Unit 1 Exam Review

Most important:

- Know the different ways that atoms and molecules are modeled, especially the Bohr model and Lewis structures.
- Know how to use the Periodic Table.
- Understand the basic principles of chemical bonding.
- Understand that molecules are in constant motion, that this results in collisions and interactions, and that molecules move faster at higher temperatures.
- Understand the behaviors of solids, liquids, and gases, including how this relates to density and intermolecular interactions.
    - Topics relevant to solids: Thermal Expansion
    - Topics relevant to liquids: Diffusion and Osmosis
    - Topics relevant to gases: Gas Laws
    - Topics relevant to all 3: Intermolecular Interactions and Density

<u>Atoms</u>

You should know how to:

- Find the number of protons, neutrons, and electrons in an element, based off of the information in the Periodic Table.
- Write an atomic symbol, based off of the information in the Periodic Table.
- Draw a Bohr model, based off of the information in the Periodic Table.

You should understand:

- What **atoms** are, what **matter** is, and how they are related.
- That atoms are made up of protons, neutrons, and electrons, which have these traits:
    - **Protons:** Positively charged, located in the nucleus, have a mass of about 1 amu, and change the atom so much that it becomes a new element.
    - **Neutrons**: Not charged, located in the nucleus, have a mass of about 1 amu, and change the radioactive stability of an atom (its isotope)
    - **Electrons:** Negatively charged, orbit the nucleus, have negligible mass, and changes the chemical reactivity of the atom
- That our best model of the atom is more advanced than the one we use most in this class (the **Bohr model**), and that models can get replaced over time as scientific understanding becomes more advanced.
    - Other models are the **Plum Pudding Model** (which was debunked and replaced by the Bohr model) and the **Electron Cloud Model** (which is our current best model)

- Where to find an element's **atomic name**, **atomic symbol**, **atomic number**, and **atomic mass** on the Periodic Table, and how **atomic number** and **atomic mass** relate to the number of protons, neutrons, and electrons.

Chemical Bonding

You should know how to:

- Determine how many valence electrons an atom/ion has, based off of the information in the Periodic Table.
- Determine the charge on a cation or an anion, based off of the information in the Periodic Table and your Polyatomic Ion sheet, and figure out how many of each ion will bond in an ionic bond so that the charges add up to zero.
- Determine whether two elements will form an ionic bond or a covalent bond.

You should understand:

- That atoms must collide (bump together) in order to form chemical bonds.
- That atoms will continue to react until they become most **stable**.
- How the concept of **stability**, the **octet rule**, and the number of **valence electrons** relate to one another.
- That all of the atoms you will be working with (except hydrogen and helium) follow the octet rule. This means that they "want" to have 8 electrons in their valence shell. Hydrogen and helium want 2. (The always-true rule is that atoms “want” to look like noble gases).
- That ionic bonds involve a positively-charged metal **cation** *donating* electrons to a negatively-charged nonmetal **anion**, which are then held together by **electrostatic forces**, or “opposites attract.”
- That atoms share electrons in a covalent bond, due to wave overlap of electron orbitals.
- That covalent bonds form between two nonmetals.
- That electronegative elements will pull electron density toward them and out of a bond, making that portion of the molecule relatively more negative.
- The relative strengths of **ionic bonds**, **hydrogen bonding**, **dipole-dipole interactions**, and **London dispersion forces**, and how this relates to whether a charge/dipole is permanent, temporary, complete, or partial.
- Which forces are most commonly found in solids, liquids, and gasses, and how that relates to the strength of the interaction.

Chemical Nomenclature

You should know how to:

- Write the long-form name of an ionic compound, if you’re given the chemical formula.
- Write the chemical formula of an ionic compound, if you’re given the formula. This requires you to be able to find the charge of the component ions and figure out how many of each ion is needed to make the total charge add up to zero.

- Do both of these things for ionic compounds involving a polyatomic ion. You will be allowed to use your Polyatomic Ion sheet on the exam.
- Write the long-form name of a covalent molecule, given the molecular formula. This requires you to know the standard greek prefixes for numbers.
- Write the molecular formula of a covalent molecule, given the long-form name.

You should memorise:
- The chemical formulas for the common elements water, ammonia, methane, and ozone.
- Which elements are only found in nature as diatomic elements.

You should understand:
- The concepts covered in "Chemical Bonding."

Molecular Models

You should know how to:
- Draw Lewis dot structures for single atoms/ions.
- Model ionic compounds using Lewis dot structures, by showing how valence electrons get transferred and how the resulting charged ions are held together by electrostatic interactions.
- How to draw Lewis dot structures for covalently bonded molecules, with single bonds, double bonds, and triple bonds.

You should understand:
- The concepts covered in "Chemical Bonding."

States of Matter

You should memorise:
- The names of the phase changes between solids, liquids, and gases:
    - Solid to liquid: melting, or fusion
    - Liquid to gas: vaporization, or boiling
    - Gas to liquid: condensation
    - Liquid to solid: freezing

You should understand:
- That molecules are closest together and bound by the strongest intermolecular forces in **solids**. Solids have definite *shape and volume*.
- That molecules are medium-close together and bound by medium-strong intermolecular forces in **liquids**. Liquids have definite *volume, but not shape*.
- That molecules are far apart and bound by weak or no intermolecular forces in **gases**. Gases have *neither* definite *volume nor shape*.
- That substances can transition between solid, liquid, and gas depending on external factors, especially **temperature** and **pressure**. Higher temperature means more

movement and more gas-like properties, and more pressure means less space between molecules and more solid-like properties.
- The concept of **heat** and how it relates to **kinetic energy** of molecules.
- How adding heat relates to phase changes: as particles move more, they can “escape” their intermolecular interactions and go from solid to liquid to gas.
- How we graph heat changes: as we add heat, solids get warmer; then, all the energy goes into melting them into liquids, so the temperature doesn’t change; then liquids get warmer; then, all the energy goes into boiling the liquid, so the temperature doesn’t change; then, gases get warmer.

Density

You should know how to:
- Calculate density from a known mass and volume.
- Identify an unknown material by calculating density and comparing it to a list of known densities.

You should memorise:
- The formula for calculating density, d = m/v.

You should understand:
- The basic definition of **density**, which is the amount of mass (weight) we can fit into a certain volume. Molecules are more crowded in more dense objects. Molecules are less crowded in less dense objects.
- How the concept of **density** relates to whether something will sink or float.
- How the density of solids, liquids, and gases relate to each other both as a general rule and in the exception case, water.
- That density is a physical property of matter, meaning it does not change based on the amount of a substance that we have, and will be constant for the same material (e.g., aluminum will always have a certain density, gold will always have a certain density, etc.)

Thermodynamics

You should know how to:
- Identify whether a reaction is **exothermic**, **endothermic**, or **isothermic**, depending on the change in temperature of the system and surroundings.

You should understand:
- That molecules are in constant motion.
- How temperature relates to the **kinetic energy** of molecules.
- The difference between **heat** (the transfer of energy) and **temperature** (average kinetic energy)
- How gases behave in **perfectly flexible containers:**

    - As we add more gas to a container, the volume will go up
    - As we increase the temperature of the gas, the volume will go up
- How gases behave in **perfectly rigid containers**:
    - As we add more gas to a container, the pressure will go up
    - As we increase the temperature of a gas, the pressure will go up

Solubility and Diffusion

You should know how to:

- Determine the direction of movement of solutes or water across a **semipermeable membrane** in a U-tube, both when solutes are allowed across and when they aren't.

You should understand:

- That, in the process of **diffusion**, molecules naturally move *down* their **concentration gradients** from areas of high concentration to low concentration, until they reach **equilibrium**, which is a state of balance where there is no net change.
- How the speed of diffusion changes based on how much molecules are moving (such as when the temperature increases)
- What **diffusion** and **osmosis** are, how they are the same, how they are different, and why osmosis would occur instead of diffusion.
- The direction of water movement during **osmosis** and how this relates to **solute** concentration.

Thermal Expansion

You should understand:

- That solids, liquids, and gases all expand when heated and contract when cooled.
- The importance of **expansion gaps** and **expansion joints** in engineering.