FINAL EXAM REVIEW AND PRACTICE QUESTIONS

UNIT 1 – MATTER, CHEMICAL TRENDS AND BONDING

CHECKLIST:
- ❑ Atomic Theory
- ❑ The Bohr Model of the Hydrogen Atom
- ❑ Ions and Isotopes
- ❑ Periodic Trends
- ❑ Identify the three types of intramolecular bonds
- ❑ Electronegativity and Bonding
- ❑ Properties of ionic compounds and molecular compounds
- ❑ Flame Tests (lab)
- ❑ Draw Lewis Structures for Ionic Compounds
- ❑ Chemical Names and Formulae for Ionic Compounds (incl. multivalent elements, and polyatomic ions)
- ❑ Draw Lewis Structures for Simple Molecular Compounds
- ❑ Chemical Names and Formulae for Molecular Compounds
- ❑ Polarity of Molecules (How to Determine whether a molecule is polar or non-polar)
- ❑ Identify and rank the three types of intermolecular forces

REVIEW QUESTIONS:
1. What is first ionization energy? What is the general trend in ionization energy on the periodic table?
2. What are the usual charges found on the ions of the metals?
3. What are the usual charges found on the non-metals?
4. What is the octet rule?
5. What forces hold a nitrogen molecule together? What forces hold together a chunk of sodium chloride?
6. Which metals on the periodic table are the most chemically reactive? Where do you find the least chemically reactive metals?
7. What happens to the chemical reactivity of the halogens as you move down the family?
8. What is an isotope?
9. Name two ions that would have the same number of electrons (isoelectronic) as a neon atom.
10. Explain how negative ions and positive ions are produced.
11. What is a triple covalent bond? What is a double covalent bond? Give an example of each.
12. Where would you find the shared pair of electrons in an H-Cl bond?
13. How are elements organized on the modern periodic table?
14. Why are most of the atomic masses on the periodic table not whole numbers?
15. What are the particles that make up the atom? What are the charges and relative sizes of these particles?
16. Precise atomic masses of each isotope of magnesium are given below with the percent abundance of each isotope.

Magnesium-24	23.98504 u	78.70%
Magnesium-25	24.98584 u	10.13%
Magnesium-26	25.98259 u	11.17%

Calculate the average atomic mass of magnesium (you MUST show all your steps here!)

17. a) An atom has only one ground state, but several excited states. Explain this statement.
    b) What is similar about the elements in a family on the periodic table?
    c) Explain two trends in the periodic table that you learned about this year.

18. Distinguish between an ionic bond and a covalent bond. Give an example of each.
19. Use the periodic table to predict which element in each of the following sets would be the most reactive with the reagent given.
    a) fluorine, chlorine or bromine with sodium- give a reason for your choice.
    b) sodium, magnesium or aluminum with oxygen - give a reason for your choice
20. What happens to an electron when it gains a specific amount of energy? (Think about the Bohr Model)
21. What is an ionic bond and how is it formed? Using Lewis Structures, show how an ionic bond is formed between (a) magnesium and nitrogen and (b) sodium and phosphorus
22. Why do ionic compounds conduct electricity?
23. What are properties of ionic compounds? How could you test for the properties of ionic compounds in a lab? Why are things like construction tools **not** made up of ionic compounds?
24. What are the seven diatomic elements. Draw Lewis structures for hydrogen gas (H_2), fluorine gas (F_2), oxygen gas (O_2) and nitrogen gas (N_2)
25. Review naming for the following compounds: Binary Ionic Compounds, Ionic Compounds (with Multiple Charges), Ionic Compounds (with Polyatomic Ions), Molecular Compounds
    Remember to determine what types of compounds they are before naming or providing a formula
    a) Ca_3N_2 _____   e) aluminum sulfide   _____
    b) Na_2CO_3 _____   f) tin (IV) hydroxide   _____
    c) SF_6 _____   g) carbon monoxide   _____
    d) NH_3 _____   h) sulfur trioxide   _____

26. What is electronegativity? What happens to electronegativity as you move down a group on the periodic table? What happens to electronegativity as you move across a period on the periodic table?
27. How do you determine whether a bond between two atoms is ionic, polar covalent or non-polar covalent?
28. What are the four shapes of molecules we studied in this course? What is meant by a polar molecule and a non-polar molecule?
29. Draw the Lewis dot diagram of each of the following compounds. Predict the shape and determine whether they are polar or non-polar if they are molecules.
    NH_3 CH_4 $CaCl_2$ H_2O CO_2 Al_2O_3

UNIT 2 – CHEMICAL REACTIONS

CHECKLIST:
❑ Balancing Chemical Equations
❑ Six Types of Chemical Reactions (General Structure) and Examples:
   Synthesis, Decomposition, Single Displacement, Double Displacement, Combustion and Neutralization
❑ Activity Series to determine a Single Displacement Reaction
❑ Forming Precipitates in Double Displacement Reactions (Using the Solubility Chart)

REVIEW QUESTIONS:

1. What is the general equation for the five types of reactions? What kind of reactants does each reaction type have (ex. elements and/or compounds)? You may use the table below to help you:

Type of reaction	How can you identify each type from a chemical equation? (Hint: Use letters to replace the elements)
Synthesis	
Decomposition	
Single Replacement	
Double Replacement	
Combustion	
Neutralization	

2. For each of the examples below indicate the type of reaction (from the choices above) and balance the equation.

a) ____ N_2 + ____ $H_2 \rightarrow$ ____ NH_3 Type:_____

b) ____ $MgCl_2$ + ____ $Al \rightarrow$ ____ Mg + ____ $AlCl_3$ Type:_____

c) ____ $AgBr$ + ____ $CaCl_2 \rightarrow$ ____ $AgCl$ + ____ $CaBr_2$ Type:_____

d) ____ H_2SO_4 + ____ $KOH \rightarrow$ ____ K_2SO_4 + ____ H_2O Type:_____

e) ____ CaI_2 + ____ $2KNO_3 \rightarrow$ ____ $Ca(NO_3)_2$ + ____ KI Type:_____

f) ____ $KClO_{3(s)} \rightarrow$ ____ $KCl_{(s)}$ + ____ $O_{2(g)}$ Type:_____

g) ____ C_2H_6 + ____ $O_2 \rightarrow$ ____ CO_2 + ____ H_2O Type:_____

3. What are the different products created when an acid reacts with a hydroxide (base) vs. when it reacts with a carbonate (base)?

4. Write a balanced equation to represent the reaction between a solution of potassium chloride and silver sulfide. How do you know whether these solutions will react? What must they form?

5. For the following double displacement reaction: sodium chloride + silver nitrate →
   a) Complete the word equation
   b) Write the balanced molecular equation

6. What are the differences between complete combustion and incomplete combustion?

7. What are the products of a reaction between a strong acid and a carbonate compound (such as sodium bicarbonate)?

UNIT 3 – QUANTITIES IN CHEMICAL REACTIONS

CHECKLIST:
❑ Calculations to determine the molar mass of a substance
❑ Be able to complete (and make conversions between) the mass of a substance, the number of moles, the number of particles (molecules)
❑ Definition of a mole - How to determine the amount (number of moles)?
❑ Determining the empirical and molecular formula of a substance
❑ Mole ratio calculations from balanced equation
❑ Limiting and Excess Reactants - Examples and Calculations
❑ Factors that affect Actual Yield and Percentage Yield
❑ Determining the amount (number of moles) in lab settings by calculating molar mass

$6.02×10^{23}$

REVIEW QUESTIONS:
1. What is the molar mass of the following compounds?
   a) CaF_2 b) H_2O c) $C_6H_{12}O_6$ d) $Al_2(CO_3)_3$
2. What is the mass of 6.3 mol of CO_2?
3. How many molecules are there in 5.0 mol of CO_2?
4. What is a mole? How many molecules are in a mole? Can this value be measured or does it have to be calculated? How do I determine the number of moles of a substance if all I have is its mass?
5. Determine the percentage composition of $Ca(NO_3)_2$ (%Ca, %N, %O)?
6. Calculate the empirical formula and molecular formula of a compound that consists of 80% carbon and 20% hydrogen, and has a molar mass of 30.1 g/mol.
7. Ammonia is produced from the reaction: $N_{2(g)}$ + 3 $H_{2(g)}$ → 2 $NH_{3(g)}$. Use mole ratios:
   (A) How many moles of N_2 is required to produce 12 moles of NH_3?
   (B) How many moles of H_2 is required to produce 12 moles of NH_3?
8. Consider the following balanced equation: 2 $AgNO_3$ + $CaCl_2$ → 2 $AgCl$ + $Ca(NO_3)_2$. Calculate the amount of silver chloride, AgCl, that will be produced from 100.0 g of calcium chloride. (Hint: You will be using mole ratios in the problem)

9. Aluminum and oxygen react to form aluminium oxide, as shown in the following chemical equation: ____ $Al_{(s)}$ + ____ $O_{2(g)}$ → ____ $Al_2O_{3(s)}$

   (A) Balance the following chemical equation.
   (B) Determine how much aluminium oxide product is formed if 5.00 g of aluminium reacts with 8.00 g of oxygen. Put a box around the correct value. (**Remember, it's the amount produced from the limiting reactant**)
   (C) Which is the limiting reactant and which is the excess reactant?

10. What is percentage yield? Provide three reasons why the percentage yield could be small (when the actual yield is less than the theoretical yield).
11. Iron is extracted from the mineral magnetite, Fe_3O_4:
    $$Fe_3O_4(s) + 2\ C(s) → 3\ Fe(s) + 2\ CO_2(g)$$
    A 35.0 g sample of magnetite produces 15.0 g of iron. Determine the percentage yield of this reaction.

UNIT 4 – SOLUTIONS AND SOLUBILITY

CHECKLIST:
❑ Types of Solutions
❑ The dissolving process for ionic compounds, polar and non-polar molecules
❑ Saturation and Solubility Curves
❑ Calculations involving molar concentration
❑ Calculations involving dilution
❑ Preparing solutions and dilutions (in lab)
❑ How to write Total Ionic Equations and Net Ionic Equations from a Formula equation
❑ Using Qualitative Chemical Analysis (ion solution colour, flame tests and solubility) to determine unknown ions present in solution
❑ Using stoichiometry to determine unknown concentration or volume of a reactant/product

REVIEW QUESTIONS:
1. Answer the following questions regarding molar concentration:
   (A) How many moles of sodium hydroxide, NaOH, are present in 0.5 L of a 0.25 mol/L solution?
   (B) What is the molar concentration when 5.6 mol of NaCl is dissolved in 250 mL (0.25 L) of water?

2. What is the difference between a concentrated and diluted solution? What can you do to increase the concentration of a solution? What can you do to decrease the concentration of a solution?
3. What volume of concentrated stock solution of hydrochloric acid do you need to make 350 mL of a 0.40 mol/L solution. Stock solutions of HCl are 12.0 mol/L.
4. What does the expression "like dissolve like" refer to?
5. Explain why calcium chloride, $CaCl_{2(s)}$, and ammonia, $NH_{3(l)}$, will dissolve in water but hexane, $C_6H_{14(l)}$, will not.
6. Aluminum metal, Al(s), reacts with hydrochloric acid to produce aluminum chloride, $AlCl_3(aq)$, and hydrogen gas.
   a) Write the balanced formula equation for the reaction.
   b) Write the total ionic equation.
   c) Identify the spectator ions in the equation.
   d) Write the net ionic equation.
7. A solution is suspected of containing strontium ions, $Sr^{2+}(aq)$, manganes ions, $Mn^{2+}(aq)$, or both.
   a) Plan a qualitative analysis for identifying the ions. Describe your plan.
   b) Draw a flow chart to represent your qualitative analysis.
8. Determine the minimum volume of 0.25 mol/L sodium carbonate needed to precipitate all of the calcium ions in 200 mL of 0.20 mol/L calcium chloride by answering the following:
   a) Write a balanced equation for the reaction.
   b) What amount of calcium chloride is present?
   c) What is the mole ratio of sodium carbonate to calcium chloride?
   d) What amount of sodium carbonate, $n_{Na_2CO_3}$ is needed to precipitate all of the calcium ions?
   e) What volume of sodium carbonate is needed?

CHECKLIST:
❑ General properties of Acids and Bases
❑ The Relationship between concentration and strength of acids and bases
❑ Naming and formulas for acids
❑ Reading the pH scale - strong acids, strong bases, weak acids, weak bases and neutral solutions
❑ Acid-Base Stoichiometry and Titration technique

REVIEW QUESTIONS:
1. What are some of the differences between acids and bases?

Property	Acids	Bases
Ion that is present in solution		
Does it react with metals?		
Electrical Conductivity		
Feel		
Taste		
Colour Change in Litmus Paper		
Neutralized with...		

2. What type of solution is present when:
   (A) The $[H^+]$ is greater than the $[OH^-]$ _____
   (B) The $[H^+]$ is equal to the $[OH^-]$ _____
   (C) The $[OH^-]$ is less than the $[H^+]$ _____

3. Draw and properly label a pH scale. What information does the pH scale give you?
4. Name the following acids:
   a) $HF_{(aq)}$
   b) $H_3PO_{4(aq)}$
   c) $HClO_{3(aq)}$
   d) $HNO_{2(aq)}$
   e) $HI_{(aq)}$
   f) $HClO_{4(aq)}$
5. Write the chemical formula for each of the following:
   a) hydrochloric acid
   b) nitric acid
   c) phosphorous acid
6. Explain (you may use diagrams) the difference between a dilute strong acid and a concentrated weak acid.
7. Are endpoint and equivalence point the same thing? Explain how they are similar and how they are different.

Add Gas law unit notes here!!!