1. Using pencil crayons, highlight the location of the chemical families on the following period table of elements.

![Periodic Table of the Elements](image)

2. How are elements arranged in the periodic table?

   Elements are in increasing atomic number.

   Elements are arranged based on properties (chemical and physical)

3. What is similar about elements in the same family?

   Elements in the same family have common physical and chemical properties.

4. What would an alkali metal have to do in order to end up with the same stable electron arrangements as the noble gases?

   Lose an electron. (Give away an electron)

5. In order to achieve the stable arrangement of noble gas atom, each halogen atom would have to gain an electron.

6. In a neutral atom, the number of electrons is always equal to the number of protons or the atomic number.
7. Isotopes of an element are two different forms that have the same number of **protons** and **electrons**, but with different numbers of **neutrons**.

8. Give the total number of electrons in each shell for the following elements:

<table>
<thead>
<tr>
<th>Element</th>
<th>Total # of electrons</th>
<th>First shell</th>
<th>Second shell</th>
<th>Third shell</th>
<th>Fourth shell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>13</td>
<td>2</td>
<td>8</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>7</td>
<td>2</td>
<td>5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Calcium</td>
<td>20</td>
<td>2</td>
<td>8</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Lithium</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Argon</td>
<td>18</td>
<td>2</td>
<td>8</td>
<td>8</td>
<td>-</td>
</tr>
</tbody>
</table>

9. Draw the Bohr diagram for one of the noble gases and explain why noble gases are unreactive.

   **Noble gases have a complete outer shell.**

10. Draw the Bohr diagram for Mg$^{2+}$

11. Define critical mass.

   **Minimum mass of fuel needed to produce a chain reaction.**
   (depends on the isotope used)

12. What prevents an explosion from occurring in a nuclear reactor once a chain reaction begins?

   The chain reaction must be controlled. Moveable rods can be inserted near the isotope to absorb neutrons so that they do not cause more fission reactions.

13. Rhenium, Re-184, has a half-life of 38 d. A sample containing Re-184 has an activity of 1 296 Bq.

   What will the activity of the sample be in 152 days?

   \[
   \text{152 days} = \frac{\text{total time}}{\text{half life of the isotope}} = \frac{152 \text{ d}}{38 \text{ d}} = 4 \text{ half lives}
   \]

   number of half lives = 4

   \[
   \text{activity} = \frac{1296}{2^4} = \text{activity of sample in 152 days}
   \]
activity\_final = \frac{1}{2^n} \quad \text{activity\_initial} = \frac{1}{2^4} (1296 \text{ Bq}) = 81 \text{ Bq}

What was the activity of the sample 190 days ago?

190 days = ? half lives

number of half lives = \frac{\text{total time}}{\text{half life of the isotope}} = \frac{190 \text{ d}}{38 \text{ d}} = 5

activity\_initial = ?

activity\_final = \frac{1}{2^n} \text{activity\_initial}

activity\_initial = 2^n \text{(activity\_final)} = 2^5 (1296 \text{ Bq}) = 32 (1296 \text{ Bq}) = 41472 \text{ Bq}

14. Complete the following nuclear reactions:

Np\* → Np + δ

Xe → Cs + e

Po → Pb + He

Am → Np + He

15. Write the chemical name or formula for each of the compounds below:

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li₃N</td>
<td>lithium nitride</td>
</tr>
<tr>
<td>Mg₃P₂</td>
<td>magnesium phosphide</td>
</tr>
<tr>
<td>KOH</td>
<td>potassium hydroxide</td>
</tr>
<tr>
<td>SO₂</td>
<td>sulphur dioxide</td>
</tr>
<tr>
<td>Na₂CO₃</td>
<td>sodium carbonate</td>
</tr>
<tr>
<td>PCl₅</td>
<td>phosphorus pentachloride</td>
</tr>
<tr>
<td>P₄S₁₀</td>
<td>phosphorus decasulfide</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>iron oxide</td>
</tr>
<tr>
<td>PbO</td>
<td>lead oxide</td>
</tr>
<tr>
<td>K₂S</td>
<td>potassium sulfide</td>
</tr>
<tr>
<td>FeBr₃</td>
<td>iron (III) bromide</td>
</tr>
<tr>
<td>Mg(NO₃)₂</td>
<td>magnesium nitrate</td>
</tr>
<tr>
<td>N₂O₄</td>
<td>dinitrogen tetroxide</td>
</tr>
<tr>
<td>MgO</td>
<td>magnesium oxide</td>
</tr>
<tr>
<td>Li₂SO₄</td>
<td>lithium sulfate</td>
</tr>
</tbody>
</table>
16. State the law of conservation of mass.
   *The total mass of reactants is equal to the total mass of the
   products in a chemical reaction.*

17. What particles are conserved in a chemical reaction?
   *atoms*

18. Use COEFFICIENTS to balance the following chemical equations. If the
   equation is already balanced, state that next to the equation.

   \[2SO_2 + O_2 \rightarrow 2SO_3\]

   \[Fe_2O_3 + 3H_2 \rightarrow 2Fe + 3H_2O\]

   \[P_4 + 5O_2 \rightarrow P_4O_{10}\]

   \[2Al + 3CuSO_4 \rightarrow Al_2(SO_4)_3 + 3Cu\]

   \[2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O\]

19. Identify each chemical reaction as synthesis, decomposition, single-
   replacement, double-replacement, or combustion reaction.

   \[Al_2(SO_4)_3 + 3Ca(OH)_2 \rightarrow 2Al(OH)_3 + 3CaSO_4 \quad \text{double replacement}\]

   \[2C_2H_2 + 5O_2 \rightarrow 4CO_2 + 2H_2O \quad \text{combustion}\]

   \[Mg + 2AgNO_3 \rightarrow Mg(NO_3)_2 + 2Ag \quad \text{single replacement}\]

   \[2PbO_2 \rightarrow 2PbO + O_2 \quad \text{decomposition}\]

   \[2Be + O_2 \rightarrow 2BeO \quad \text{synthesis}\]
20. Complete the following reactions by predicting the products and balance the reactions when necessary:

Synthesis: \( 2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO} \)
Decomposition: \( 2\text{NaCl} \rightarrow 2\text{Na} + \text{Cl}_2 \)
Single replacement: \( 2\text{Ag(NO}_3\text{)} + \text{Cu} \rightarrow \text{Cu(NO}_3\text{)}_2 + 2\text{Ag} \)
Double replacement: \( \text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O} \)
Combustion: \( 2\text{C}_4\text{H}_{10} + 13\text{O}_2 \rightarrow 8\text{CO}_2 + 10\text{H}_2\text{O} \)

21. List the following substances in order of increasing acidity:
apples, bleach, black coffee, lemon juice, drain cleaner, baking soda
drain cleaner, bleach, baking soda, black coffee, lemon juice

22. Classify the following substances as acids, bases, salts, or organics:
\( \text{KCl} \{\text{salt}\}, \text{Ca(OH)}_2 \{\text{base}\}, \text{HBr} \{\text{acid}\}, \text{H}_2\text{SO}_4 \{\text{acid}\}, \text{NaOH} \{\text{base}\}, \text{C}_4\text{H}_{10} \{\text{organic}\}, \text{C}_2\text{H}_6\text{O} \{\text{organic}\}, \text{NaNO}_3 \{\text{salt}\} \)

23. For the reaction of \( \text{AB} \rightarrow \text{A} + \text{B} \), the following data was collected. Use the data to calculate the reaction rate.
\begin{align*}
t= 0 \text{ min} &\; [\text{AB}] = 2.5 \text{ g} \\
t= 2 \text{ min} &\; [\text{AB}] = 2.12 \text{ g} \\
\text{reaction rate} = \frac{\text{mass of product formed}}{\text{time of reaction}} &= \frac{2.5 \text{ g} - 2.12 \text{ g}}{2 \text{ min}} = 0.19 \text{ g/min}
\end{align*}

24. According to the collision theory, what must happen in order for two molecules to react?
Particles must collide with a certain minimum amount of energy to overcome the repulsive forces between reactants and break the necessary bonds to bring about the reaction.

25. Draw the Lewis Diagram for a molecule of \( \text{F}_2 \)