

5 • What Do Atoms Look Like?

Classifying the Elements:

The elements can be classified in two ways:

- Metals, non-metals, and semi-metals
- Chemical families (groups)

Metals are good _____ of heat and electricity. They are _____ and lustrous. They are _____ which means they can be pounded into thin sheets. They are _____ which means they can be drawn into wires.

Metals have low _____ which means that they do not hold onto their valence electrons tightly. In their compounds they form ions with _____ charge.

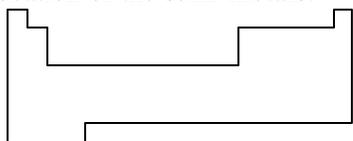
Nonmetals are poor _____ of heat and electricity. An important exception is pure carbon in the form of _____. Unlike metals, as solids they are _____ when hit with a hammer.

All of the diatomic elements are nonmetals. Note that _____ is a nonmetal even though it is located with the metals on the periodic table.

Nonmetals have high _____ and tightly hold onto their valence electrons. In their compounds the nonmetals form ions with a _____ charge.

Semimetals have properties that are in between metals and nonmetals. They are important in the semiconductor and computer industries. The semimetals are: _____.

Sketch the location of the semi-metals:



PROPERTIES & TRENDS

Properties of the Families:

Alkali Metals (1): _____

- In their compounds they always form _____ ions.
- They react with _____ to form $H_2(g)$ and OH^- ions.
Example: $Na + \quad \rightarrow$
- Their chemistry involves _____ (gaining/losing) one electron. They have one _____ electron.
- They are _____ metals and can be cut with a knife.
- They are never found uncombined in nature because they are so reactive.
- They are stored _____.
- Na^+ and K^+ have characteristic flame test colors of _____ (Na^+) and _____ (K^+).

Alkaline Earth Metals (2): _____

- In their compounds they always form _____ ions.
- They *slowly* react with _____ to form $H_2(g)$ and OH^- ions. *Example:* $Ca + \quad \rightarrow$
- Their chemistry involves _____ (gaining/losing) two electrons. They have two _____ electrons.
- _____ was used in our lab to form $H_2(g)$.
- _____ is a component of bones and teeth. The loss of this mineral is called _____.
(<http://www.nof.org/>)

Noble Gases (18): _____

- These elements do not easily combine with other elements. They are odorless, colorless and therefore were difficult to discover.
- When air is cooled, O_2 liquefies first at $-182^\circ C$. N_2 liquefies at $-195^\circ C$. About 1% of the air is still gas composed of the noble gas _____, _____.
- One noble gas was discovered on the Sun. It's spectrum was identified first. This is _____, _____.
- One noble gas is radioactive and seeps up through basement floors and walls. It is _____, _____.
- This noble gas is used in electronic flashes and other bright lights. It is _____, _____.
- One noble gas is best known for its orange color in gas discharge tubes. It is used for signs that bear its name. It is _____, _____.

Halogens (17): _ _ _ _ ()

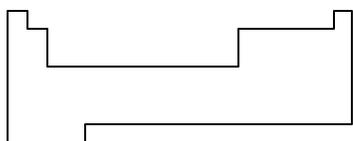
- In their compounds they always form _ ions.
- They have _ valence electrons.
- They react with _____ to form salts which gives them their name of “salt formers.”
Example: $2 \text{Na} + \text{Cl}_2 \rightarrow$
- Their chemistry involves _____ (gaining/losing) one electron.
- All of the members of this family are _____.
(We assume At_2 *would* exist if there *were* any.)
- Halogen bulbs are unique for their _____, but dangerous because they are _____.
<http://www.howstuffworks.com/question151.htm>
- Halogens are very _____. The element on the table with the greatest attraction for electrons is _____, ____ (4.0).
- Halogens _____ (gain/lose) electrons and are _____ (oxidized/reduced) and therefore are good _____ (oxidizers/reducers). Because of this, Cl_2 is used to purify _____.

Hydrogen, H

- Hydrogen is its own family because it has properties like two families: _____ & _____.
- It usually forms _ ions.
- It can combine with halogens.
Example: $\text{H}_2 + \text{Cl}_2 \rightarrow$
- In this case, H _____ (gains/loses) one electron.
- Hydrogen has _ valence electron.
- H is located with the _____ family.
- It has one less electron than the noble gas, _____.
- It can combine with alkali and other metals.
Example: $2\text{Li} + \text{H}_2 \rightarrow$
- In this case, H _____ (gains/loses) one electron.
- In this case, H has a _ charge (oxidation #).
- It is diatomic like the _____ family.

Trends in the Periodic Table:

Size of the Elements:



(Sketch the trend in size)

Think “electron cloud” model.

The size of the atom is due to the size of the _____. The two forces at play are _____ between the electrons and other electrons and _____ between the electrons and protons in the nucleus.

Left to right **across** the table, the atoms get _____ because there are more and more _____ in the nucleus pulling on the valence electrons. In any period, the valence electrons are on the same level (floor).

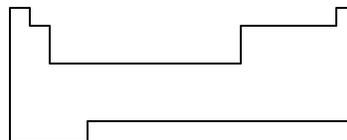
Going **down** any group or family, the atoms get _____ because there are more and more _____ of electrons. Each level of electrons is _____ from the nucleus.

Ionization Energy (IE)

This is defined as the energy needed to remove an electron from an atom.



It is _____ (easier/harder) to remove an electron from a larger atom. This is because the electron is _____ (closer/farther) from the nucleus and feels _____ (less/more) attraction.



(Sketch the trend in ionization energy)

Sizes of Ions:

Each time an electron is removed, the atom/ion becomes _____ (smaller/larger) because there is _____ (more/less) $\text{e}^- - \text{e}^-$ repulsion. So... each successive electron removed has a _____ (higher/lower) ionization energy. (Atoms that gain electrons become _____.)

After all the valence electrons are removed, the next electron is much _____ (closer to/farther from) the nucleus and is much more difficult to remove. There is a big jump in Ionization NRG.