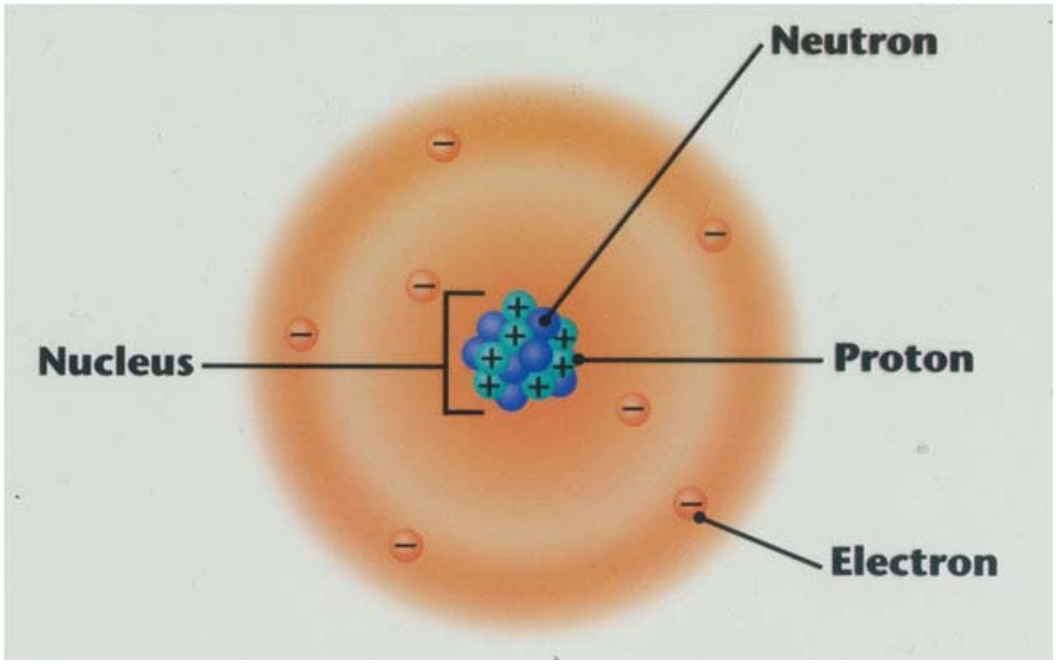
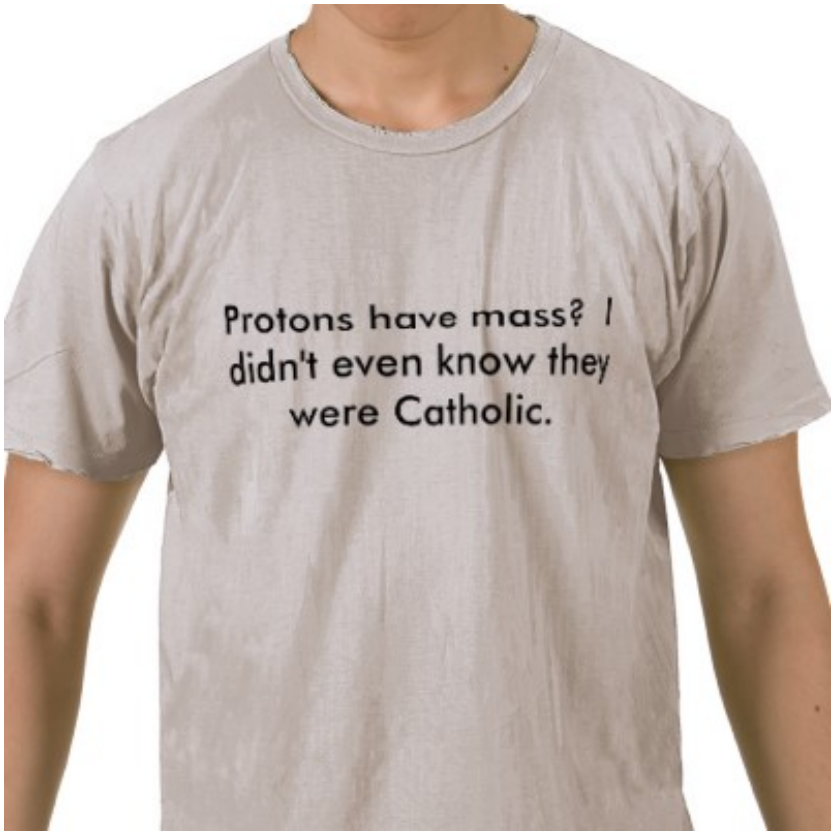
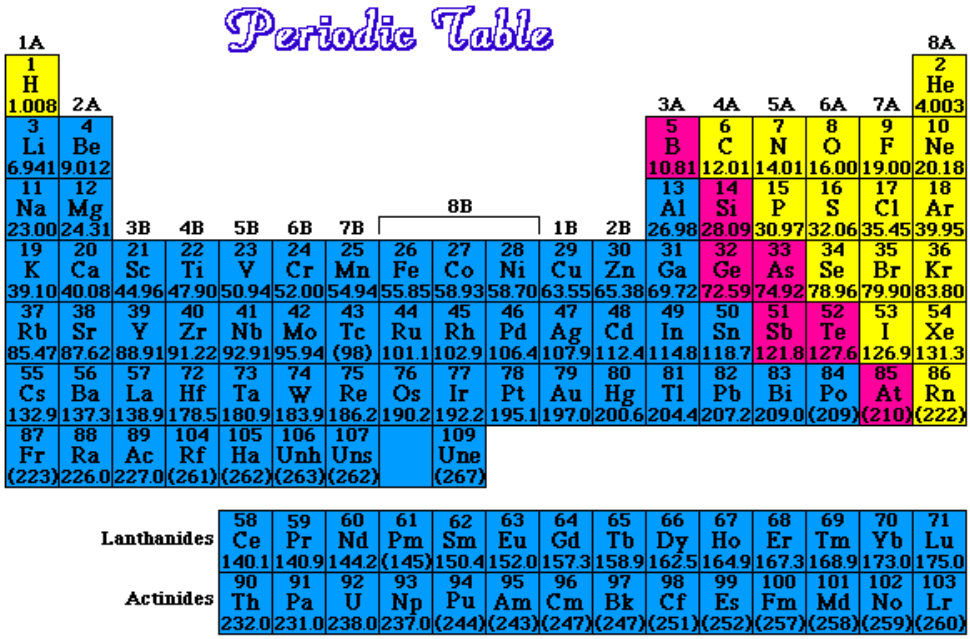
The Atom (A Nitrogen Atom is Depicted Here)



Important points to remember about the atom

1. Protons and neutrons are in the nucleus.
2. Electrons are distributed around the nucleus within well-defined energy levels or "electron shells".
3. Protons are positive, electrons are negative, neutrons are neutral (have no charge).
4. Neutrons are particles that hold the nucleus together.
5. The number of protons is equal to the number of electrons in a neutral atom. (Note that protons are in the nucleus, but electrons are not- they are outside the nucleus.)
6. The number of neutrons is not necessarily equal to the number of protons.
7. The mass of a proton = the mass of a neutron (so the ratio of a proton's mass to a neutron's mass is 1).
8. The mass of a proton (or neutron) is 1840 times the mass of an electron.
9. The volume of the nucleus occupies a very small fraction of the total volume of the atom.


Protons have mass? I
didn't even know they
were Catholic.



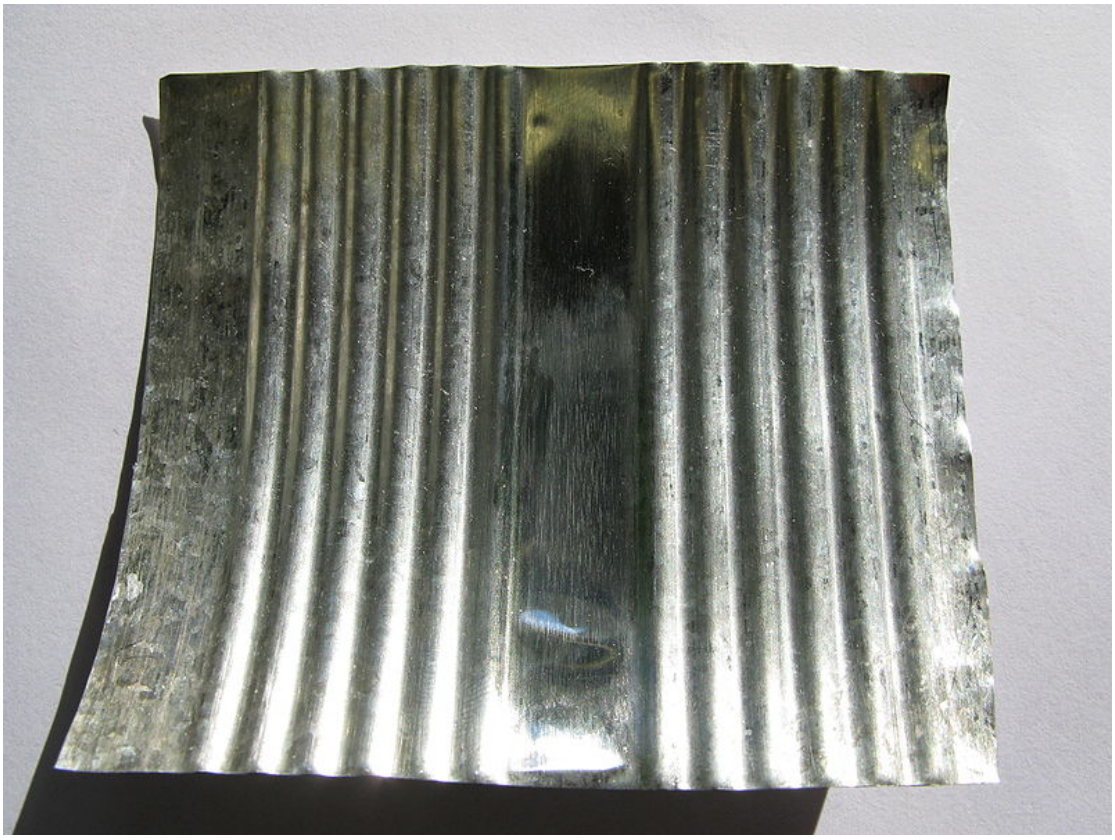
Yellow: Nonmetals
Blue: Metals
Pink: Metalloids


Mercury

Some characteristics of metals to know:

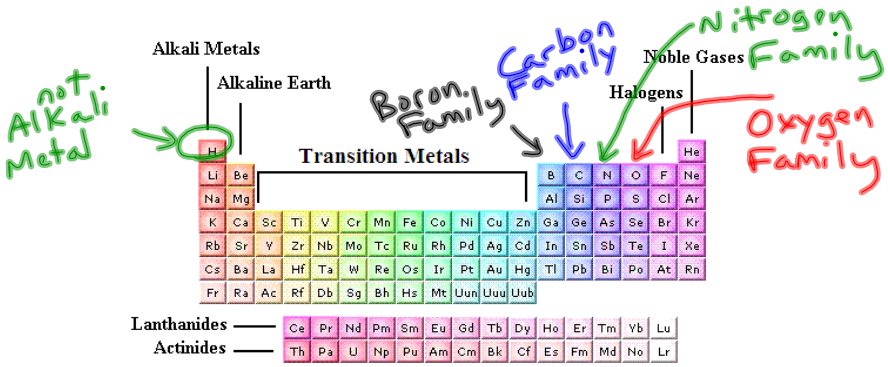
1. All metals are solid at room temperature <u>except for mercury.</u> (So it wouldn't be true to say that they are<u>all</u> solid at room temperature!)
2. Metals are shiny.
3. Metals are malleable (they can be pulled into sheets).
4. Metals conduct electricity.

One characteristics of non-metals to know:
Nonmetals <u>do not</u> conduct electricity.



Metals are malleable (can be pulled into sheets)!

Metals are ductile (can be pulled into wires)!

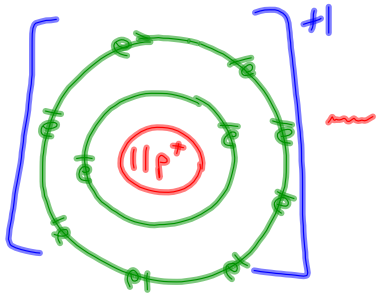


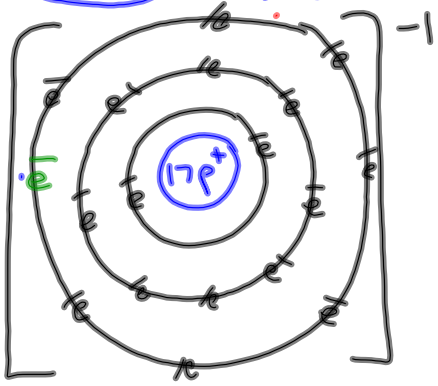
Families of Elements: Each vertical column is a "family". The elements within a family share similar characteristics. Each different family has characteristics that are not shared by other families.
Let's look at the families....

Alkali metals

1. Are the first family on the periodic table. (Hydrogen is not an alkali metal).
2. They react readily with oxygen and the halogens. → e.g. Cl

e.g. Na metal





$11p^+ = +11$
$10e^- = -10$
$+1$

$17p^+ = +17$
$18e^- = -18$
-1

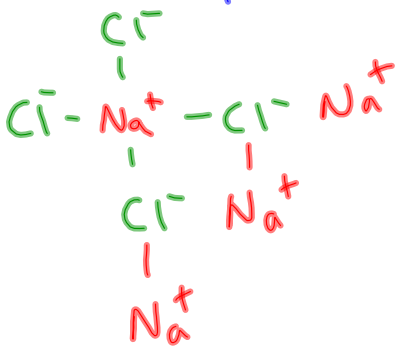


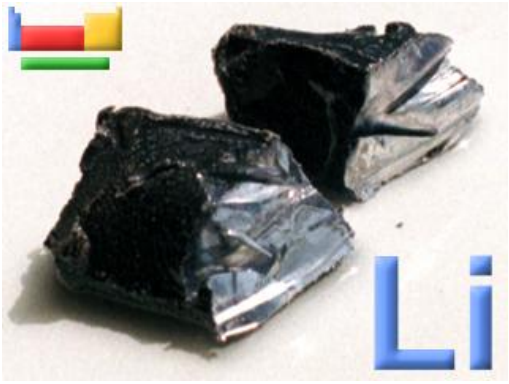
Table Salt

NaCl

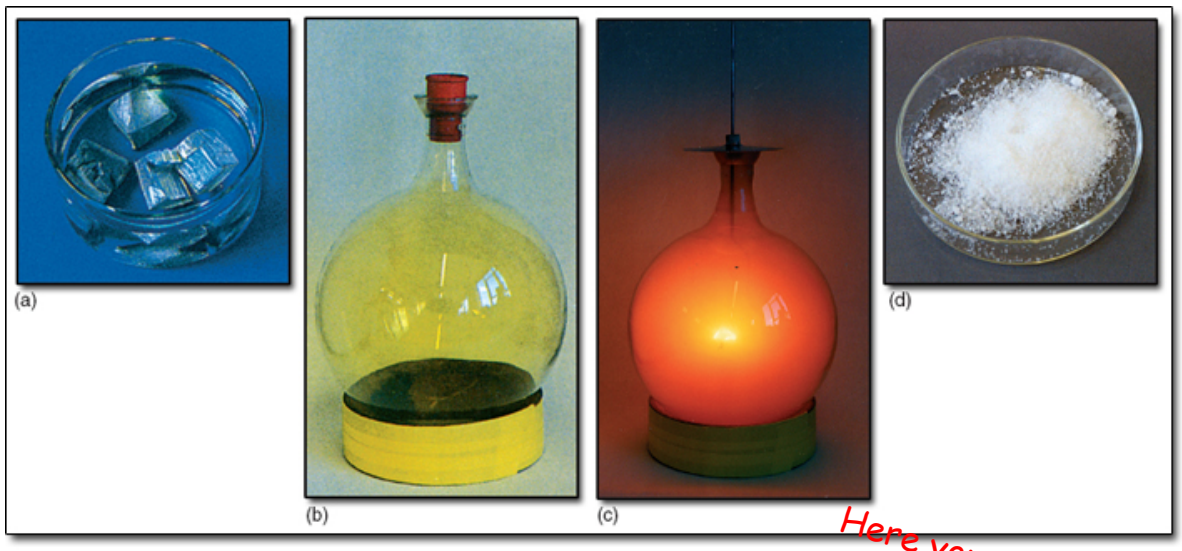
Sodium sulphide

Na_2S

(all have 1 valence electron!)



Reaction between alkali metal (sodium) and halogen (chlorine gas):



Here you see an example of a chemical reaction!
A new substance is produced!

(a) Sodium metal (Na)
(b) Chlorine gas (Cl_2)
(c) Reaction when the sodium is placed in the chlorine gas:

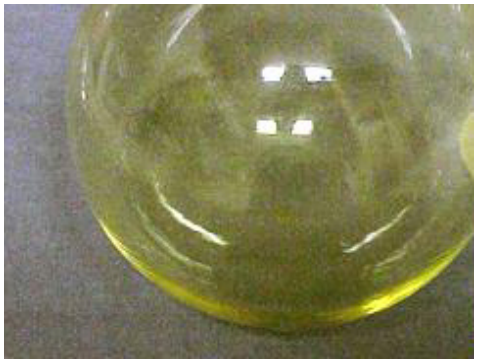
$Na + Cl_2$ ----> NaCl

(d) Result: table salt (NaCl)

Alkaline Earth Metals : Are the second vertical family. They have properties tha are different from those of the alkali metals. (all have 2 valence electrons!)


LETS TAKE ALL THESE BAD CHEMISTRY JOKES
AND BARIUM
quickmeme.com

Halogens: Are the second last vertical family. They are all diatomic. Different states of matter exist. All toxic.



Halogen #1

F_2 gas

(all have 7 valence electrons!)

Fluorine is a greenish-yellow gas. Very corrosive.

Uses: Fluorine and its compounds are used in producing uranium. Fluorochlorohydrocarbons are used in refrigeration applications. Fluorine is used to produce many chemicals, including several high-temperature plastics. The presence o sodium fluoride in drinking water at the level of 2 ppm may cause mottled enamel in teeth, skeletal fluorosis, and may be associated with cancer and other diseases. However, topically applied fluoride (toothpaste, dental rinses) has been shown to help reduce dental caries.

Chlorine gas : was used in gas warfare in WW1

Halogen #2

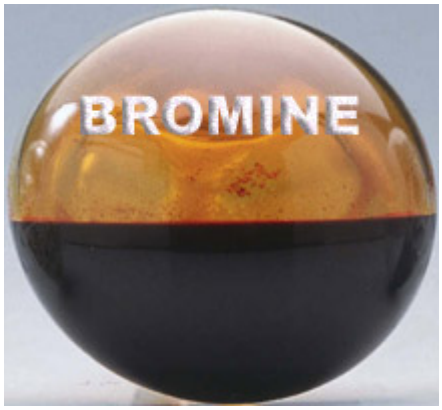
Cl_2 *gas*

What chlorine is

- Chlorine is an element used in industry and found in some household products.
- Chlorine is sometimes in the form of a poisonous gas. Chlorine gas can be pressurized and cooled to change it into a liquid so that it can be shipped and stored. When liquid chlorine is released, it quickly turns into a gas that stays close to the ground and spreads rapidly.
- Chlorine gas can be recognized by its pungent, irritating odor, which is like the odor of bleach. The strong smell may provide an adequate warning to people that they have been exposed.
- Chlorine gas appears to be yellow-green in color.
- Chlorine itself is not flammable, but it can react explosively or form explosive compounds with other chemicals such as turpentine and ammonia.

Where chlorine is found and how it is used

- Chlorine was used during World War I as a choking (pulmonary) agent.
- Chlorine is one of the most commonly manufactured chemicals in the United States. Its most important use is as a bleach in the manufacture of paper and cloth, but it is also used to make pesticides (insect killers), rubber, and solvents.
- Chlorine is used in drinking water and swimming pool water to kill harmful bacteria. It is also as used as part of the sanitation process for industrial waste and sewage.
- Household chlorine bleach can release chlorine gas if it is mixed with other cleaning agents.



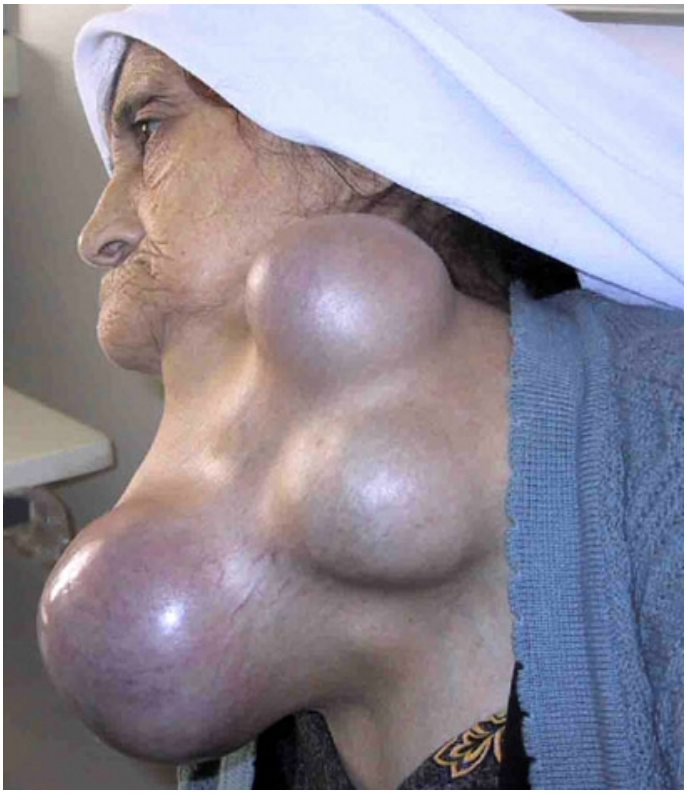
Halogen #3

Br_2 liquid

Bromine is the only liquid non-metallic element.
It is a heavy, volatile, mobile, dangerous reddish-brown liquid. The red vapour has a strong unpleasant odour and the vapour irritates the eyes and throat. When spilled on the skin it produces painful sores. It is a serious health hazard, and maximum safety precautions should be taken when handling it.

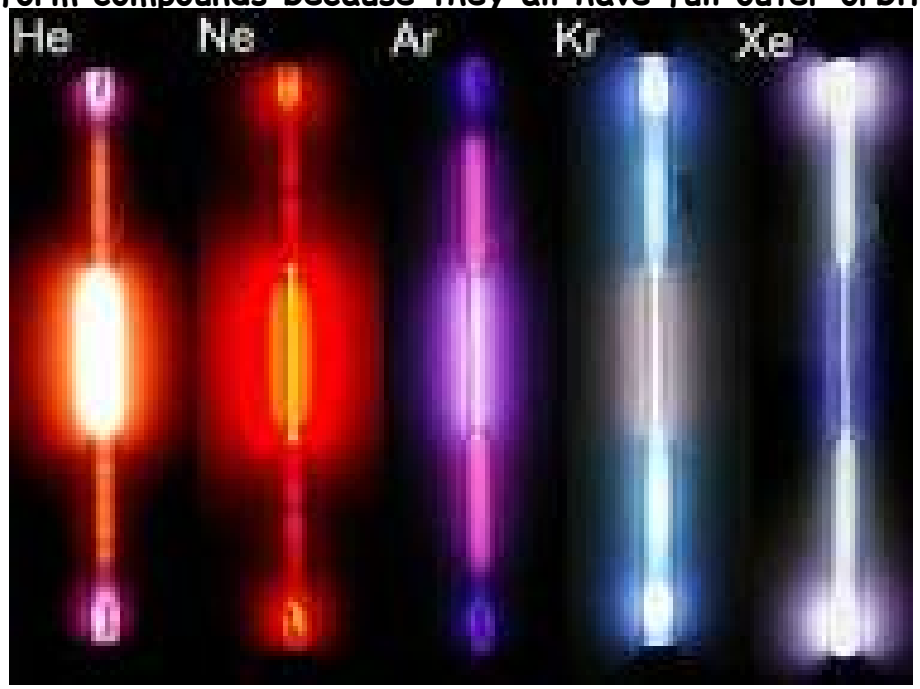
Although iodine is essential for proper nutrition, care is needed when handling the element, as skin contact can cause lesions and the vapor is highly irritating to the eyes and mucous membranes.

The radioisotope I-131, with a half-life of 8 days, has been used to treat thyroid disorders. Insufficient dietary iodine leads to the formation of a goiter. A solution of iodine and KI in alcohol is used to disinfect external wounds. Potassium iodide is used in photography.

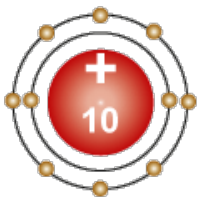


Goiter

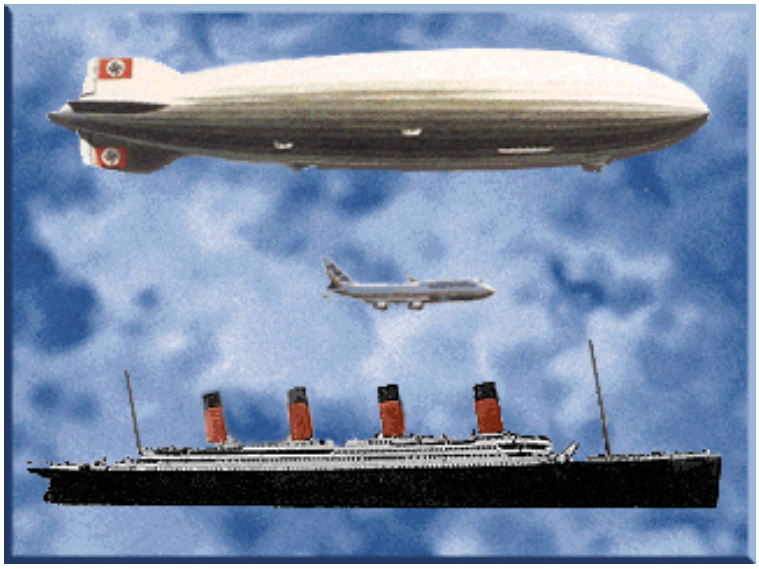
Noble Gases: are the last vertical column on the periodic table. They are also called the inert gases. These gases do not react with other elements to form compounds because they all have full outer orbits of electrons.



Neon (full outer orbit):



German airship: contained hydrogen gas (7,062,000 cubic feet of gas!)
It holds the record for the largest aircraft ever flown.
It exploded into flames in 1937, 35 people killed.



A size comparison of the Hindenburg with a 747 and the Titanic. The Titanic is only 78 feet longer than the Hindenburg at 882 feet long.

Helium is the second most abundant element in the universe (next to hydrogen).
Helium is the second lightest element (also next to hydrogen).
However, unlike hydrogen, helium is not explosive and it is nonreactive.

Since the *Hindenburg* disaster in 1937 helium has replaced hydrogen as a liing gas in blimps and balloons due to its lightness and incombusbility.

All other families are named according to the element at the top of the column.

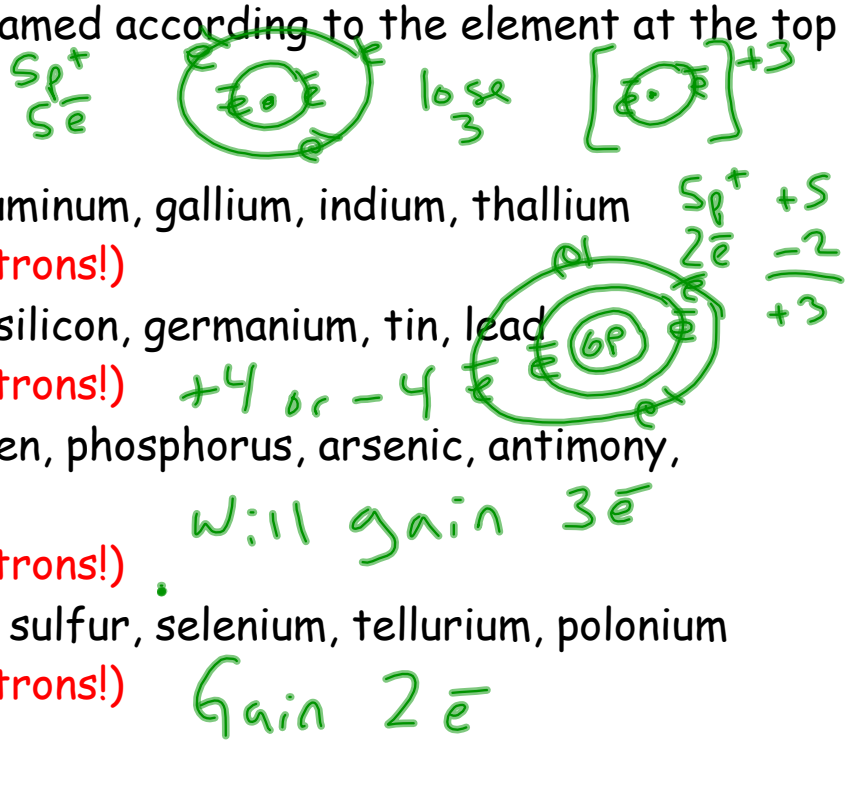
Egs:

Boron family: boron, aluminum, gallium, indium, thallium
(all have 3 valence electrons!)

Carbon family: carbon, silicon, germanium, tin, lead
(all have 4 valence electrons!)

Nitrogen family: nitrogen, phosphorus, arsenic, antimony, bismuth
(all have 5 valence electrons!)

Oxygen family: oxygen, sulfur, selenium, tellurium, polonium
(all have 6 valence electrons!)

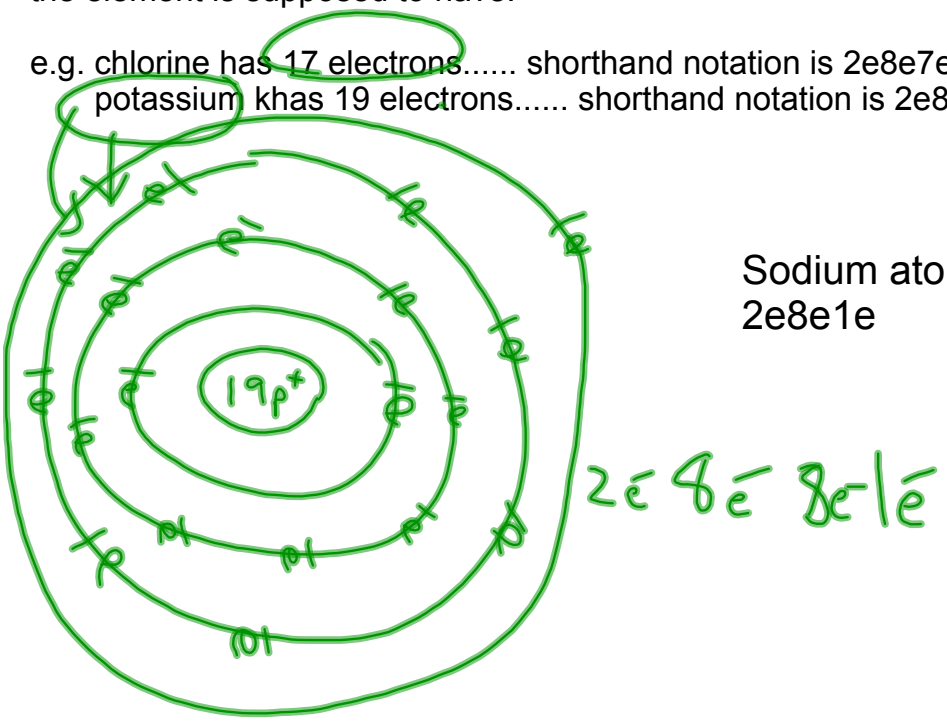


Periods are <u>horizontal rows</u> on the periodic table.
Egs.
Period 1: H, He
Period 2: Li, Be, B, C, N, O, F, Ne
Period 3: Na, Mg, Al, Si, P, S, Cl, Ar
Period 4: K, Ca, Sc, Ti....etc.

Reminder about Electron Configuration shorthand:

Determine the number of electrons that the element has (same as the atomic number) then write the number of electrons present in each orbit, working from the inside...out. Remember, the first orbit holds up to 2 electrons, after that each orbit will hold up to 8. Keep working outward until your total number of electrons is equal to the total number tha the element is supposed to have.

e.g. chlorine has 17 electrons..... shorthand notation is 2e8e7e
potassium khas 19 electrons..... shorthand notation is 2e8e8e1e



Sodium atom
2e8e1e

Electronic configuration	Family	Period number
2e 7e	Halogen	2
2e8e1e	Alkali Metals	3
2e8e4e	Carbon	3
2e8e6e	Oxygen	3
2e8e8e	Noble gas	3
2e8e5e	Nitrogen	3
2e3e	Boron	2

14 Si
16 S
18 Ar
P
15
S
B

Isotopes Review

Isotopes are atoms of the same element (so they have the same number of protons), but they have different numbers of neutrons. The number of electrons is irrelevant if you are looking at whether two atoms are isotopes of the same element.

Summary: If you are asked if two atoms are isotopes of the same element, look at whether the number of protons is the same. The number of neutrons will be different, and the number of electrons doesn't matter.

Eg.

Element A: 38 protons, 38 neutrons, 38 electrons

Element B: 37 protons, 38 neutrons, 36 electrons

Element C: 38 protons, 37 neutrons, 36 electrons

*Elements A and C are isotopes of the same element because they have the same number of protons.

Some new definitions:

Ion : is a charged particle. It can refer to either a positively charged particle or a negatively charged particle. In an ion (charged particle) the number of protons (which are positively charged) is different than the number of electrons (which are negatively charged).

Eg. Al^{+3} has 13 protons and 10 electrons

(+13) (-10) = +3 overall

S^{-2} has 16 protons and 18 electrons

(+16) (-18) = -2 overall

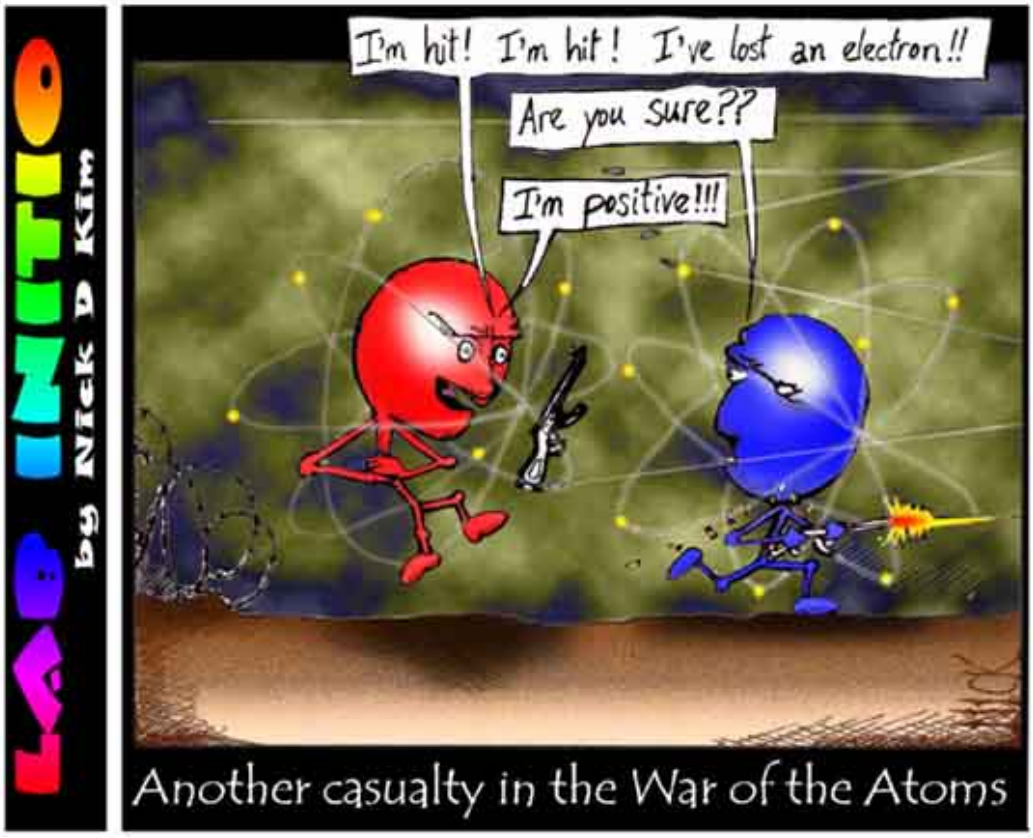
*Whenever an atom has more protons than electrons it is positive overall. Whenever an atom has more electrons than protons it is negative overall!

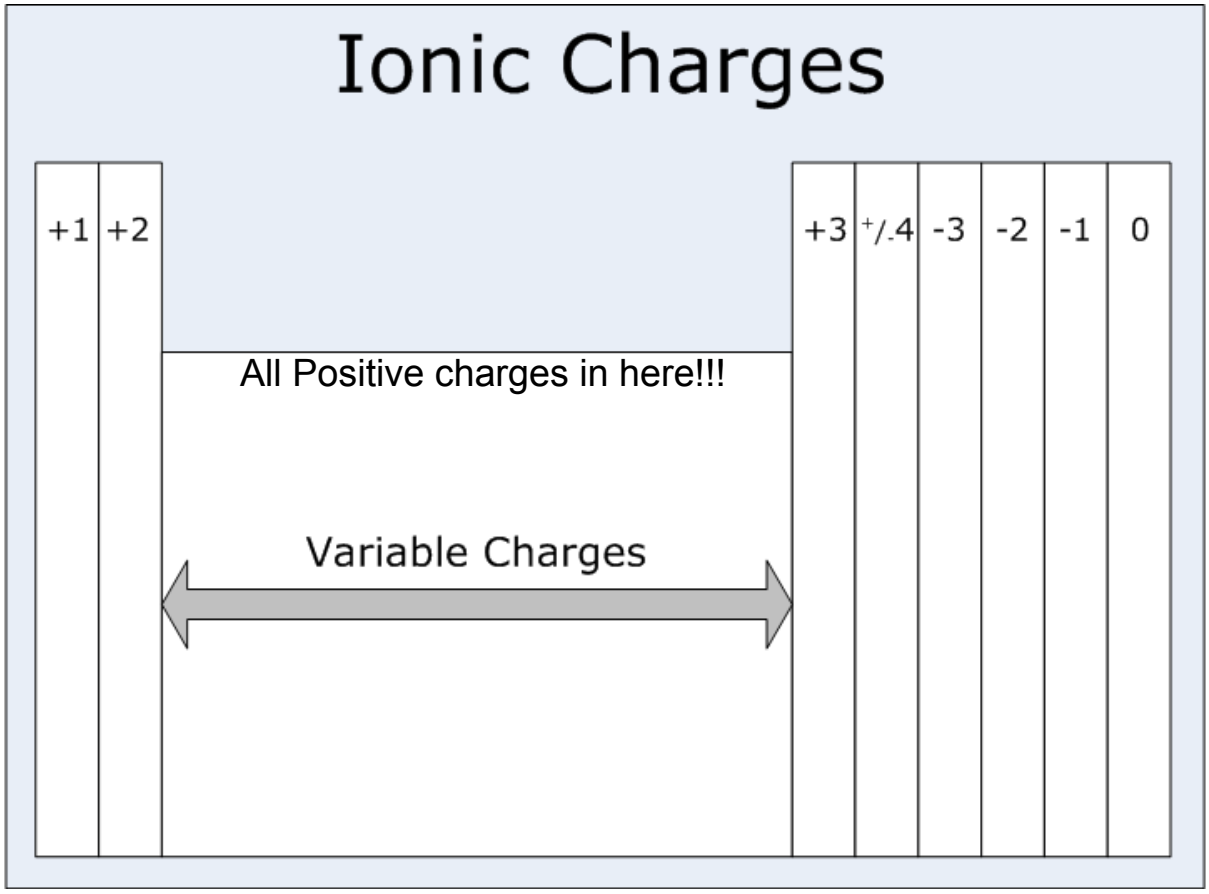
Cation: is a positive ion. It is a positively charged particle. It has more protons than electrons.

Eg. K^{+1} has 19 protons and 18 electrons

Mg^{+2} has 12 protons and 10 electrons

- All metal atoms lose electrons to become stable. Therefore all metal atoms form cations when metals react with other atoms to form compounds. Metal atoms always combine with nonmetal atoms when they react to form compounds. Two metal atoms can't react to form a compound because there can't be two cations together!


LAB INTIO
by Nick D Kim
I'm hit! I'm hit! I've lost an electron!!
Are you sure??
I'm positive!!!
Another casualty in the War of the Atoms


Ionic Charges
+1
+2
+3
+/.4
-3
-2
-1
0
All Positive charges in here!!!
Variable Charges

Anion: is a negative ion. It is a negatively charged particle. It has more electrons than protons.

Eg. O^{-2} has 8 protons and 10 electrons

Br^{-1} has 35 protons and 36 electrons

- All nonmetal atoms gain electrons to become stable. When nonmetals react with metals to form a compound the nonmetal forms an anion (while the metal forms a cation). The two oppositely charged particles then attract each other within the compound.

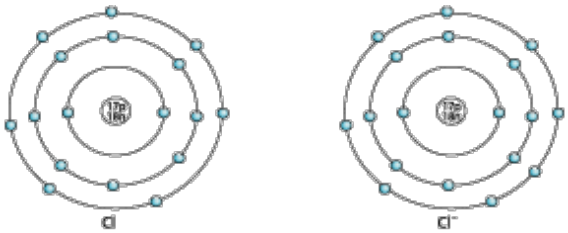
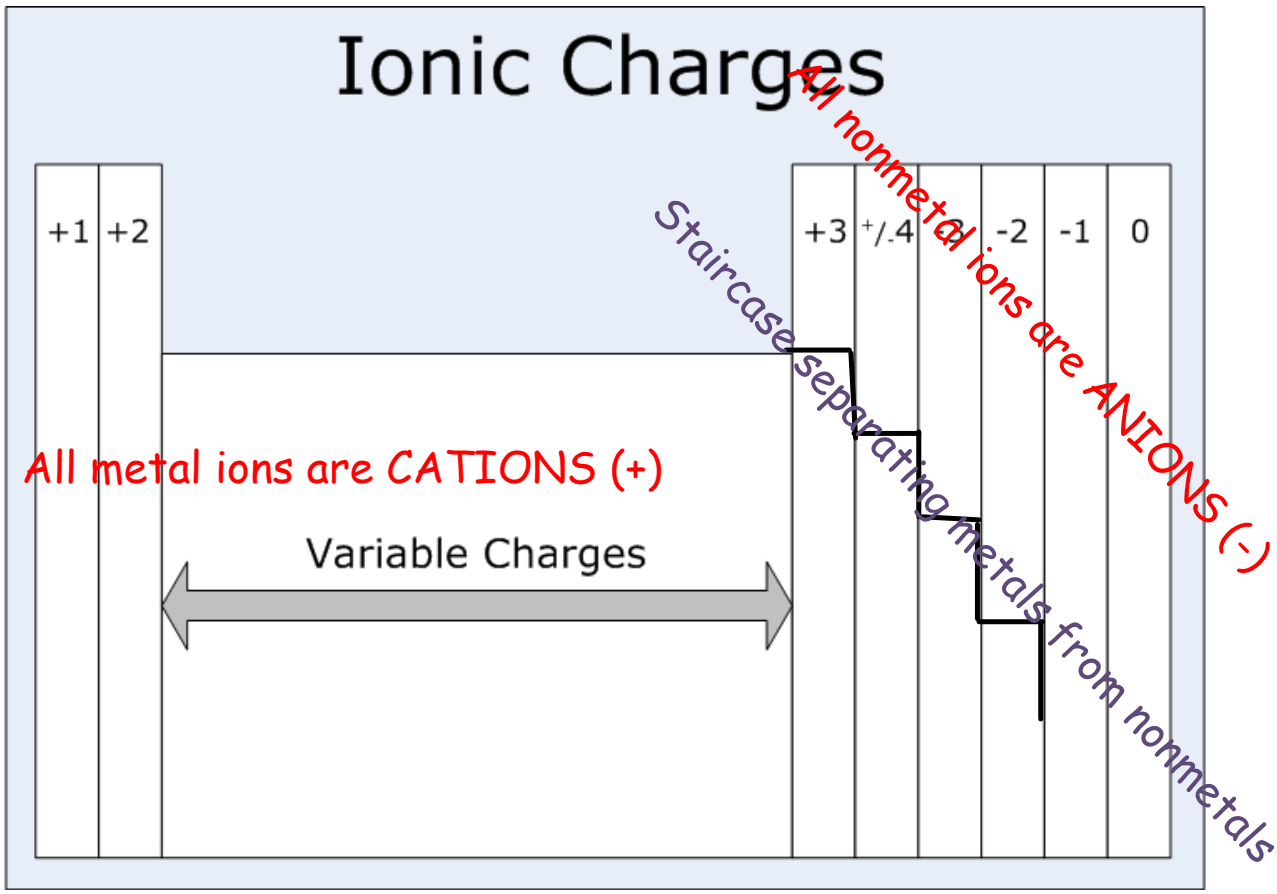


Fig. 5.2


PLEASE SPARE AN ELECTRON
e⁻
e⁻
Hi, I'M HAL O'GEN
J J
LZ


Ionic Charges
+1
+2
+3
+/-4
-3
-2
-1
0
All nonmetal ions are ANIONS (-)
Staircase separating metals from nonmetals
All metal ions are CATIONS (+)
Variable Charges

Determine the Germanium isotopes below. You may refer to a periodic table:

↳ Atomic number = 32 = 32 protons

A, D, G

Elements	Number of protons	Number of neutrons	Number of electrons
A	32	32	28
B	33	32	36
C	31	32	28
D	32	33	36
E	30	29	27
F	30	30	30
G	32	31	32

Indicate whether the seven elements above are neutral atoms, anions or cations by placing their corresponding letters in the appropriate boxes.

$\#p^+ < \#\bar{e}$ $\#p^+ > \#\bar{e}$

$\#p^+ = \#\bar{e}$ more $\bar{e}$ than p^+ more p^+ than $\bar{e}$

Neutral Atoms	Anions	Cations
F, G	B, D	A, C, E