First Semester Final Exam Study Guide

Unit 1

Know the structure of the atom.

a) Define atom-**the smallest particle of an element that can exist either alone or in combination** ,
neutron- **a subatomic particle of about the same mass as a proton but without an electric charge,**
proton**-** **a positively charged subatomic particle**,
electron- **a subatomic particle with a negative charge and almost no mass,**
atomic number- **the number of protons in the nucleus of an atom**,
atomic mass- **the number of protons and neutrons in the nucleus of an atom.**

b) How would you determine how many protons an atom has? **The atomic number.**
Electrons? **Same as the atomic number in a neutral atom.**
Neutrons? **Subtract the atomic number from the atomic mass.**

c) Which two sub-atomic particles make up the atomic mass of an atom? **Protons + neutrons = mass**

d) Where are the protons, neutrons, and electrons found in an atom? **Protons and neutrons in the nucleus, electrons in the electron cloud**

e) What do all atoms of the same element have in common? (What must never change for the same atom?) **Same number of protons**

f) How many protons, neutrons, and electrons does Ni have? **Protons = 28, electrons = 28, neutrons= 31**

g) How many protons, neutrons, and electrons does Au-197 have? **Protons = 79, electrons = 79, neutrons= 118**

Know the significant scientists, experiments, and finds for the history of the atom.

Know the scientists that contributed to the development of atomic structure and their significant contributions.

a) Rutherford- **Gold Foil Experiment, atom is mostly empty space, nucleus is very dense and positively charged**
b) Bohr- **Solar System Model, electrons move in circular paths around the nucleus of an atom**
c) Schrodinger - **current model of atom, Quantum Mechanical Model (Electron Cloud Model)**
d) J.J. Thomson- **Cathode Ray Tube (Plum Pudding Model), discovered the electron and it was negatively charge**

Know the difference between ion and isotope.

a) Define ion- **an atom with a charge (due to gaining or losing an electron),**
anion- **negatively charged ion (usually a nonmetal),**
cation- **positively charged ion (usually a metal)**,
isotope- **an atom with a different number of neutrons.**

b) What can change between an atom and ion of the same element? **The number of electrons**
c) What can change between an atom and isotope of the same element? **The number of neutrons**
d) Lithium will become a cation or anion? So, it will gain or lose electrons? **Cation, lose electrons, Li^+**
e) How do you find the average atomic mass?

Isotopes	Atomic Mass	% Natural Abundance
^{35}Cl	34.968853	75.78
^{37}Cl	36.965903	24.22

Solution

$$\text{Average Atomic Mass} = \frac{(\text{mass of isotope A} \times \%\ \text{natural abundance}) + (\text{mass of isotope B} \times \%\ \text{natural abundance})}{100}$$

Substitute:

$$\text{Average Atomic Mass} = \frac{(34.968853 \times 75.78) + (36.965903 \times 24.22)}{100}$$

Final Answer:

$$\text{Average Atomic Mass of Cl} = 35.45253851\ \text{amu}$$

f) Why is the average atomic mass different from a normal average? **The average atomic mass of is calculated by multiplying the mass of each isotope by its natural abundance (the decimal percent). Instead of a normal average that is found by adding all of the numbers in a set together and then dividing them by the quantity of numbers in the set.**

g) If there are three isotopes of one element that are fairly common. One has a mass of 28.965 and is found 65.5% of the time. Another has a mass of 23.96 and is found 10.1% of the time. The final isotope has a mass of 27.11 and is found 24.4% of the time. Find the average atomic mass of this element.

Average atomic mass = $\frac{(28.965 \times 65.5) + (23.96 \times 10.1) + (27.11 \times 24.4)}{100} = 28.01$

Know how to classify matter.

a) Know key terms like:
matter- **Anything that has mass and occupies space**,
atom- **the smallest particle of an element that can exist either alone or in combination**, element- **A substance that cannot be broken down into simpler substances by chemical means.**
Mixture- **A mixture is a combination of two or more pure substances in which each pure substance retains its individual chemical properties.**
pure substance- **substances that are made of only one type of atom or only one type of molecule (a group of atoms bonded together)**
homogeneous mixture- **any combination of substances that has uniform composition and properties; a *mixture* that is uniform throughout.**
Solution- **is a homogeneous mixture composed of two or more substances. Can be a solid, liquid or gas**
heterogeneous mixture- **any combination of substances that is not uniform in composition and properties**
compound- **A compound is a substance formed when two or more chemical elements are chemically bonded together**

b) Identify each as either an element or a compound. Put an E for element and a C for compound.
E Au **C** H_2O **C** NaCl **E** He

c) Describe the difference between an **Element- A substance that cannot be broken down into simpler substances by chemical means. Compound- A compound is a substance formed when two or more chemical elements are chemically bonded together**.

d) Identify each as either a homogeneous mixture (Ho) or heterogeneous mixture (He).
He Chocolate Chip Cookie Dough
He Trail Mix
Ho Air
Ho Salt Water (completed dissolved)
He Granite
Ho Shampoo

Know the difference between physical and chemical properties and changes.

a) Define physical change- **Any change that occurs without altering the chemical composition of a substance is a physical change. (Ex: freezing, melting, cutting).**
Define chemical change **- a change where one or more substances are altered into new and different substances. (ex: burning)**

b) What are the five indicators of a chemical change? **Color change, production of gas, production of a solid (precipitate), production of light or heat, production of an odor**

c) Identify each of the examples as a physical (P) or chemical (C) change.
(P) glass breaking **(C)** burning toast **(C)** frying an egg
(C) a nail rusting **(P)** making salt water **(P)** mowing the lawn

d) Identify each of the examples as a physical (P) or chemical (C) property.
(P) color (as a description not a color change!!) **(P)** taste
(P) ability to dissolve **(C)** ability to rust **(C)** flammability **(P)** density

Know how to identify elements from the periodic table as metals, nonmetals, and metalloids.

a) Describe the main characteristics and properties of each type of element:
Metal- **good conductor of heat and electricity, ductile & malleable, lustrous (shiny)**
Nonmetal- **Brittle, dull, poor conductor of heat and electricity**
metalloid/semi-metal- **brittle, good conductor of heat and electricity, lustrous (shiny)**

b) Identify each of the elements below as metals (M), nonmetals (N), or metalloid/semi-metal (S).
_(S)_ Si (N) F (M) Li (M) Ag (N) C

c) If an element is shiny, good conductor of electricity it is probably a **Metal**

Know the organization of the periodic table.

a) What are the vertical columns called? **Group or family** Horizontal rows? **periods**

b) Where are the alkali metals? **Group 1A** Alkaline earth metals? **Group 2A** Halogens? **Group 7A** Noble gases? **Group 8A**

Know the periodic trends: atomic radius, ionization energy, and electronegativity

a) Define atomic radius, ionic radius, ionization energy, and electronegativity.
Atomic radius – the size of the atom
Ionization energy – the energy required to remove an electron from the outer most energy level of an atom
Electronegativity – the likelihood to gain an electron

b) What is the trend for atomic radius going across the periodic table? Ionization? Electronegativity?
As you go across the periodic table, the atomic radius decreases.
As you go across the periodic table, the ionization energy increases.
As you go across the periodic table, the electronegativity increases.

c) What is the trend for ionization energy going down the periodic table? Ionization? Electronegativity?
As you go down the periodic table, the atomic radius increases.
As you go down the periodic table, the ionization energy decreases.
As you go down the periodic table, the electronegativity decreases.

d) Why does ionization energy increase going across a period?
As you go across the periodic table, the atoms are smaller and can hold all their electrons closer. When they do that, it will require more energy in order to remove one of those electrons. The bigger the atom, the easier it is to remove an electron.

e) Why does electronegativity increase going across a period?
As you go across the periodic table, the smaller atoms can hold electrons close and are eager to grab one or two electrons to become a noble gas. So the smaller the atom and the closer it is to being a noble gas, the more it wants to bring electrons in.

f) Is a sulfur atom or sulfur ion bigger? Why?
Sulfur ion (anion) is bigger because it brings in electrons when it becomes an ion.

g) Is a potassium atom or potassium ion bigger? Why?
Potassium atom is bigger because when it becomes an ion it loses electrons and becomes smaller.

Know the three types of bonds.

a) What types of elements are involved in ionic bonds? **Ionic bonds happen between a metal and a nonmetal.** What happens to the electrons? **The electrons are transferred from a metal to the nonmetal and locked into place.** What are the properties for ionic bonds? **Ionic bonds have many properties: crystalline, solid structure (salts), high melting point, high boiling point, ability to dissolve in water, conduct electricity when dissolved**

b) What types of elements are involved in covalent bonds? **Covalent bonds happen between two nonmetals.** What happens to the electrons? **The electrons are shared and locked into place between the elements/atoms bonding.** What are the properties of covalent bonds? **Covalent bonds have many properties: could be solid, liquid, or gas compounds, relatively low melting and boiling points, when dissolved do not conduct electricity.**

c) What types of elements are involved in metallic bonds? **Metallic bonds are between two metals.** What happens to the electrons? **The electrons are shared between the metals – but are delocalized (creating a sea of electrons).** What are the properties of metallic bonds? **Metallic bonds have many properties: good conductors of heat and electricity, malleable, and ductile.**

d) Why do elements bond? **Elements bond to become stable. They become stable by obtaining a full outer energy level or eight valence electrons.**

e) What is the octet rule? What do we use it for?
The octet rule tells us that all atoms want to have a full octet, eight valence electrons, to be stable. We use the octet rule to help us decide what type of bond they may form, and if they will gain, lose, or share electrons.

f) What type of bond would magnesium and fluorine make?
Magnesium is a metal and Fluorine is a non-metal. They would create an ionic bond – magnesium fluoride, MgF

g) What type of bond would silicon and sulfur make?
Silicon is a non-metal and sulfur is a non-metal. They would create a covalent bond – silicon disulfide, SiS_2

h) What type of bond would lithium and sulfur make?
Lithium is a metal and sulfur is a non-metal. They would create an ionic bond – silicon sulfide, Li_2S.

i) What type of bond would potassium and chlorine make?
Potassium is a metal and chlorine is a non-metal. They would create an ionic bond – potassium chloride, KCl.

Know how to determine valence electrons.

a) What are valence electrons?
Valence electrons are outer energy electrons and are the electrons that are involved in bonding.

b) How do we determine valence electrons?
You can determine valence electrons by what group/family they are in or you could add up the last s and p sublevel electrons to determine valence electrons.

c) Why are valence electrons important?
Valence electrons are important because they help determine the number of bonds and bond type that could be involved in bonding.

d) How many valence electrons does sulfur have? Does it become a cation or anion? Did it gain or lose electrons?
Sulfur has 6 valence electrons (group 6). Sulfur will become an anion (closer to 8 than to 0). It will gain to electrons and become a S^{2-} ion.

e) How many valence electrons does magnesium have? Does it become a cation or anion? Did it gain or lost electrons?
Magnesium has 2 valence electrons (group 2). Magnesium will become a cation (closer to 0 than to 8). It will lose both electrons and become a Mg^{2+} ion.

Know how to name compounds and write chemical formulas.

a) How do you determine if a compound is ionic or molecular?
You determine the type of compound by identifying the atoms involved as either metals or non-metals.

b) What do you need to keep in mind when writing chemical formulas for ionic compounds?

When writing chemical formulas, you need to reminder to crisscross ionic charges to make neutral compounds. There should be no charges on your final answer.

c) What do you need to keep in mind when naming molecular compounds?
When naming molecular compounds, you must remember to add a prefix for the first element (unless it's one, we don't write mono-) and you must add a prefix to the second element (ALWAYS) and change the ending to –ide.

d) When a polyatomic ion is involved, what type of bond is occurring?
Polyatomic ions are involved in ionic bonding.

e) Write the chemical formulas for the following compounds. *You should identify if they are ionic or molecular first*

copper (I) bromide (ionic)
CuBr

magnesium oxide (ionic)
MgO

ammonium sulfate (ionic)
$(NH_4)_2SO_4$

diphosphorous trioxide (molecular)
P_2O_3

sulfur trichloride
SCl_3

manganese (III) cyanide
$Mn(CN)_3$

f) Write the names for the following compounds. *You should identify if they are ionic or molecular first*

AlF_3
Aluminum Fluoride

$Fe(ClO_4)_3$
Iron (III) Perchlorate

NO_3
Nitrogen Trioxide

$Li(OH)$
Lithium Hydroxide

$Sr(NO_2)_2$
Strontium Nitrate

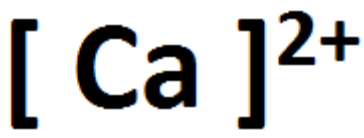
CI_5
Carbon Pentiodide

Know how to draw Lewis dot structures for atoms, ions, ionic and covalent structures.

a) What do you need to know in order to draw Lewis dot structures?
You need to know the chemical symbol and number of valence electrons.

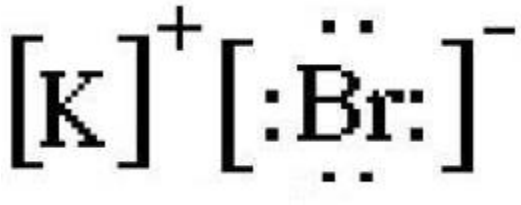
b) Draw the Lewis dot structure for calcium, xenon, and silicon.

c) Draw the Lewis dot structure for a calcium ion and silicon ion.

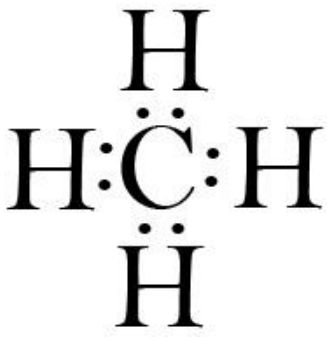


x x
[:Si :]4-
x x

d) Draw the Lewis dot structure for potassium bromide.



e) Draw the Lewis dot structure for carbon tetrahydride.



Know how to determine if a covalent bond or polar molecule.

a) What is happening when a bond is polar?

When a bond is polar, it means that the atoms sharing electrons are sharing unequally due to the differences in electronegativity.

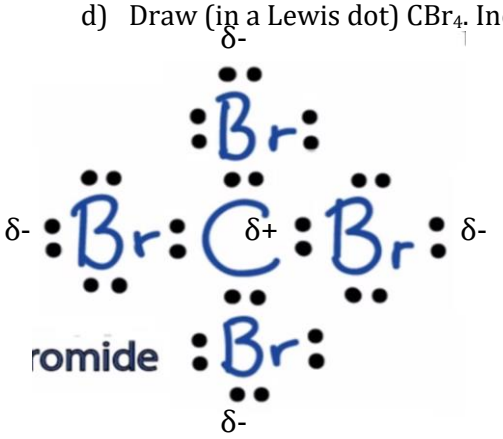
b) How do you determine if a bond is polar?

You determine if a bond is polar by identifying electronegativity and the differences between the two atoms electronegativity. If there is a difference in electronegativity is greater than .5 but less than 2 we would typically say the bond is polar covalent.

c) How do you determine if a molecule is polar?

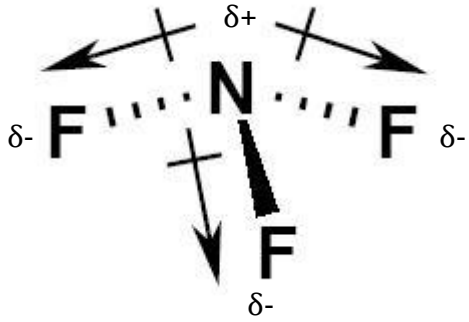
If you draw the structure properly, using VSEPR, you will be able to look at the shape of the structure and identify if the charge is symmetrically distributed. If it is symmetrically distributed we say it is non-polar, if there is a difference in distribution we say it is polar.

d) Draw (in a Lewis dot) CBr_4. Include partial charges and determine if the molecule is polar or nonpolar.



Carbon tetrabromide is a nonpolar covalent compound – the charges are all the same around the outside which means the charges are symmetrically distributed.

e) Draw (in a Lewis dot) NF_3. Include partial charges and determine if the molecule is polar or nonpolar.



Nitrogen trifluoride is a polar covalent compound – the charges are not evenly distributed, symmetrically around the outside.

Know the difference between the three intermolecular forces.

a) What is an intermolecular force? An attraction between molecules caused by opposite charges.
b) When would a molecular experience dipole-dipole forces? London dispersion? Hydrogen bonding? Dipole-Dipole occurs when polar covalent molecules are attracted to each other and do not have hydrogen bonds (hydrogen bonded to O, N, F). London Dispersion occurs when nonpolar covalent molecules are attracted to each other. Hydrogen bonding occurs when polar covalent molecules that have Hydrogen bonded directly to N, O, F involved. This causes a very strong polar region in the molecule.
c) Which is the strongest IMF? Hydrogen Bonding
d) Which is the weakest IMF? London Dispersion
e) For a hydrogen bond to form, what three elements must be involved? Hydrogen bonded directly to N, O, and/or F.

Know the difference between fission, fusion, and radiation.

a) What happens during fission? **The splitting of a larger atom, into smaller atoms (in nuclear power plants)**

b) What happens during fusion? **The combining of 2 smaller atoms, into a larger atom**

c) Give an example where fusion is happening. The **Sun**
d) List the symbols for alpha particles__$^{4}_{2}$**He** ___, **gamma particles**_$^{0}_{0}\gamma$ __, **and beta particles**__$^{0}_{-1}$**B**
e) List the symbols from most penetrating to least penetrating. **Gamma, Beta, Alpha**

Know how to balance nuclear equations.

a) Complete & balance the following nuclear reactions. **Label the type of radiation (alpha, beta, gamma, electron capture, positron emission)**
b) The alpha decay of iridium-174 $^{174}_{77}$**Ir** → $^{4}_{2}$**He** + $^{170}_{75}$**Ir**

c) The beta decay of plantinum-199 $^{199}_{78}$**Pt** → $^{0}_{-1}$**B** + $^{199}_{79}$**Au**

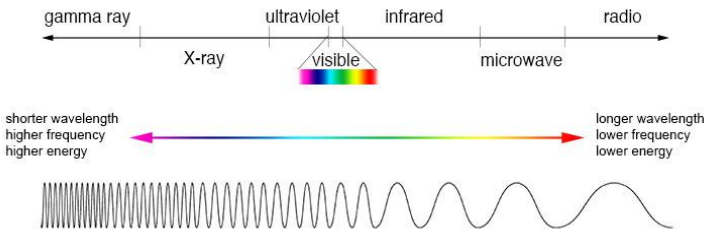
d) What is happen to the protons and neutrons in alpha decay? Beta decay? Gamma decay?
Alpha Decay: nucleus loses 2 protons and 2 neutrons (changes proton # by 2, but mass by 4)
Beta Decay: nucleus converts a neutron into a proton (changes proton # by 1, but not mass #)
Gamma Decay: doesn't influence protons or neutrons – just a high energy wave is released

e) Using a band of stability, could you identify if a radioactivity isotope would undergo alpha decay, beta decay, or electron capture?
Above the band is beta decay, below the band is electron capture, and to the far right (above atomic # 82) is alpha decay.

f) $^{214}_{83}$Bi → $^{0}_{-1}\beta$ + __$^{214}_{84}$**Po** ___
g) $^{230}_{90}$Th → $^{4}_{2}\alpha$ + ___$^{226}_{88}$ **Ra** __
h) $^{239}_{92}$ U + $^{0}_{-1}\beta$ → _$^{239}_{91}$ **Pa** _
i) _$^{238}_{92}$ **U** ___ → $^{4}_{2}\alpha$ + $^{234}_{90}$Th + 2 $^{0}_{0}\gamma$

Know about waves and light behavior.

a) Be able to label and use the electromagnetic spectrum. (from gamma rays to radio waves)



b) What is the photoelectric effect? How does the frequency of light influence the photoelectric effect?

The photoelectric effect shows us how light acts like a particle. If high energy waves strike a piece of metal (has to be super high energy) it will eject particles at the same ratio as photons striking the metal.

c) Using the bright line spectra, what can you tell about how much energy an electron is releasing?

High energy release will appear as blue band of light versus low energy will appear as red band of light.

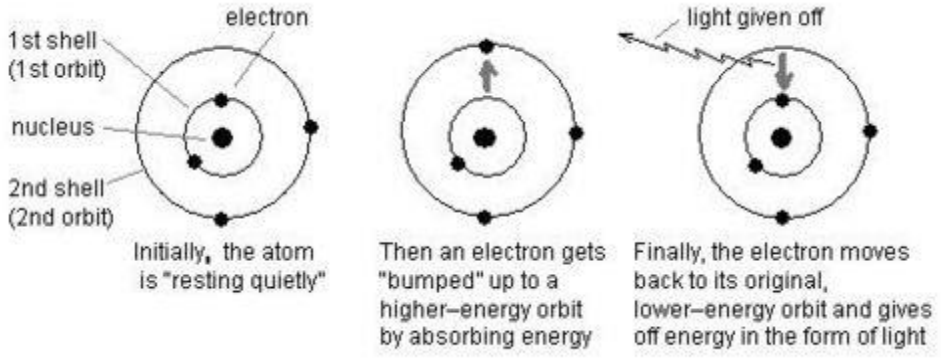
d) How do electrons release light?

Electrons release light when DROP DOWN TO GROUND STATE after they absorb energy and jump to higher energy levels.

e) What color of light is said to have the most energy? Least energy?

Blue most energy, red the least energy

f) Draw a model that explain how an atom give off light/color



g) How are wavelength and frequency related? How are energy and frequency related?

Wavelength and frequency are inversely proportional – one big, the other small

Energy and frequency are directly proportional – both high or low at the same time

h) How do you measure the wavelength? Frequency?

Wavelength is measured from crest to crest

Frequency is measured by how often the waves passes a point as particular point each second.

Know about the Big Bang and Stars.

a) What did the universe look like before the big bang?

No one knows what was before the big bang. The big bang explains that the universe was compressed to the size of a pin head began to expand outward when the 4 forces in nature came together as the unified force and acted on the pin sized universe.

b) What evidence do we have that supports the big bang? Explain.

Red shifts. The universe is expanding out in all directions and this supports the idea of an expansion that started at a single point.

c) According to the Big Bang Theory, how long ago did the universe form? **13.7 billion years ago**

d) What is the single factor that determines the life cycle of a star? **Mass of nebula**

e) All stars begin with the same three stages, list and define them. **Nebula, protostar, main sequence**

f) Why are stars so important to understand in terms of chemistry? **Stars have produced all of the elements in the universe. They can fuse up to the element Iron and then all the larger elements are made in super novas.**

g) Main sequence stars fuse __Hydrogen__ to form ___Helium___.

h) Red giants fuse __He___ to form _Carbon____, and _Carbon___ fuses to form ___Iron____.

i) Stars can fuse elements up to ___Iron__. The other elements in the universe are formed from ____Supernovas____.

j) Using an H-R diagram, what color represents the hottest star? Blue Coldest? Red

Know about the layers of the Sun

a) What are three inner zones? Core, radiative zone, convective zone

b) What are the three outer zones? What are the nicknames for each? Photosphere- sphere of light, chromosphere- sphere of color, corona- suns crown

c) What type of heat transfer is happening in the convective zone? Convection Radiative zone? Electromagnetic radiation

d) What is happening in the core of the Sun? fusion

e) What elements are most abundant on the Sun? hydrogen and helium

Know and be able to solve for molar mass, gram to mole, and % composition.

a) What is the molar mass of HNO_3? H: 1 x 1.01 = 1.01 grams, N: 1 x 14.01 = 14.01 grams, O: 3 x 16.0 = 48 grams
63.02 grams total for HNO_3? NaCl? KBr?

b) What is a mole? One mole is **6.02** x 10^{23} atoms, particles, molecules, and is also called the Avogadro constant.

c) What is mass of 1.49 mols of hydrogen gas (H_2)?

$$\frac{1.49\ mol\ H2}{1} \times \frac{2\ g\ H2}{1\ mol\ H2} = 2.98\ g\ H_2$$

d) How many moles are in 321 grams of dinitrogen trihydride?

$$\frac{321\ g\ N2H3}{1} \times \frac{1\ mol\ N2H3}{31\ g\ N2H3} = 10.35\ mol\ N_2H_3$$

e) What is the percentage composition of nitrogen in the compound HNO_3?

H: 1 x 1.01 = 1.01 grams $\quad \frac{1.01\ grams}{63.02\ grams} \times 100 = 1.6\%$ hydrogen

N: 1 x 14.01 = 14.01 grams $\quad \frac{14.01\ grams}{63.02\ grams} \times 100 = 22.2\ \%$ nitrogen

O: 3 x 16.0 = 48 grams $\quad \frac{48\ grams}{63.02\ grams} \times 100 = 76.2\%$ oxygen

HNO_3 = 63.02 grams total

f) An 8.20 grams piece of Mg combines completely with 5.40 grams of O to form a compound. What is the percentage composition on Mg and O in this compound? **Hint: write out compound and find molar mass**

Molar mass: 8.20 grams + 5.40 grams = 13.6 grams

$$\frac{8.20\ grams}{13.6\ grams} \times 100 = 60.3\ \%\ Mg$$

$$\frac{5.40\ grams}{13.6\ grams} \times 100 = 39.7\%\ O$$

g) 9.03 grams of Mg combines completely with 3.48 grams of N to form a compound. What is the percentage composition of Mg and N in the compound? **Hint: write out compound and find molar mass**

Molar mass: Mg_3N_2 = 100 grams

Mg_3 = 48.62 grams $\quad \frac{48.62\ grams}{100\ grams} \times 100 = 48\ \%\ Mg$

N_2 = 28 grams $\quad \frac{28\ grams}{100\ grams} \times 100 = 28\ \%\ N$

Know how to translate chemical reactions, balance equations, and predict chemical reactions.

Write the following chemical reactions into chemical formulas and a full chemical equation.

a) Sulfur burns in oxygen gas to produce sulfur dioxide.

$$S + O_2 \rightarrow SO_2$$

b) Sulfuric acid (H_2SO_4) and sodium hydroxide reaction together for form sodium sulfate and water.

$$H_2SO_4 + 2\ NaOH \rightarrow Na_2SO_4 + 2\ H_2O$$

c) Sodium oxide reacts with water to produce sodium hydroxide.

$$Na_2O + H_2O \rightarrow 2\ NaOH$$

d) Zinc sulfide reacts with oxygen gas to produce zinc oxide and sulfur dioxide.

$$2\ ZnS + 3\ O_2 \rightarrow 2\ ZnO + 2\ SO_2$$

Balance the following chemical equations and identify reaction types

e) $N_2 + 3\ H_2 \rightarrow 2\ NH_3$ Synthesis

f) $3\ Zn + 2\ MoO_3 \rightarrow \_\_Mo_2O_3 + 3\ ZnO$ Single displacement

g) $P(OH)_2 \rightarrow PO + H_2O$ - balanced decomposition

h) $Cd(NO_3)_2 + Na_2S \rightarrow CdS + 2\ NaNO_3$ double displacement

i) $Na_2O + H_2O \rightarrow 2\ NaOH$ Synthesis

Know how to use a balanced equation and a mole map to convert from one substance to another (stoichiometry).

$$2\ Cr + 3\ CuSO_4 \rightarrow 3\ Cu + Cr_2(SO_4)_3$$

a) How many grams of copper would be produced from 49.48 grams of chromium?

$$\frac{49.98\ grams\ Cr}{1} \times \frac{1\ mol\ Cr}{52.0\ grams} \times \frac{3\ mol\ Cu}{2\ mole\ Cr} \times \frac{63.55\ grams\ Cu}{1\ mol\ Cu} = 91.6\ grams\ Cu$$

b) How many grams of chromium are required to react with 125 mL of $CuSO_4$?

$$\frac{125\ mL\ of\ cuSo4}{1} \times \frac{1\ L}{1000\ ml} \times \frac{1\ mol\ CuSO4}{22.4\ L} \times \frac{2\ mol\ Cr}{3\ mole\ CuSO4} \times \frac{52.0\ grams\ Cr}{1\ mol\ Cr} = 0.1934\ grams\ Cr$$

$$2\ ZnS + 3\ O_2 \rightarrow 2\ ZnO + 2\ SO_2$$

c) How many liters of sulfur dioxide are created when 12.6 L of oxygen gas reacts with zinc sulfide?

$$\frac{12.6\ L\ O2}{1} \times \frac{1\ mol\ O2}{22.4\ L} \times \frac{2\ mol\ SO2}{3\ mole\ O2} \times \frac{22.4\ L\ SO2}{1\ mol\ SO2} = 8.4\ L\ of\ SO_2$$

d) If 3.45×10^{18} atoms of zinc sulfide react with oxygen gas, much many moles of zinc oxide are produced?

$$\frac{3.45 \times 10^{18}\ atoms\ ZnS}{1} \times \frac{1\ mol\ ZnS}{6.022 \times 10^{23} atoms\ ZnS} \times \frac{2\ mol\ ZnO}{2\ mole\ ZnS} = 0.57 \times 10^{-5}\ atoms = 5.7 \times 10^{-6}\ atoms$$

e) When 54 grams of oxygen gas react with zinc sulfide, how many atoms of sulfur dioxide are produced?

$$\frac{54 grams\ O2}{1} \times \frac{1\ mol\ O2}{32.0\ grams\ O2} \times \frac{2\ mol\ SO2}{3\ mole\ O2} \times \frac{6.022\ x\ 10^{23} atoms\ SO2}{1\ mol\ SO2} = 6.77 \text{ x } 10^{23} \text{ atoms } SO_2$$

$$2\ NaClO_3 \rightarrow 2\ NaCl + 3\ O_2$$

f) What is the mole ratio between $NaClO_3$ and NaCl?

2 moles $NaClO_3$: 2 NaCl

g) 12 moles of $NaClO_3$ will produce how many grams of O_2?

$$\frac{12\ moles\ NaClO3}{1} \times \frac{3\ mol\ O2}{2\ mole\ NaClO3} \times \frac{32.0\ grams\ O2}{1\ mol\ O2} = 576 \text{ grams } O_2$$

h) If you have 24.7 grams $NaClO_3$ how many grams of NaCl will be produced?

$$\frac{24.7\ grams\ NaClO3}{1} \times \frac{1\ mol\ NaClO3}{106.44\ grams\ NaClO3} \times \frac{2\ mol\ NaCl}{2\ mole\ NaClO3} \times \frac{58.44\ grams\ NaCl}{1\ mol\ NaCl} = 13.56 \text{ grams NaCl}$$

i) If you have 10 grams $NaClO_3$, how many liters of oxygen gas will be produced?

$$\frac{10\ grams\ NaClO3}{1} \times \frac{1\ mol\ NaClO3}{106.44\ grams\ NaClO3} \times \frac{3\ mol\ O2}{2\ mole\ NaClO3} \times \frac{22.4\ L\ O2}{1\ molO2} = 3.16 \text{ L } O_2$$

Know how to calculate the percentage composition of a substance.

a) What is the percentage composition of nitrogen in the compound HNO_3?

H: 1 x 1.01 = 1.01 grams — $\frac{1.01\ grams}{63.02\ grams} \times 100 = 1.6\%$ hydrogen

N: 1 x 14.01 = 14.01 grams — $\frac{14.01\ grams}{63.02\ grams} \times 100 = 22.2\ \%$ nitrogen

O: 3 x 16.0 = 48 grams — $\frac{48\ grams}{63.02\ grams} \times 100 = 76.2\%$ oxygen

HNO_3 = 63.02 grams total

b) An 8.20 grams piece of Mg combines completely with 5.40 grams of O to form a compound. What is the percentage composition on Mg and O in this compound?

8.20 grams + 5.40 grams = 13.6 grams

$\frac{8.20\ grams}{13.6\ grams} \times 100 = 60.3\ \%$ Mg

$\frac{5.40\ grams}{13.6\ grams} \times 100 = 39.7\%$ O

c) 9.03 grams of Mg combines completely with 3.48 grams of N to form a compound. What is the percentage composition of Mg and N in the compound? **Hint: write out compound and find molar mass**

Mg_3N_2 = 100 grams

Mg_3 = 48.62 grams — $\frac{48.62\ grams}{100\ grams} \times 100 = 48\ \%$ Mg

N_2 = 28 grams — $\frac{28\ grams}{100\ grams} \times 100 = 28\ \%$ N