SHOW WHAT YOU KNOW

Atoms & Elements

1. Identify each part of the atom.
   A:
   B:
   C:

2. An element is determined by the number of ________ in its nucleus (also known as its atomic number).
   a. neutrons
   b. electrons
   c. protons
   d. glons

3. Each chemical element is made up of only one kind of
   a. atom
   b. molecule
   c. electron
   d. neutron

4. Chemists use letters of the alphabet as ________ for the elements.

5. A ________ is a particle with no charge.

6. What is the atomic number of this element? ________
7. How many neutrons does this element have? ________
8. What is the atomic mass of this element? ________
9. How many electrons does this element have? ________

10. Explain how you could identify what type of element the atom in question 1 is using the diagram and a periodic table.

Homework today: p 12-013
Match each item with the correct statement:

1. The smallest particle of an element that retains the properties of that element
   - A. PROTON
   - B. NUCLEUS
   - C. ATOM
   - D. ELECTRON
   - E. NEUTRON

2. A positively charged subatomic particle

3. A negatively charged subatomic particle

4. A subatomic particle with no charge

5. The central part of an atom containing protons and neutrons

Match each item with the correct statement:

1. Atoms with the same number of protons but different numbers of neutrons
   - A. ATOMIC MASS
   - B. MASS NUMBER
   - C. ISOTOPE

2. Total number of protons and neutrons in the nucleus

3. The weighted average of the masses of the isotopes of an element

Label each part of the Periodic Table square:

- Manganese
  - 54.94

These are the nuclei of three different atoms. Write the isotopic notation for each (for example, Carbon - 12)

Complete the table below by referencing a periodic table. The first row has been completed as an example.

<table>
<thead>
<tr>
<th>Chemical Symbol</th>
<th>Atomic Number</th>
<th>Atomic Mass</th>
<th>Mass Number</th>
<th>Isotopic Notation of Most Common Isotope</th>
<th># of protons</th>
<th># of electrons</th>
<th># of neutrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphorus</td>
<td>P</td>
<td>15</td>
<td>30.97</td>
<td>Phosphorus - 31</td>
<td>15</td>
<td>15</td>
<td>31 - 15 + 16</td>
</tr>
<tr>
<td>Aluminum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potassium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Argon</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>
Organization of the Periodic Table

Russian chemist Dmitri Mendeleev systematically predicted the properties of the chemical element germanium 15 years before it was discovered.

He was able to do this because all known elements had been arranged into a set of rows called Periods and a set of columns called Groups. He called the periodic table.

This periodic table shows 112 elements. Scientists have reported the discovery of elements with atomic numbers up to 118. However, some of these elements have not been confirmed by the International Union of Pure and Applied Chemistry (IUPAC). Until they are, their existence is "nominal." The properties of new elements are predicted before their discovery, just as they were in Mendeleev’s time.

The periodic table shows that the physical and chemical properties of the elements recur at regular intervals when elements are arranged in order of increasing atomic number.

The elements are divided into several categories based on their properties:

- **Metallic**
- **Non-metallic**
- **Alkali metals**
- **Alkaline earth metals**
- **Transition metals**
- **Lanthanides**
- **Actinides**

In the periodic table, elements in Group 1A have a single valence electron, and elements in Group 2A have a double valence electron.

The periodic table is a valuable tool for organizing and understanding the properties of elements.

**Review: The Chemical Elements**

Self-Test: For each of the following, give the name of the element if the symbol is given, and give the symbol if the name is given.

- (a) Sodium: Na
- (b) Potassium: K
- (c) Calcium: Ca
- (d) Barium: Ba
- (e) Mercury: Hg
- (f) Sulfur: S
- (g) Selenen: Se
- (h) Iodine: I
- (i) Phosphorus: P
- (j) Nitrogen: N
- (k) Oxygen: O
- (l) Hydrogen: H

We'll learn the naming of compounds made from metals and non-metals.

**Ionic Compound**

Metals and non-metals form ionic compounds when they react. The metal loses an electron to form a positive ion, and the non-metal gains an electron to form a negative ion. The compound formed is an ionic compound.

**Covalent Bonding**

Non-metals often form covalent compounds. In covalent bonding, the atoms share electrons to form stable molecules.

**Ions & Charges**

When ions form, the number of electrons changes. For example, sodium loses an electron to become a +1 ion, and chlorine gains an electron to become a -1 ion. Understanding these changes is crucial for predicting the behavior of elements in various compounds.

- Sodium (Na) becomes Na⁺ (loses 1 electron).
- Chlorine (Cl) becomes Cl⁻ (gains 1 electron).
- Oxygen (O) becomes O²⁻ (gains 2 electrons).
- Nitrogen (N) becomes N³⁻ (gains 3 electrons).

These charges help us write balanced chemical equations and understand the electrical neutrality of compounds.
**Ion Formation**

When atoms gain or lose electrons, they become electrically charged particles called **ions**

- **Gain** electrons to form **negative** (anions)
- **Lose** electrons to form **positive** (cations)

Metal atoms, for example, lose electrons to form cations

Many metals can form a cation only in one way.
For example, aluminum forms a cation by losing three electrons to become $\text{Al}^{3+}$

Some metals are **multivalent**, which means they can form ions in more than one way, depending on the chemical reaction they undergo.
For example, iron is a multivalent element because it can lose 2 or 3 electrons to become $\text{Fe}^{2+}$ or $\text{Fe}^{3+}$ cations.

Look at the periodic table! Which metals are multivalent?

Fe, Ti, Cu, Sn, Mn, Au, Hg, Pb, Bi, etc.

Many non-metals also form ions. However, these are not metal atoms, with various exceptions. Non-metals that form ions are called **anions**. For example, oxygen forms $\text{O}^{-}$ ion called anion.

For example, the periodic table shows that chlorine will form a $\text{Cl}^{-}$ ion.

This happens when a chlorine atom **gain** one electron

You should become VERY familiar with the following ion changes, as they are the most common and you will use them often:

<table>
<thead>
<tr>
<th>Ion</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{H}^{+}$</td>
<td>$\text{Li}^{+}$</td>
</tr>
<tr>
<td>$\text{Na}^{+}$</td>
<td>$\text{Ca}^{2+}$</td>
</tr>
<tr>
<td>$\text{Al}^{3+}$</td>
<td>$\text{F}^{-}$</td>
</tr>
<tr>
<td>$\text{Cl}^{-}$</td>
<td>$\text{Br}^{-}$</td>
</tr>
<tr>
<td>$\text{I}^{-}$</td>
<td>$\text{Ag}^{+}$</td>
</tr>
</tbody>
</table>

**IMPORTANT:** Metals form **cations**. Non-metals form **anions**.