Chemistry 1 – Semester 2 Final Review

Name Key

Standards Covered:

ALT 5: I can describe how and why atoms form bonds.

I can use models to explain the role of valence electrons in bond formation.

I can describe the relationship between electronegativity and bond type.

I can use the VESPR model to explain molecular geometry

ALT 9: I can explain how chemical changes demonstrate the law of conservation of mass.

I can translate word equations into balanced symbol equations.

I can identify different types of reactions

I can balance chemical equations to uphold the Law of Conservation of Mass.

I can explain how the Law of Conservation of Mass holds in all chemical reactions

ALT 10: I can apply stoichiometry in the calculation of reactant and product quantities.

I can apply molar mass, Avogadro's number, and mole ratios as conversion factors in stoichiometry calculations.

I can convert between units of mass, number of particles and moles

ALT 11: I can differentiate between physical and chemical changes

I can provide evidence that a physical or chemical change has occurred.

ALT 12: I can explain the relationship between endothermic and exothermic processes and heat transfer.

I can describe the changes in energy in a chemical process

I can explain the relationships among thermal energy, heat, specific heat and temperature in physical processes.

Practice problems

A. I can identify the number of valence electrons for an element

Write the number of valence electrons for each element

Magnesium	2	Sodium	1	Neon	8	Lithium	1
Chlorine	7	Oxygen	6	Phosphorus	5	Carbon	4

Group # = column #

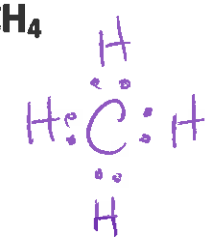
Write any element that has the given number of valence electrons

2 = Group 2	8 = Group 8	1 = Group 1	6 = Group 6
5 = Group 5	7 = Group 7	3 = Group 3	4 = Group 4

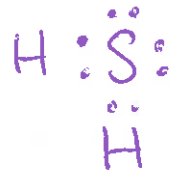
B. I can draw a complete Lewis Structure

Write the Lewis Structure for the following molecules

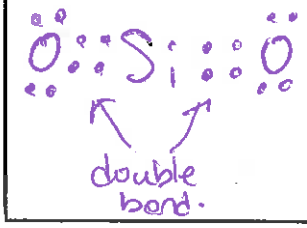
CH_4



H_2S



SiO_2



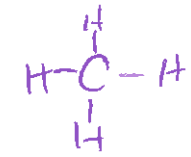
C. I can identify the number of electron pairs (domains)

	Electron domains ~~(pairs)~~ involved in a bond	Lone pair domains	Total electron domains ~~(pairs)~~
CH_4	4	0	4
H_2S	2	2	4
SiO_2	2	0	2

D. I can identify the geometry of the molecule

Identify the molecular geometry (shape) of each molecule

CH_4



tetrahedral

H_2S

Bent

SiO_2

Linear

E. I can write a balanced molecular formula

Calcium Chloride	Lithium Bromide	Aluminum Phosphide
$CaCl_2$	$LiBr$	AlP

Calcium Chlorate	Aluminum Phosphate	Barium Sulfate
$Ca(ClO_3)_2$	$AlPO_4$	$BaSO_4$

Barium Chloride	Sodium Nitrate	Calcium Phosphate
$BaCl_2$	$NaNO_3$	$Ca_3(PO_4)_2$

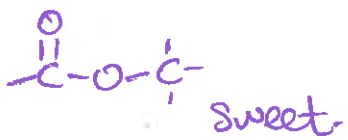
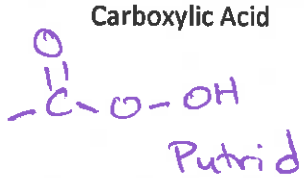
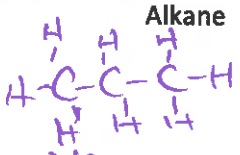
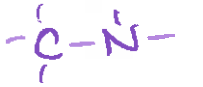
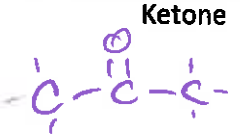
F. I can identify the type of bond based on electronegativity
Write the electronegativity of each element and determine the type of bond

Calcium with Oxygen	Lithium with Bromine	Carbon with Phosphorus
3.44 − 1.00 = 2.44 Ionic	2.96 − 0.98 = 1.98 Ionic	2.55 − 2.19 = 0.36 Non-Polar Covalent
Oxygen with Oxygen	**Sulfur with Hydrogen**	**Sodium with Oxygen**
3.44 − 3.44 = 0 Non-Polar Covalent	2.58 − 2.20 = 0.38 Non-Polar Covalent	3.44 − 0.93 = 2.51 Ionic

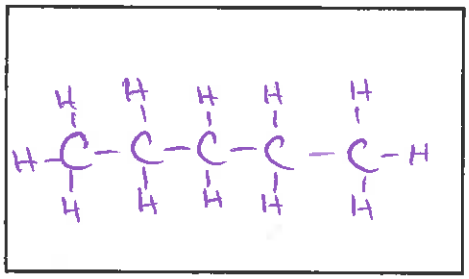
G. I can name the molecule
Write the name of each molecule

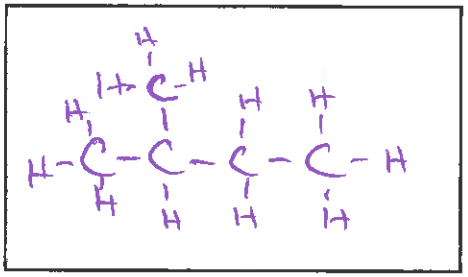
$AlPO_4$	CaO	NBr_3
Aluminum Phosphate	Calcium Oxide	Nitrogen Tribromide

H. I can draw the functional groups in the molecule and identify the smell

Ester	Carboxylic Acid	Alkane
 Sweet	 Putrid	 None or Gas
Amine	**Alcohol**	**Ketone**
 Fishy	 Medicine	 Sweet

I. Draw the structural diagram for two isomers of C_5H_{12}





J. Name two ways in which elements form bonds.

Share electrons — Covalent

transfer electrons (give/take) — Ionic

K. Explain how valence electrons are involved in the formation of chemical bonds.

Valence electrons are either shared or transferd so an atom can satisfy the octet rule.

L. Provide two reasons why the shape of a molecule is important in the world around us

Smell, DNA, biological functions

A. I can tell the difference between a chemical change and a physical change

Write physical or chemical to indicate the type of change

Wood burns	chemical	Salt dissolves in water	physical
Water melts	physical	Sandwich digests	chemical

Write physical or chemical to indicate the type of change

$H_2 + O_2 \rightarrow H_2O$	chemical	$NaCl_{(s)} \rightarrow Na^+_{(aq)} + Cl^-_{(aq)}$	Physical
$H_2O_{(s)} \rightarrow H_2O_{(g)}$	physical	$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$	Chemical

B. I can identify different types of chemical reactions

Write the type of reaction next to each equation or partial equation

$H_2 + O_2 \rightarrow H_2O$	Synthesis	$NaCl_{(s)} \rightarrow Na^+_{(aq)} + Cl^-_{(aq)}$	Disolving
$NH_3 \rightarrow N_2 + H_2$	Decomposition	$Mg_{(s)} + O_{2(g)} \rightarrow MgO_{2(s)}$	Synthesis
$B(NO_3)_3 + Na \rightarrow$	Single Replacement	$Na_2(SO_4) + Al \rightarrow$	Single Replacement

C. I can predict the products from a chemical reaction

Write the balanced molecular formulas for the products of the chemical reaction

Reactants	Products
$Na_2SO_4 + Al \rightarrow$	$Al_2(SO_4)_3 + Na$
$MgO + BBr_3 \rightarrow$	$MgBr_2 + B_2O_3$
$Li + F_2 \rightarrow$	LiF
$B(NO_3)_3 + Na \rightarrow$	$NaNO_3 + B$
$AlPO_4 + LiCl \rightarrow$	$AlCl_3 + Li_3PO_4$
$BeS + F_2 \rightarrow$	$BeF_2 + S$

D. I can balance a chemical equation

1 S + 1 O_2 --> 1 SO_2

2 Na + 1 O_2 --> 1 Na_2O_2

2 Hg + 1 O_2 --> 2 HgO

2 Ag_2O --> 4 Ag + 1 O_2

1 $Ba(OH)_2$ + 1 H_3PO_4 --> 1 $BaHPO_4$ + 2 H_2O

2 NaOH + 1 H_3PO_4 --> 1 Na_2HPO_4 + 2 H_2O

1 C_4H_8 + 6 O_2 --> 4 CO_2 + 4 H_2O

1 C_3H_8 + 5 O_2 --> 3 CO_2 + 4 H_2O

2 Fe + 3 Cl_2 --> 2 $FeCl_3$

E. I can convert between moles, number of particles, and mass.

Convert the following:

13g Na to moles $13\text{g Na}\left(\frac{1\text{mol Na}}{22.99\text{g}}\right) = 0.57\text{mol Na}$	3.2g NaCl to number of NaCl units $3.2\text{g NaCl}\left(\frac{1\text{mol NaCl}}{22.99\text{g}}\right)\left(\frac{6.02\times10^{23}\text{ NaCl}}{1\text{mol NaCl}}\right) = 8.4\times10^{22}\text{ NaCl units}$
2.5 moles to # of particles $2.5\text{mol}\left(\frac{6.02\times10^{23}\text{ particles}}{1\text{mol}}\right) = 1.5\times10^{24}\text{ particles}$	3.7 moles $CaCl_2$ to number of Cl^- ions $3.7\text{mol CaCl}_2\left(\frac{2\text{mol Cl}^-}{1\text{mol CaCl}_2}\right)\left(\frac{6.02\times10^{23}\text{ Cl}^-}{1\text{mol Cl}^-}\right) = 4.5\times10^{24}\text{ Cl}^-\text{ ions}$
1.63 moles H_2O to grams H_2O $1.63\text{mol H}_2\text{O}\left(\frac{18.02\text{g}}{1\text{mol H}_2\text{O}}\right) = 29.37\text{g H}_2\text{O}$ molar mass H_2O: 2(1.01)-H, 16.00-O, 18.02 g/mol	3.26 x10^{26} C atoms to grams of carbon $3.26\times10^{26}\text{ C atoms}\left(\frac{1\text{mol C}}{6.02\times10^{23}\text{ C atoms}}\right)\left(\frac{12.01\text{g}}{1\text{mol C}}\right) = 6{,}503.8\text{g C}$ or 6.5 kg C

Problem 3: 40 g of Al is used in this reaction, calculate the mass of each of the products.

$$\text{Al} + 3\,\text{NaOH} \rightarrow \text{Al(OH)}_3 + 3\,\text{Na}$$

mass of $Al(OH)_3$: 3(1.01) H, 3(16.00) O, 26.98 Al, 78.01 g/mol

$$40\text{g Al}\left(\frac{1\text{mol Al}}{26.98\text{g}}\right)\left(\frac{1\text{mol Al(OH)}_3}{1\text{mol Al}}\right)\left(\frac{78.01\text{g}}{1\text{mol Al(OH)}_3}\right) = 116\text{g Al(OH)}_3$$

$$40\text{g Al}\left(\frac{1\text{mol Al}}{26.98\text{g}}\right)\left(\frac{3\text{mol Na}}{1\text{mol Al}}\right)\left(\frac{22.99\text{g}}{1\text{mol Na}}\right) = 102\text{g Na}$$

Problem 4: 35 g of $LiNO_3$ is used in this reaction. Predict the products, balance the equation, and determine the mass of both of the products?

$$2\,\text{LiNO}_3 + \text{BaSO}_4 \rightarrow \text{Li}_2\text{SO}_4 + \text{Ba(NO}_3)_2$$

mass $LiNO_3$ = 68.94 g/mol

Li_2SO_4 = 109.95 g/mol

$Ba(NO_3)_2$ = 261.33 g/mol

$$35\text{g LiNO}_3\left(\frac{1\text{mol LiNO}_3}{68.94\text{g}}\right)\left(\frac{1\text{mol Li}_2\text{SO}_4}{2\text{mol LiNO}_3}\right)\left(\frac{109.95\text{g}}{1\text{mol Li}_2\text{SO}_4}\right) = 28\text{g Li}_2\text{SO}_4$$

$$35\text{g LiNO}_3\left(\frac{1\text{mol LiNO}_3}{68.94\text{g}}\right)\left(\frac{1\text{mol Ba(NO}_3)_2}{2\text{mol LiNO}_3}\right)\left(\frac{261.33\text{g}}{1\text{mol Ba(NO}_3)_2}\right) = 66\text{g Ba(NO}_3)_2$$

F. **Energy transfer in a chemical or physical process**

Define exothermic

Process where heat is transfered from the system to the surroundings

Define endothermic

process where heat is transfered from the surroundings to the system

G. **Thermal equilibrium, answer the best of your ability.**

a. If you mix 50g of 100 °C water with 50g of 0°C water what will the final temperature of the mixture be after it has achieved thermal equilibrium?

50°C

b. If you mix 50g of 100 °C water with 35g of 0°C water what will the final temperature of the mixture be after it has achieved thermal equilibrium?

100°C > 50°C

c. If you mix 50g of 100 °C water with 50g of 0°C ice what will the final temperature of the mixture be after it has achieved thermal equilibrium? Is this the same as in problem a? why or why not?

$\lesssim$50°C different from a b/c some heat is used to melt the ice.

H. **Heat transfer in physical processes**

How much heat (q) is absorbed by ice that cools 25g of 80°C water to 50°C?

$q = mC\Delta T$

$C = 1\frac{cal}{g°C}$

$80°C - 50°C$

$\Delta T = 30°C$

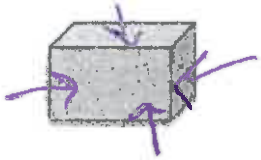
$q = 25g\left(1\frac{cal}{g°C}\right)(30°C) = 750\,cal$

G. **exo/endothermic processes**

Determine if the following changes are exothermic or endothermic.

Burning wood	exo	Freezing ice	exo
Reaction in an instant cold pack	endo	Melting ice	endo
Reaction in an instant hot pack	exo	Cooking a potato	endo

I. **Heat transfer: Draw a diagram showing the movement of heat in an ice cube on a table.**



J. Refer to the phase change diagram below to answer the following questions.

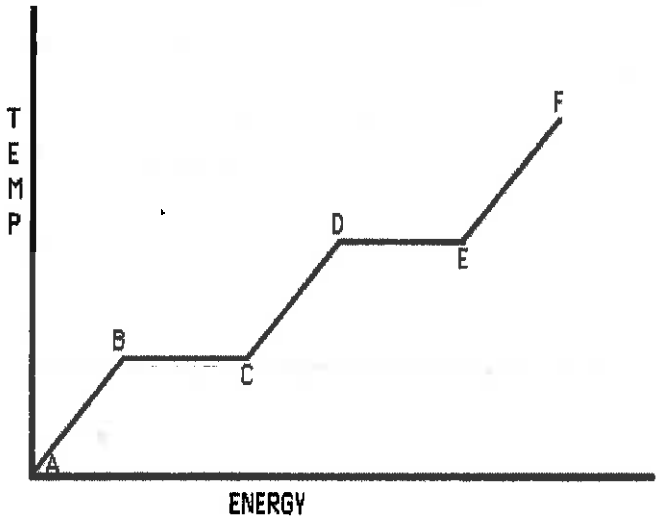
10. What section (s) of this graph would you find any trace of a solid? A – B – C

11. Between what two points does boiling occur? D – E

12. At what point do you have a liquid at its boiling point? D

13. At what point do you have a solid at its melting point? B

14. Between which two points would you find any translational motion? ~~~~~



Chemistry 1 – Semester Review Part 3 (Super-Problem)

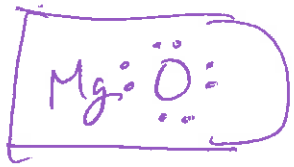
100 g of Magnesium metal reacts with excess oxygen gas. Answer the following questions and show all work.

a. Identify the type of reaction and whether this involves physical or chemical change.
b. Write the complete balanced chemical reaction.
c. Predict the mass of each product.
d. Draw the Lewis dot structure of the product.
e. If the reaction produces 150J of energy is the reaction endo or exothermic?

a) Synthesis - chemical change

b) $2Mg_{(s)} + O_{2(g)} \rightarrow 2MgO$

c) $100\,g\,Mg\left(\frac{1\,mol\,Mg}{24.31\,g}\right)\left(\frac{2\,mol\,MgO}{2\,mol\,Mg}\right)\left(\frac{40.31\,g}{1\,mol\,MgO}\right) = 166\,g\,MgO$

d) $Mg^{+} \rightarrow :\ddot{O}:^{-} \Rightarrow$ 

e) exothermic