43- | Phosphate |
| PO33- | Phosphite |
| HPO42- | Hydrogen Phosphate |
| H2PO4- | Dihydrogen Phosphate |
| CN- | Cyanide |
| CNO- | Cyanate |
| SCN- | Thiocyanate |
| SO42- | Sulfate |
| SO32- | Sulfite |
| HSO3- | Hydrogen Sulfite (bisulfite) |
| HSO4- | Hydrogen Sulfate (bisulfate) |
| OH- | Hydroxide |
| ClO- | Hypochlorite |
| ClO2- | Chlorite |
| ClO3- | Chlorate |
| ClO4- | Perchlorate |
| NH4+ | Ammonium |

**AP Chemistry Summer Packet Part I: Uncertainty in Measurement and Calculations**

**1. Exact Numbers:**

*Counted numbers* and *definitions* do not involve any measurement and are considered asexact numbers

*Definitions*: 1 week = 7 days.

1 mile = 5,280 feet

1 yard = 3 feet

*Counted*: 5 Players on the basketball court.

23 students in a room

25 pennies used by a class in an experiment.

5 rocks

**2. Measured Numbers:**

All ***measured numbers*** have some degree of uncertainty.

When recording measurements, ***record only the significant figures***. Record measurements to include one decimal estimate beyond the smallest increment on the measuring device.

**Examples (consider a measuring instrument like a ruler):**

* If smallest increment = 1m, then record measurement to 0.1m (i.e. 3.1***m***)
* If smallest increment = 0.1m, then record measurement to 0.01m (i.e. 5.67 ***m***)
* If smallest increment = 0.01m, then record measurement to 0.001m (i.e.12.675 ***m***)

c. Unless otherwise stated the uncertainty in the last significant figure *(the uncertain digit)* is assumed to be ±1 unit. Modern digital instruments and many types of volumetric glassware will state the level of uncertainty.



***3. Rules for counting Significant Figures.***

a.***Non-Zero Numbers***: Non-zero numbers are always significant.

* 1. ***Zeros:***

1. **Leading zeros** that come before the first non-zero number are ***never*** significant
2. **Captive zeros** (*sandwich zeros*) that fall between two non-zero digits are ***always*** significant.
3. **Ending zeros** that appear after the last non-zero digit are significant only when a decimalpoint appears somewhere in the number.

**Examples:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number** | **0.005** | **5005** | **5005.00** | **500.** | **0.0050** |
|  |  |  |  |  |  |
| **Sig Figs** | **1** | **4** | **6** | **3** | **2** |
|  |  |  |  |  |  |

***c. Scientific Notation:*** Significant figures are recorded in the mantissa (*number 1*≤*x < 10)*

**Examples:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number** | **3.0 x 103** | **5.998 x 105** | **6.00000 x 10-23** | **5 x 104** |
| **Sig Figs** | **2** | **4** | **6** | **1** |
|  |  |  |  |  |

1. **Rules for Using Significant Figures in Calculations**

***(a) Multiplication, Division***, ***Powers and Roots***:-***“LEAST SIG.FIG RULE”***

1. The result should be reported to the same number of significant figures as the measured number having the ***least number of significant figures.***
2. Only consider the number of significant figures in each of the ***measured numbers! (not*** ***constants)***

A screenshot of a math problem

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A screenshot of a math problem

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***(b) Addition and Subtraction:*** “***LEAST PRECISE DECIMAL RULE”***

1. The result should be reported with the same decimal precision as the measured number having the uncertain digit in the ***least precise decimal place.***
2. Only consider the decimal precision in each of the ***measured numbers! (not constants)***

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***(c) Addition/Subtraction combined with Multiplication/Division***

1. Always perform the addition portion of the calculation 1st to determine the correct decimal precision of the sum. (***least precise decimal rule***)
2. Once the precision of the sum has been determined you can count the number of significant figures in the sum to apply the “***least sig.fig rule***” in performing the multiplication.
3. *Do not round until the final calculation has been completed*.

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(***d) Scientific Notation with different powers of 10:***

***A calculator with numbers and a number

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**Problems**

*How many significant figures in the following numbers:*

|  |  |  |  |
| --- | --- | --- | --- |
| 1. | \_\_\_\_\_\_ 1,245m | 2. | \_\_\_\_\_\_\_ 0.030m |
| 3. | \_\_\_\_\_\_\_ 10,000m | 4.\_\_\_\_\_\_\_ 1.340 x 1023m | |
| 5. | \_\_\_\_\_\_\_ 3.02003 x 1014m | 6. | \_\_\_\_\_\_\_ 0.0000001m |
| 7. | \_\_\_\_\_\_\_ 1,000. | 8. | \_\_\_\_\_\_\_ 0.10000010 |

1. Convert the following numbers into standard scientific notation:
   1. 96.3 x 104 *g* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. 0.05 x 1023 *s* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. 123 x 10-7 *m* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Problems 10 – 18: Perform the following Calculations and record your answers in the proper number of significant figures and units.

1. 0.6030*s* + 0.82*s* =
2. 4.1*m* + 0.3789*m* – 153.22*m* =

12. 3.1567 x 102 *g* + 9.212 x 104 *g* – 4.677 x 106 *g* =

**Part II: Simple Metric Conversions and Consistent Units**

**Section 1: Metric Conversions**

One of the major benefits of using the metric system is the ability to move from a large unit of measure to a smaller unit of measure simply by moving the decimal point or changing the exponent.

For example, 0.003 *km* is easily changed to 3.00*m* and 4.50 x 102 *nm* is changed to 4.50 x 10-7 *m* by applying a few simple rules.

***Step 1:*** Determine the number of decimal places between the units involved in the conversion.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Decimal** |  |  |  |  |  |  |
| **places from** | 3 | 0 | -2 | -3 | -6 | -9 |
| **base** |  |  |  |  |  |  |
| **Unit** | km = 103 m | m = 100 m | cm = 10-2 m | mm = 10-3 m | µm = 10-6 m | nm = 10-9 |

A diagram of a diagram

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**Move decimal to the left to convert to a larger**

**Move decimal to the right to convert to a**

***Step 2: for Standard Numbers:*** If you are converting from a ***large*** *unit to a* ***smalle****r unit*the numberwill *get bigger* and the *decimal place will move to the right*. If you are converting from a *smaller unit to* *a larger* unit the number will *get smaller* and the decimal place will be *moved to the left*. A way toremember the direction of the decimal shift is to use this mnemonic:

***Large Unit → Small Unit → Large Number*** ***Small Unit → Large Unit → Small Number***

***Example:*** Convert 0.003*km*to*cm*.

**Step 1:** There are 5 decimals between ***km*** and ***cm***. (3-(-2)) = 5

**Step 2: *km*** is larger than ***cm*** so the number must become larger. The decimal must be moved tothe right by a total of 5 decimal places. **Therefore 0.003*km*** **= 300*cm***

***Scientific Notation:*** If you are converting from a large unit to a smaller unit the number becomeslarger which means the exponent must increase. If you are converting from a smaller unit to a larger unit the number will become smaller and the exponent will decrease. An easy way to remember the direction of the decimal shift is to use the previously stated rule of thumb.

***Example:*** Convert 3.0 x 10-3µ***m*** to ***cm*.**

**Step 1:** There are 4 decimals between µ**m** and ***c*m**. (-6(-2)) = -4)

**Step 2:** µ**m** is smaller than **c*m*** which means the number must become smaller! The exponent mustbe decreased by 4. **Therefore 3.00 x 10-3** µ***m*** **= 3.00 x 10-7** ***cm***

* **You can also always use dimensional analysis/factor labeling to do these metric conversions!**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

**Section 2:** **Using Consistent Units in Calculations:**

When performing calculations, it is important to verify that all of the basic units of measurement (***length, mass, time, etc***) are measured in the ***same metric prefix***.

***Example:*** An ant was observed to travel**3.00*m*** south, turn to the west and move an additional

**50.1*cm***, and finally turn to the north and travel an additional **0.0110*km***. Determine the total distancein meters traveled by the ant.

***Solution:*** The first step is to recognize that the three distances have been given to you in differentunits of length. Before you can perform the addition you will need to convert all of the measurements to the same unit of length. In this case the most convenient choice is the meter. Make certain to preserve the ***correct number of significant figures*** as you make the conversions.

3.00*m* = 3.00*m* (3 *sf*) 50.1*cm* = 0.501*m* (3 *sf*) 0.0110*km*=11.0 *m* (3 *sf)*

We can now proceed with the addition: (3.00*m* + 0.501*m* + 11.0*m*) = 14.501m

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

**Problems**

***Part (a): Make the following conversions – preserve the number of significant figures in the answer!***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1. |  | 450*nm* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ *mm* | *2.* | 34*km* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*cm* | |
| 3. | 43 000*mm* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*m* | | *4.* | 4.0 x 106 *nm* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_µ*m* | |
| 5. | 3.98 x 10-3*km* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*m* | | *6.* | 456*mm* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*km* | |
| 7. | 136 000*m* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*km* | | *8.* | 4.89 x 1012 *mm* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*km* | |
| 9. | 2.68 x 106 *m* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*km* | | *10.* | | 456 000 µ*m* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*mm* |
| 11. | | 450*mm* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*m* | *12.* | | 23*cm* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*mm* |
| 13. | | 234 µ*m* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*cm* | *14.* | | 2.34 x 104 *cm* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*m* |
| 15. | | 4.56 x 10-7 *cm* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*nm* |  |  |  |

**Unit Multiplication – Dimensional Analysis – Factor Labeling**

**Units:**

In the world of mathematics numbers often exist as abstract and unit-less entities. However, in the world of physics and chemistry where numbers are based upon experimentation and measurement all numbers are based in a physical reality. ***As a result, every number consists of two important*** ***parts.*** The first is a**magnitude**and the second equally important part is a**unit**. It is the unit thatgives physical, real-world meaning to the number. We never write one without the other!

**Examples:** Note that these are all “equivalence statements”!

12 ***inches*** in one ***foot***

365 ***days*** in one ***year***

***7*** days in one ***week***

1.0 x 109 ***bytes*** in one ***gigabyte***

**Derived Units and Calculations**

Many of the common units we use are actually derived units that result from performing mathematical operations on the basic units. ***When performing mathematical operations the units are treated*** ***and manipulated as if they were algebraic variables*.**Here are a few examples:

*Area* = (length -**m**) x (width -**m**) =**m2**

*Volume* = (length -**m**) x (width -**m**) x (height -**m**) =**m3**

*Velocity* = ( distance traveled–**m**)/(time -s) =**m/s**

*Density* = (mass–**g**)/(volume - mL ) =**g/mL**

**Unit Conversions**

It is often necessary to convert from one system of units to another. The most efficient way to do this is using a process known as “*unit multiplication*”, “*factor labeling”* or “*dimensional analysis*”.

***Example No. 1:*** Consider a pin measuring 2.85 ***cm*** in length in the metric system. What would bethe corresponding length in the English system?

***Step 1:*** find an equivalence statement: i.e. 1 inch = 2.54 cm

This gives rise to two conversion factors: 1 inch/2.54 cm = 1 or 2.54 cm/1 inch = 1

***Step 2:*** Chose the conversion factor that will result in the cancelation of the given unit to convert into the desired unit.

Given cm 🡪 inches so use 1 inch/2.54 cm

Note that the units for cm cancels out (cm is in both the numerator and denominator) leaving the desired units of inches!

“**Goal posting”**

One useful version of this method is called “goal posting”. ***Step 1:*** Draw a “*goal post*”with the

horizontal bar extending on each side. ***Step 2:*** Place the original number and unit to the left. Place the final unit on the right. ***Step 3:*** Move the original unit (cm) from the top left (*numerator*) to the bottom of the conversion factor (*denominator*). Now there is no confusion about which form of the conversion factor you will use. If you have done this correctly the original units on the top (*cm*) will be cancelled by the same unit in the denominator of the conversion factor.

**Dimensional Analysis**

1. I have 470 milligrams of table salt, which is the chemical compound NaCl. How many liters of NaCl solution can I make if I want the solution to be 0.90% NaCl? (9 grams of salt per 1000 grams of solution).

The density of the NaCl solution is 1.0 g solution/mL solution.

1. I have a bar of gold that is 7.0 in 4.0 in 3.0 in. The density of gold is 19.3 g/cm3. The price of gold currently is $1,945.94 per ounce. How much is my gold bar worth? (Note: 1 inch = 2.54 cm and 1 ounce = 28.35 g)
2. If the RDA for vitamin C is 60 mG per day and there are 70 mg of vitamin C per 100 G of orange, how many 3 oz. oranges would you have to eat each week to meet this requirement?
3. Owls generally maintain territories of 3 acres. How many owls could live in a large wooded area of 20 hectares? (1 hectare=1 sq. dekameter=100 m2= 2.47 acres)

5. I have 14.25 ng of glucose (C6H12O6). If 180.18 grams is the mass of 6.10 x 1023 molecules of glucose, how many carbon atoms are in my sample?

**Part III: Subatomic Particles, Isotopes and Ions**

Fill in the chart below.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Element or Ion** | **Atomic Symbol** | **Atomic Number** | **Average Atomic Mass** | **Protons** | **Neutrons** | **Electrons** |
| Oxygen | O | 8 | 16.00 |  |  |  |
|  |  |  |  |  |  |  |
| Bismuth | Bi |  | 209.0 |  |  |  |
|  |  |  |  |  |  |  |
|  | F- |  |  |  |  |  |
|  |  |  |  |  |  |  |
| Carbon | C | 6 | 12.01 |  |  |  |
|  |  |  |  |  |  |  |
| Carbon-14 | 14C |  | 14.00 | 6 |  |  |
| Pb-208 |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  | 15 | 30.97 |  |  | 15 |
|  |  |  |  |  |  |  |
|  |  |  | 55.845 |  |  | 23 |
|  |  |  |  |  |  |  |
| Potassium Ion |  |  | 39.10 |  |  | 18 |
|  | K+ |  |  |  |
|  |  |  |  |  |  |
| Sulfur Ion |  |  | 32.07 |  |  |  |
|  | S2- |  |  |  |  |
|  |  |  |  |  |  |
| **\*- Calculate the number of protons, neutrons, and electrons for the most prevalent isotope** | | | | | | | |  |

**Average Atomic Masses:**

1. Silver has two isotopes, one with 60 neutrons and the other with 62 neutrons. Give the chemical notation for each of these isotopes and calculate the relative abundance for each isotope given that the average atomic mass for silver is 107.87 amu.
2. Potassium has three isotopes. The number of neutrons and the natural abundance of these are: 20 neutron (93.23%); 21 neutrons (0.012%); and 22 neutrons (6.73%). Give the chemical notation for each of these isotopes and calculate the average atomic mass for potassium.

**Part IV: Electron Configurations**

*In the space below, write the electron configurations of the following elements:*

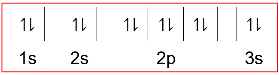
|  |  |  |
| --- | --- | --- |
| 1. | Oxygen | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 2. | Chlorine | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 3. | Sodium | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 4. | Aluminum | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 5. | Argon | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 6. | Iron | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

|  |  |  |
| --- | --- | --- |
| 7) | 1s22s22p63s23p5 | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 8) | 1s22s22p63s23p64s23d104p65s24d1 | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 9) | 1s22s22p3 | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 10) | 1s22s22p63s23p64s23d104p65s24d105p66s24f145d6 | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 11) | 1s22s22p63s23p64s23d104p3 | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

Determine what elements are denoted by the following electron configurations:

Shape

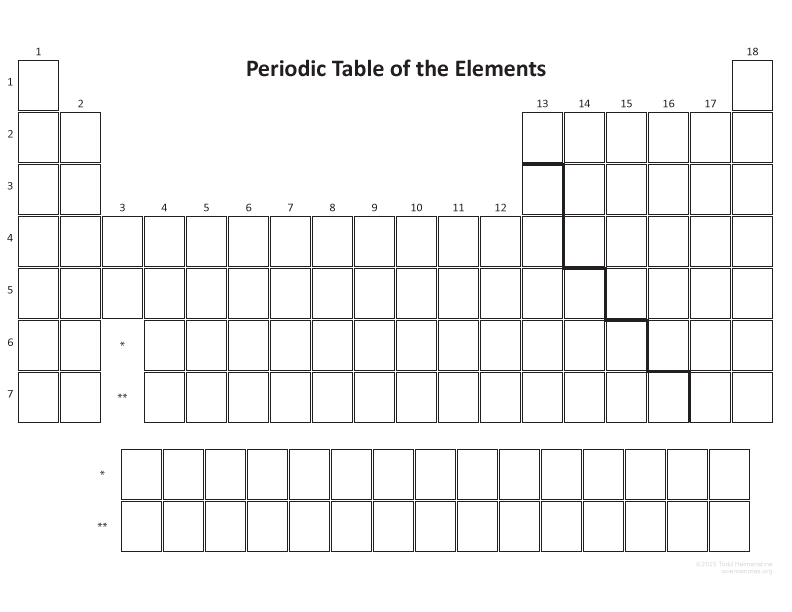
Description automatically generated with medium confidence

Draw the orbital diagrams for the flowing elements: Example: Mg or

1. Nitrogen
2. Sodium
3. Chlorine
4. Potassium

**Part V: Periodic Trends**

1. On the blank periodic table, color and label:
   1. alkali metals
   2. alkaline metals
   3. transition metals
   4. nonmetals
   5. metalloids
   6. halogens
   7. noble gases
   8. inner transition metals
2. On the blank periodic table, color and label.
   1. the s block
   2. the p block
   3. the d block
   4. the f block
3. On the blank periodic table, draw arrows to show the following periodic trends across each period and down each group. Be sure to label which way the trend is increasing and which way it is decreasing.
   1. Atomic radius
   2. Ionization energy
   3. Electronegativity



**Part VI: Chemical Bonding**

**Section 1: Ionic Bonding**

Ionic bonds involve a transfer of electrons from one atom (or atomic group) to another. Cations are positive ions resulting from the loss of electrons. Anions are negative ions resulting from the gain of electrons. Atoms generally lose or gain electrons to achieve a “stable octet” or set of 8 electrons in the valence shell (although there are exceptions!)

Metals tend to have low electronegativity and ionization energy and tend to form cations.

Nonmetals tend to have high electronegativity and tend to form anions.

Things to know – study the charts available on the course website!

1. Placement of metals and nonmetals on Periodic Table.
2. The charges/oxidation states taken by elements in different groups of Periodic Table.
3. Charges of common metals that take multiple charges (multivalent metals).
4. Common Polyatomic Ions (memorize the chart – both names and formulas with charges!).

**Section 2: Covalent Bonding**

Covalent bonds involve a sharing of electrons between atoms. Usually both elements in a covalent bond are nonmetals.

Equal sharing of electrons produces a **nonpolar covalent bond** and occurs when the bonding atoms have equal or very similar electronegativity. Unequal sharing of electrons occurs when atoms have significantly different electronegativities and results in a **polar covalent bond** in which one atom has a partial negative charge and the other a partial positive charge.

***Things to know:***

1. Be able to determine whether a bond is ionic, polar covalent or nonpolar covalent based on the elements bonding and electronegativity chart.
2. Draw a basic Lewis Dot structure showing the placement of all electrons.

**Check for Comprehension:**

1. Is a metal more likely to gain or lose an electron during ionic bonding?
2. How can you determine if a compound is ionic or covalent?
3. What is the difference between a polar and nonpolar bond?

**Part VIb: Nomenclature of Binary Compounds**

* **Before you start naming compounds or writing formulas from names be sure to review which elements are metals, transition metals & nonmetals and the charges they take as well as common polyatomic ions with their charges (makes this much easier!)**

**Part 1: Determine if the compound is ionic or covalent to decide which set of naming rules to apply:**

1. ***Ionic compound:***
   1. Compound contains a polyatomic ion
   2. Compound contains a metal and a nonmetal
2. ***Covalent compound:***
   1. Compound contains only nonmetal elements

**Part 2: Ionic Compound Nomenclature**

1. ***Name the cation***

i.Univalent metal cations = same name as the element

* + 1. Na+ = sodium, Ba2+ = barium, Al3+ = aluminium etc.
    2. These are usually Group 1, 2 and 13 elements
    3. Zn2+, Ag1+, Cd2+

1. Multivalent metal cations = same name as element + charge denoted by Roman Numeral in parenthesis
   1. Fe2+ = Iron (II), Fe3+ = Iron (III)
   2. Multivalent metal cation are usually in the transition metal block (Iron, Copper, Nickel, Chromium etc.)
   3. Pb and Sn are two metals not in the transition block that can take either the charge 2+ or 4+. As such, Pb and Sn always have a Roman Numeral when being named in a compound.
   4. If the cation is a polyatomic ion – it takes the same name as the ion. I.e. NH41+ is ammonium.

***B. Name the anion***

* 1. Anion that is based on a nonmetal element:
     1. Use the root of the elemental name
     2. Change the suffix to -ide
     3. Cl- = chloride, O2- = oxide, P3- = phosphide, N3- = nitride etc.

1. Anion that is a polyatomic ion:
   1. Use the name of the polyatomic ion
   2. SO42- = sulfate, PO33- = phosphite, CrO42- = chromate etc.

***C. Examples***

MgCl2 🡪 Magnesium Chloride

FeCl3 🡪 iron (III) chloride

NH4Cl = ammonium chloride

Sn3(PO4)2 = Tin (II) phosphate

(NH4)2SO4 = ammonium sulfate

**Part 3: Covalent Compound Nomenclature**

1. ***Name the first element – use Greek Prefixes (except mono)***

i. Select the appropriate Greek prefix using subscript of the element

* + 1. Mono = one
    2. Di = two
    3. Tri = three
    4. Tetra = four
    5. Penta = five
    6. Hexa = six
    7. Hepta = seven
    8. Octa = eight
    9. Nona = nine
    10. Deca = ten
  1. Name the first element using the prefix and the element name:
     1. Do not use the prefix mono- for the first element. If there is only one atom of the first element in the compound “mono” is implied

1. ***Name the second element***
   1. Select the appropriate Greek prefix using the subscript of the element
   2. Use the root of the element name for the second element
   3. Convert the suffix of the elemental name to -ide.
2. ***Examples:***

H2O = dihydrogen monoxide (the o from mono- gets dropped in monoxide)

CO2 = carbon dioxide

CO = carbon monoxide

PCl5 = phosphorus pentachloride S2O3 = disulfur trioxide

**Writing Chemical Formulas Practice I**

Fill in the symbols and charges of the ions and then write the correct chemical formulas and the chemical

names in the corresponding blocks. The first one is done for you.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Ions** | **Sodium**  Na+ | **Calcium** | **Aluminum** | **Ammonium** | **Hydrogen** |
| **Chloride**  Cl- | NaCl  Sodium chloride |  |  |  |  |
| **Acetate** |  |  |  |  |  |
| **Oxide** |  |  |  |  |  |
| **Sulfite** |  |  |  |  |  |
| **Phosphate** |  |  |  |  |  |
| **Iodide** |  |  |  |  |  |

**Part VI: Problems - More Naming Practice!**

Write the name or chemical formula of each compound. Then indicate if it is ionic or covalent.

**Ionic or Covalent?**

1. Vanadium (V) phosphate \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_
2. Sodium permanganate \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_
3. MnF2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_
4. Ni(SO3)2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_
5. Phosphorous triiodide \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_
6. H­3PO4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_
7. Nitrogen trifluoride \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_
8. Pb3N4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_
9. Sn(OH)2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_
10. SiCl4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_
11. Calcium phosphide \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_

**Part VII: Mole Conversions Notes & Practice Worksheet**

A screenshot of a test

Description automatically generated A math problem with equations

Description automatically generated with medium confidence

A math equations and formulas on a white background

Description automatically generated**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Problems I: Mole Conversions Practice – Show Work**

1. How many moles are 1.20 x 1025 atoms of phosphorous?
2. How many atoms are in 0.750 moles of zinc?
3. How many molecules are in 0.400 moles of N2O5?
4. Find the number of moles of argon in 452 g of argon.
5. Find the grams in 1.26 x 10-4 mol of HC2H3O2.
6. Find the mass in 2.6 mol of lithium bromide.
7. What is the volume of 0.05 mol of neon gas at STP?
8. What is the volume of 1.2 moles of water vapor at STP?
9. Determine the volume in liters occupied by 14 g of nitrogen gas at STP.
10. Find the mass, in grams, of 1.00 x 1023 molecules of N2.
11. How many particles are there in 1.43 g of a molecular compound with a gram molecular mass of 233 g?