Name: _____ Period: 4 Date: _____

Regents Chemistry

Midterm Review

Directions: Use you note packets and the information included to review the content. This is a general review and may not cover all material that will be on the midterm in detail.

METRIC

Using tables on page one of your reference tables you should be able to identify which units are used to measure each quantity and you should be able to convert between units using the prefixes. Locate the prefix assigned to the measurement unit that you are starting with and then find the prefix that you want to convert to. Count the number difference between the factors and then move your decimal that many places.

a. Identify the unit used for each quantity:

(1) mass grams

(2) volume liters

(3) energy joules

(4) temperature Kelvin / celcius

(5) length meters

(6) time seconds

b. Convert the following:

(1) 4500 mL to L 4.5 L

(2) 0.0888 g to mg 88.8 mg

(3) 45880 mm to km 0.04588 km

(4) 560km to m 560,000 m

(5) 100C to K 373 K K = 273 + C

(6) 200K to C −73 °C

Density is the measurement of mass divided by volume. A substance's density can help identify it. For example, water's density is 1.00g/mL. Substances float in water of they have low densities, and sink when their densities are greater than 1.00 g/mL.

a. Calculate the density of a 4.6 gram sample of an unknown substance, which has a volume of 6.25mL.

$D = \frac{m}{V}$ $\frac{4.69}{6.25 mL} = 0.74 g/mL$ (2sf)

b. Calculate the mass of a substance with a density of 3.50 g/mL and a volume of 13.0mL.

$D = \frac{m}{V}$ $3.50 g/mL = \frac{D}{13.0 mL} = 45.5 g$

c. Calculate the volume of a metal square with a length of 2.0cm.

$V = l \times w \times h = 2.0 cm \times 2.0 cm \times 2.0 cm = 8.0 cm^3$

d. If the metal in question (d) above is iron, calculate the mass. (Hint: density is on table S)

density Fe = $7.87 g/cm^3$

$D = \frac{m}{V}$

$7.87 g/cm^3 = \frac{D}{8.0 cm^3} = 62.96$ 2sf

63 g

SIGNIFICANT FIGURES

All whole numbers 1-9 count. Preceding zeros never count, trapped zeros always count, and trailing zeros count IF THERES A DECIMAL before the zero. Count the number of significant figures:

5678	4	0.09809	4	0.00345	3	0.0712	3
0.0987	3	10000	1	10200	3	102.0986	7

When rounding, your answer can only be as precise as your least precise measurement. When adding or subtracting numbers, round your answer to the lowest decimal place given. When multiplying or dividing, round your answer to the least number of significant figures. Calculate and round to the correct number of significant figures:

a. 4.567 + 1.2 = 5.8

b. 678.345-234.98 = 443.37

c. 45 x789 = 3 5505 → 25f → 36,000

d. 67065/87.2 = 769.

e. (54.0-32.34)/1.202 = 18.0 or 18.1

f. 3.108*(98.70-8.20) = 281

ELEMENTS, COMPOUNDS, AND MIXTURES

Matter is anything that has a mass and takes up space. An **element** is the simplest form of matter, which cannot be broken down any further. Elements are listed on Table S and the periodic table. Their symbols start with an uppercase letter.

a. Which of the following is not matter? light

energy Light element Calcium mixture Sugar water compound Magnesium Iodide

b. Which of the above is an element? calcium

Compounds are composed of two or more elements. They can only be decomposed chemically. Elements and compounds are also known as **substances**.

a. Which of the choices in number one was a compound? magnesium iodide

b. How can compound be broken down? adding energy

c. Which of the choices in question one are substances? calcium magnesium iodide

Mixtures are physical combinations of two or more substances (elements and/or compounds). Mixtures can be **homogeneous** (completely mixed, cannot see the parts) or **heterogeneous** (unevenly mixed, can see the parts). Mixtures can be separated by physical means. Homogeneous mixtures with water solvents are labeled (aq). Label each as homogeneous or heterogeneous:

Trail mix: hetero

Steel: homo

Iron and sulfur: hetero

Sugar and water: homo (aqueous solution)

Compounds must be separated chemically but mixtures can be separated easily using physical methods.

a. Match each method with its name.

Distillation	Separated by differences in particle size
Filtration	To pour off the top layer of an uneven mixture
Decant	Separated by differences in boiling point.
Chromatography	Just a test for purity

b. Which of the above processes only work if the mixture is heterogeneous? filtration

Mixtures are composed of **solutes** that dissolve and **solvents** that do the dissolving. The solute should be the smaller quantity.

a. In salt (aq), what is the solute? salt solvent? water

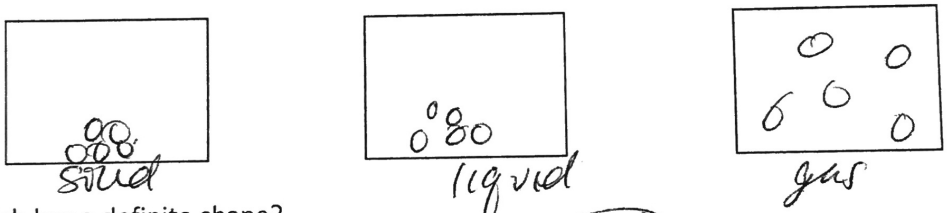
b. In iodine alcohol medicine name a solute: iodine

c. Do all solvents have to be water? Explain. No, solvent just has to be a liquid that something can dissolve in

SOLIDS, LIQUIDS, AND GASES

A **solid** has a definite shape and volume. Solids are arranged in a geometric pattern. **Liquids** have a definite volume but take the shape of the container they are in. **Gases** have an indefinite shape and volume; they take the shape and volume of the container. Gases are easily compressed.

a. Draw particle diagrams for a solid, liquid, and a gas using at least 5 particles:



b. Which has a definite shape?

$HCl_{(g)}$ $H_2O_{(l)}$ $Cu_{(s)}$ solid

c. Which has a definite volume?

$LiF_{(g)}$ $Br_{2(l)}$ $Mg_{(s)}$

Phase changes occur when heat is given to or taken from a sample. For each of the following, give the phases involved and if it is endothermic or exothermic.

Evaporation	l → g	endo
Melting	s → l	endo
Deposition	g → s	exo
Freezing	l → s	exo
Condensation	g → l	exo
Sublimation	s → g	endo

CHANGES IN THE LAB

Physical changes are changes where the substance retains its properties. **Chemical changes** will make substances change into new substances and change properties.

a. Label the following as physical (P) or chemical (C) properties:

Texture P flammability C boiling point: P

Odor C color P chemical composition: C

b. Label the following as physical (P) or chemical (C) changes:

Corrosion: C melting: P mixing: P

Freezing: P cutting: P decaying: C

MOLES and MOLAR MASS

The mole represents 6.02×10^{23} particles such as atoms and molecules of any substance. The Molar Mass (aka gram formula mass or molecular mass) is the mass of one mole of a substance. Element's molar masses are reported on the periodic table. Using formulas on the last page of your reference tables as well as you periodic table you should be able to calculate the mass or moles of any substance.

a. Calculate the molar mass of the following:

Na 23g/mol F_2 38g/mol LiBr 87g/mol

$MgCl_2$ 94g/mol $CaSO_4$ 136g/mol $Sr_3(PO_4)_2$ 454 g/mol

b. Calculate the moles of the following: mol = g/gfm

32.0 grams Na $\frac{32.0\,g}{23\,g/mol} = 1.4\,mol$ 109.0 grams of F_2 $\frac{109.0\,g}{38\,g/mol} = 2.9\,mol$

59.0 grams $CaSO_4$ $\frac{59.0\,g}{136\,g/mol} = 0.43\,mol$ 870.0 grams of $Sr_3(PO_4)_2$ $\frac{870.0\,g}{454\,g/mol} = 2.68\,mol$

c. Calculate the mass of the following:

g = mol x gfm

5.00 moles of $MgCl_2$ $5.00\,mol \times 94\,g/mol = 470\,g$ 0.025 moles of LiBr $0.025\,mol \times 87\,g/mol = 2.2\,g$

2.50 moles of F_2 $2.50\,mol \times 38\,g/mol = 95\,g$ 1.50×10^{-4} moles of $CaSO_4$ $1.50 \times 10^{-4}\,mol \times 136\,g/mol = 0.020\,g$

REACTIONS

Reactants refer to the substances you start with in a reaction (before the arrow). Products refer to the substances you create in a reaction after the arrow). Coefficients are how many moles of the substance are needed in a reaction. To relate moles of one substance to another, simply create a proportion.

a. Identify the reactants and products in the reaction below:

$Li_2CO_3 + 2Cu \rightarrow 2CuCO_3 + Li$

Reactants Products

Types of Reactions include:

Synthesis:	$A + 2B \rightarrow AB_2$
Decomposition:	$AB_2 \rightarrow A + 2B$
Combustion:	$CH_4 + O_2 \rightarrow CO_2 + HO$
Single Replacement:	$AB + C \rightarrow CB + A$
Double Replacement:	$AB + CD \rightarrow AD + CB$

Identify the types of reactions in question 3.

Single replacement

$Li_2CO_3 + 2Cu \rightarrow 2CuCO_3 + Li$

PERCENT COMPOSITION

Percent composition formula is on the last page of the reference tables.

a. Find the percent of C in the following:

% comp = $\frac{part}{whole} \times 100$

C_3H_8 C: 12.0g

$\frac{36.0g}{44.0g} \times 100 = 81.8\%$

CO_2

$\frac{12.0g}{44.0g} \times 100 = 27.3\%$

NAMING COMPOUNDS

When naming, always name the positive, cation first and then the negative, anion last. The elements are named in the same order they appear on the periodic table. When compounds have more than 2 elements, it contains a polyatomic ion. Use Table E on page 2 of your reference tables. Transition Metals are in the middle group of the periodic table. Nonmetals are on the right side of the staircase. They have multiple charges or oxidation numbers and so you must show which charge you are using with roman numerals. Polyatomic ions are a group of 2 or more atoms that are bonded very strongly and act as one ion. Name the following:

MgF_2 Magnesium fluoride	$LiCl$ Lithium chloride	KOH Potassium hydroxide	$CaSO_4$ Calcium Sulfate
$NiBr_2$	$NiBr_3$	$Cu(OH)_2$	$FeCl_3$ Iron (III) chloride

To write a formula, write the two ions separately showing their charges. Charges are on the periodic table. Then, swap the two numbers and drop the sign. Write the formula for the following:

① Sodium oxide $Na^+ \; O^{-2}$ Na_2O

② Silver (I) acetate $Ag^{+1} \; C_2H_3O_2^-$ $AgC_2H_3O_2$

③ Iron(II) iodide $Fe^{+2} \; I^{-1}$ FeI_2

④ Cesium hydroxide $Cs^{+1} \; OH^{-1}$ $CsOH$

⑤ Strontium phosphate $Sr^{+2} \; PO_4^{-3}$ $Sr_3(PO_4)_2$

⑥ Manganese (VII) chloride $Mn^{+7} \; Cl^{-1}$ $MnCl_7$

SCIENTIFIC THEORIES

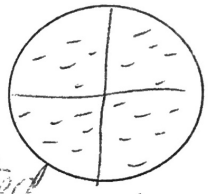
Dalton theorized that atoms were the smallest particle and could not be divided. Atoms can bond with one another in whole number ratios to form compounds but cannot be created or destroyed. Atoms of the same element are identical. Dalton's model is known as the **hard sphere model**.

a. According to Dalton, what is inside the atom? solid sphere

b. What part of Dalton's theory has been disproven? there are subatomic

Thompson worked with the cathode ray tube and discovered a ray of light travelling to the positive plate in the tube. This particle was the **electron** which must have a negative charge. Because atoms are neutral, Thompson assumed there must be invisible positively charged particles as well. These discoveries lead to Thompson's **plum pudding model**.

a. Draw the plum pudding model:

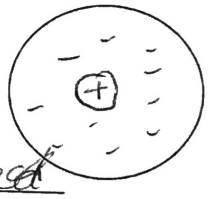


b. Explain why Thompson didn't find protons, but knew they were there.

He knew the atom was electrically neutral. There had to be a positive charge

Rutherford shot alpha particles at gold foil in an effort to disprove either Dalton or Thompson's theory. If Dalton were right, the alpha particle would deflect, if Thompson were right the alpha particle would go straight through. 99% of the alpha particles went straight through. Rutherford concluded the atom was mostly empty space with a dense positive **nucleus** containing **protons** and **neutrons**. His model is known as the **nuclear model**.

a. Draw the nuclear model:

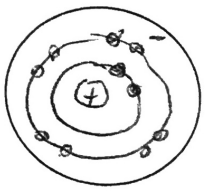


b. How did Rutherford know the nucleus is dense and positive?

Only some alpha particles were deflected

Bohr used complicated mathematics to organize electrons into **orbits** around the nucleus with specific energies. His model is known as the **planetary model**.

a. Draw the planetary model:



b. Why did Rutherford's model need to be revised?

Rutherford didn't put the electrons into specific locations or orbits, just outside of the nucleus

SUBATOMIC PARTICLES

Atoms are neutral and contain subatomic particles. **Protons** are positively charged particles located in the nucleus. **Neutrons** are neutral particles located in the nucleus. **Electrons** are negatively charged particles found in orbit around the nucleus. Protons and neutrons both weigh 1 amu and the electron's mass in negligible.

a. Fill in the chart below:

	Charge	Mass	Location
Proton	+	1	nucleus
Neutron	0	1	nucleus
Electron	−	0	outside nucleus

c. What is an amu? "atomic mass unit" - unit of mass for subatomic particles

d. What are orbitals? probable location of an electron based on energy

e. If atoms are neutral, then the number of protons equals the number of electrons because protons are positive and electrons are negative

The **atomic number** is the identity of an element. The periodic table and table S are arranged according to the atomic number. It tells you how many protons an atom has.

a. Which element has 23 protons? V (vanadium)

b. How many protons does bromine have? 35 (Br)

The **mass number** of an element is a whole number equal to the number of protons and neutrons. Every atom has it's own mass number.

a. Why aren't electrons counted in the mass number? they have a negligible mass

b. How many electrons does B-10 have? 5 (10 = atomic mass) Ca-40? 20 Ne-20? 10

IONS

Ions represent atoms that have either gained or lost electrons forming anions and cations. A list of allowable charges is listed on the top right corner of every element box on the periodic table.

a. How are positive ions formed? electrons are lost by an atom

b. How are negative ions formed? electrons are gained by an atom

c. What are negative ions called? anions

d. What are positive ions called? cations

e. A sample has 17 protons and 18 electrons. Give the element symbol and charge. Cl^{-1}

f. A sample has 1 protons and 1 electrons. Give the element symbol and charge. H

g. A sample has 20 protons and 18 electrons. Give the element symbol and charge. Ca^{+2}

ISOTOPES

Isotopes are atoms of the same element with the same number of protons. But they have different number of neutrons and a different mass.

a. What do isotopes have in common? same atomic number (# of p^+)

b. How are isotopes different? different atomic mass (# of n^0)

c. Which of the following are isotopes?

$^{12}_{6}C$ $^{15}_{7}N$ $^{14}_{6}C$ $^{15}_{7}N$ $^{12}_{5}B$

The **atomic mass** of an element is the weighted average mass of the naturally occurring isotopes.

a. Explain how mass number and atomic mass are different.
mass # = $p^+ + n^0$ atomic mass is an average weighted mass

d. What the atomic mass of Calcium? 40.08 amu

e. If there are two isotopes of carbon, ~~Ca~~-40 and ~~Ca~~-39 which is more abundant? Ca-40
(calcium)

c. Calculate the atomic mass of a sample of element X which contains 25% X-122 and the rest is X-123.

ELECTRONS, BOHR, AND SPECTRA

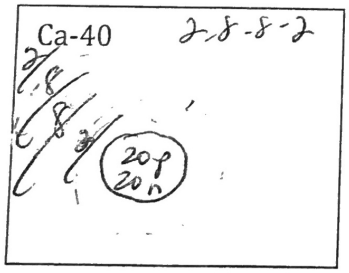
Neils **Bohr** organized the electrons into energy levels. Electrons closer to the nucleus have less energy than electrons further from the nucleus. The first level holds only 2 electrons. The second level holds 8, third holds 18 and fourth 32. These numbers are reported on the periodic table. Each element's box has an **electron configuration** in the **ground state** showing how many electrons are in each level.

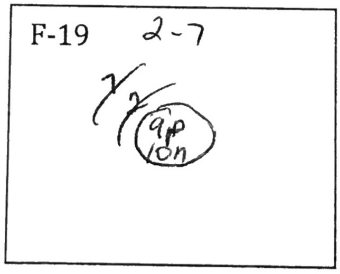
a. What is the electron configuration of Lithium? 2-1

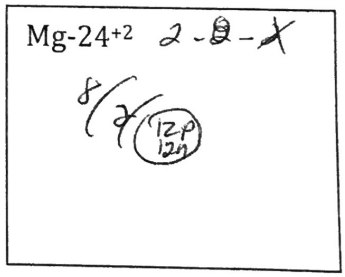
b. What is the electron configuration of Neon? 2-8

c. Which element has the ground state electron configuration 2-8-1? Na (Sodium)

d. Draw the Bohr diagram of the following:







The last level contains **valence** electrons that can be lost or gained to form ions involved in bonding. **Cations** are positive ions that have lost electrons, therefore having more positive protons than negative electrons. **Anions** are negative ions that have gained electrons and then have fewer protons than electrons.

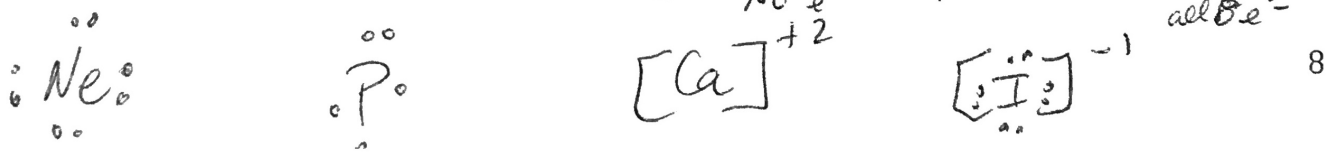
a. How many valence electrons does Lithium have? 1

b. How many valence electrons does Chlorine have? 7

c. Draw the lewis diagram of the following:

Ne P Ca^{+2} I

cation - Brackets, charge, No e⁻ anion - Brackets charge all 8 e⁻



When energy is added to the atom, electrons can move up to higher energy levels, in the excited state. The excited state is unstable. When the electrons return to the ground state they release energy in the form of light called a spectra. Every atom has a different spectrum.

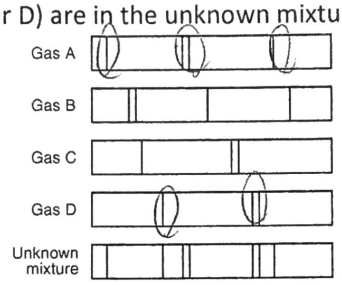
a. Energy is released when electrons move from higher to lower energy levels.

b. Energy is absorbed when electrons move from lower to higher energy levels.

c. Spectra is observed when electrons move from high to low energy levels.

d. Why can you identify atoms by their spectra? unique like a finger print

e. Identify which two gases (A, B, C, or D) are in the unknown mixture: A and D



THE PERIODIC LAW

The **Periodic Law** states that when elements are arranged in order of increasing atomic number, repetitious trends can be seen. **Mendeleev's** periodic table was arranged in order of increasing atomic mass. He then arranged columns in order to have elements with similar properties align in columns. The **modern** table is arranged by atomic number.

a. What subatomic particle decides the order of the modern periodic table? protons

b. Explain how Mendeleev's table is only slightly different than the modern table. Mendeleevs table was organized based on atomic mass.

METALS, NONMETALS, AND METALLOIDS

Metals are elements on the left side of the staircase on the periodic table. They have 1-2 valence electrons, which they tend to lose to form cations. Metals are **lustrous**, **malleable**, **ductile**, and good conductors of heat and electricity.

a. Define lustrous. shiny

b. Define malleable. flatten into a sheet

c. Define ductile. pull into a wire

d. Circle the metal: H P (Cu) S

Nonmetals are elements on the right side of the staircase on the periodic table. They have 4-8 valence electrons, which they tend to gain to form anions and fill their octet. Nonmetals are dull, brittle, and poor conductors of heat and electricity.

a. Circle the nonmetal: (C) Mg Na Au

b. Why is hydrogen considered to be a nonmetal? tends to gain an electron in a chemical bond. gas at STP.

Metalloids are elements that touch the staircase on the periodic table. They have properties of both metals and nonmetals.

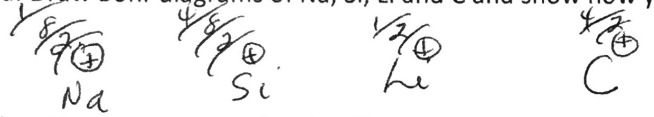
a. Most elements on the periodic table can be classified as metal, nonmetal, or metalloid?

b. Circle the metalloid:	S	(Si)	Se	Sr
c. Circle the element that is lustrous:	(Na)	N	Rn	Ne
d. Circle the element that is malleable:	(Mg)	C	Ar	H
e. Circle the element that is dull:	(S)	Sc	Sr	Sn
f. Circle the best conductor:	C	Cl	(Cu)	He
g. Circle the element that has properties of both metals and nonmetals:		Ge	(Ga)	

GROUPS AND PERIODS

Periods are the horizontal rows on the periodic table. Elements in the same period have the same number of electron levels in the Bohr diagram.

a. Draw Bohr diagrams of Na, Si, Li and C and show how you can tell which are in the same period.



Same number of shells (principle energy levels)

b. How many energy levels will an atom in the second period have? 2 Third period? 3

Groups (or families) are the vertical columns on the periodic table. Elements in the same group have the same number of valence electrons and often have similar properties.

a. How many valence electrons do the following atoms have?

Na: 1 Mg: 2 Al: 3 Si: 4 P: 5 S: 6 Cl: 7

b. Which two have the same number of valence electrons? (Ca) S (Mg)

Group 1 elements are the **Alkali Metals**, which have 1 valence electron and are very reactive (explode in water). Group 2 elements are the **Alkaline Earth Metals**, which have 2 valence electrons and are still very reactive (not as much as alkali). Groups 3-12 are the **Transition Metals**, which form colored compounds and solutions. Group 17 elements are the **Halogens**, which have 7 valence electrons and are the most reactive nonmetals. Group 18 are the **Noble Gases**, which have 8 valence electrons and are not reactive.

a. Why are the noble gases not reactive? stable octet (8 valence e⁻)

b. Which element may be blue in solutions?	C	(Cu)	Ca	Cl
c. Which element is a halogen?	C	Cu	Ca	(Cl)
d. Which element is an alkaline earth metal?	C	Cu	(Ca)	Cl
e. Which element is a noble gas?	H	F	Cs	(Rn)
f. Which element is the most reactive metal?	H	F	(Cs)	Rn
g. Which element is the most reactive nonmetal?	H	(F)	Cs	Rn

ATOMIC RADIUS

The **atomic radius** is the size of an atom. You can look up the atomic radius on Table S of the reference tables.

a. Record the atomic radius of: Li 130 Be 99 B 84 C 75

N 71 O 64 F 60 Ne 62

b. As you go across a period the atomic radius decreases because the nuclear charge increases pulling the electrons closer

c. Record the atomic radius of: Na 160 Li 130 K 200 Rb 215 Cs 238

c. As you go down a group the atomic radius increases because another principal energy level is being added (more shells)

d. Which element is the largest? Fr The smallest? F

ELECTRONEGATIVITY

The **electronegativity** of an atom is its ability to gain an electron. You can look up the electronegativity on Table S of the reference tables.

a. Record the electronegativity of: Li 1.0 Be 1.6 B 2.0 C 2.6

N 3.0 O 3.4 F 4.0 Ne —

b. As you go across a period the electronegativity increases because the nuclear charge increases attracting more electrons

c. Record the electronegativity of: Na 0.9 Li 1.0 K 0.8 Rb 0.8 Cs 0.8

c. As you go down a group the electronegativity decreases because there is more shielding from the nucleus by the increase in principal energy levels

d. Why don't noble gases have electronegativity values? They don't form chemical bonds - inert - non reactive

e. Which element has the highest electronegativity? F

IONIZATION ENERGY

The last level contains **valence** electrons that can be lost or gained to form ions involved in bonding. **Cations** are positive ions that have lost electrons, therefore having more positive protons than negative electrons. **Anions** are negative ions that have gained electrons and then have fewer protons than electrons.

a. How many valence electrons does Sodium have? 1

b. How many valence electrons does fluorine have? 7

c. If an atom has 8 protons and 10 electrons, what is the charge? -2 What type of ion is it? anion

d. If an atom has 12 protons and 10 electrons, what is the charge? +2 What type of ion is it? cation

The **ionization energy** of an atom is how much energy is required to remove an electron from the valence. You can look up the ionization energies on Table S of the reference tables.

a. Record the ionization energies of: Li 520 Be 900 B 801 C 1086
N 1402 O 1314 F 1681 Ne 2081

c. As you go across a period the ionization energies increases because (closer to octet) the nuclear charge increases making it difficult to remove e⁻

c. Record the ionization energies of: Na 496 Li 520 K 419 Rb 403 Cs 376

d. As you go down a group the ionization energies decrease because shielding from the nucleus requires less energy to remove electrons from outer shells as number of principal energy level increase

e. Which element has the highest ionization energy: He The lowest? Fr

BONDING

Elements are the simplest form of matter and cannot be decomposed. Compounds can be formed between two or more elements. They can be decomposed chemically.

a. Which of the following is a compound? Ne H_2O Be F

b. Which of the following cannot be decomposed by chemical means?

$C_{12}H_{24}$ NH_3 Li CS_2

Atoms bond in order to obtain a stable electron configuration, like noble gases, called the **octet**. Most atoms will gain or lose electrons in order to have eight valence electrons. However, small elements such as H, Li, and Be will settle for two valence electrons. Obtaining an octet makes the atoms more stable and they can release energy. The electrons obtain the octet by sharing or transferring electrons.

a. Draw the Lewis dot diagram of the following elements:

Na Mg Al Si

P S Cl Ar

b. Draw the Lewis dot diagram of the following ions:

Na^+ $[Na]^{+1}$ Mg^{+2} $[Mg]^{+2}$ Al^{+3} $[Al]^{+3}$

P^{-3} $[:\ddot{P}:]^{-3}$ S^{-2} $[:\ddot{S}:]^{-2}$ Cl^- $[:\ddot{Cl}:]^{-1}$

c. Explain why the metals lost electrons but the nonmetals gained electrons. Metals have lower IE/EN than nonmetals

d. Explain why Ar doesn't form an ion. nonreactive - stable octet noble gas

e. Fill the blanks with **release or absorb**; "When atoms bond they release energy. In order to break a bond, energy must be absorbed.

IONIC BONDING

Compounds that form between a metal and a nonmetal contain **ionic bonds**, transferring electrons. Ionic bonds are strong. Ionic compounds have high melting points, are generally solids at room temperature, and conduct in the liquid phase.

a. Which of the following has ionic bonds?	(NaCl)	NH_3	Mg
b. Which of the following transfers electrons?	($MgBr_2$)	Li	CO_2
c. Which of the following has a higher melting point?	Cu	C_6H_{12}	(LiF)
d. Which of the following can conduct in the aqueous phase?	NO	(KI)	Ne

COVALENT BONDING

Compounds that form between two nonmetals have **covalent bonds,** sharing electrons. Covalent bonds are weaker than ionic bonds. Covalent compounds have low melting points, are generally gases, liquids, or powdery solids at room temperature, and never conduct. These are also known as **molecular compounds**.

a. Which of the following has covalent bonds?	(HF)	LiCl	Rb
b. Which of the following shares electrons?	(H_2O)	Ag	$CaCl_2$
c. Which of the following can never conduct electricity?	Kr	Rb_2O	(H_2O)
d. Which of the following has both ionic and covalent bonds?	Li	NH_3	($CaCO_3$)
e. Which of the following is a molecular compound?	(H_2O)	Mg	LiBr

METALLIC BONDING

Metallic Bonds form when a metal loses their valence electrons and a "sea of mobile electrons" form that allows the metal to conduct electricity in the solid or liquid phase.

a. Which of the following is metallic? NaCl NH_3 Mg

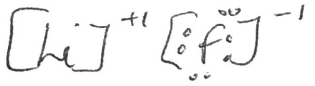
b. Which of the following has a sea of mobile electrons? Cu C_6H_{12} LiF

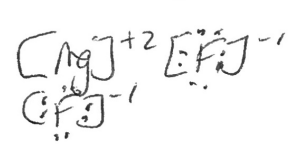
c. Which of the following can conduct in the solid phase? Ne Ag $CaCl_2$

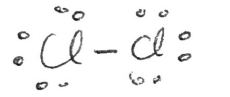
LEWIS STRUCTURES/GEOMETRY

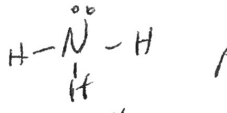
Ionic Lewis diagrams show the ions involve in the bond, but no arrangement. Covalent Lewis diagrams show the sharing of electrons with lines representing two electrons. They form shapes such as **linear, bent, pyramidal, and tetrahedral.**

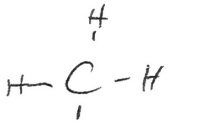
a. Draw the following and give the number of shared pairs, unshared pairs, and the shape if applicable.

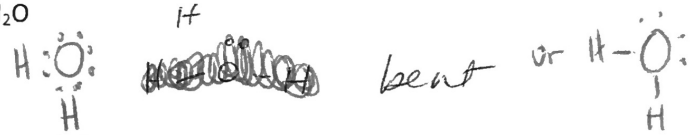
LiF  ionic crystal

MgF_2  ionic crystal

Cl_2  linear

NH_3  pyramidal

CH_4  tetrahedral

H_2O  bent

POLARITY

Bonds are **polar** when two atoms have different electronegativities and share unevenly. The more electronegative atom has the electrons more of the time. **Nonpolar bonds** form when two atoms have the same electronegativity values and share equally.

a. Label the bonds as polar or nonpolar:

NH_3 P CH_4 P Cl_2 NP H_2O P

Molecules are polar when the molecule is asymmetrical. They are nonpolar if the molecule is symmetrical.

b. Label the bonds as polar or nonpolar (Use your drawing to help you):

NH_3 polar CH_4 nonpolar Cl_2 nonpolar H_2O polar

INTERMOLECULAR FORCES

Intermolecular forces are what keeps molecules together (not atoms-that's bonds) and are responsible for phases, phase changes, surface tension and various other properties. Nonpolar molecules have the weakest attractive forces dependent on their size 9the bigger the stronger). Polar molecules have stronger forces dependent on their polarity. **Hydrogen bonds** are a special case of polar forces between H and either F,O, or N. Molecules that are hydrogen bonded have high melting and boiling points, strong surface tension, and have closely packed particles.

a. Which of the following has the highest melting point?

HF HCl HBr HI HF greatest EN difference

b. Which of the above has the lowest boiling point? HF

IMF = hydrogen bonding