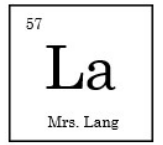


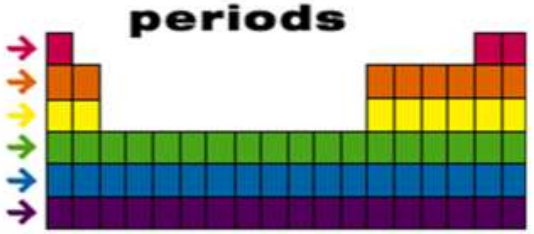
LESSON 9 1: Development of the Periodic Table

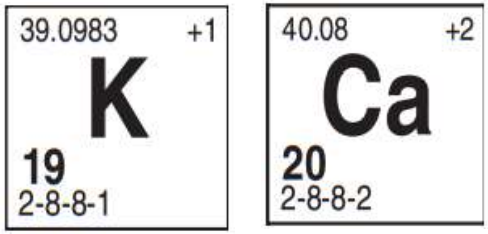
1869: Dimitri Mendeleev
- Originally organized elements based upon _____
- Elements with similar properties were supposed to be in the same _____ (up and down)

1914: Henry Moseley
- Developed the _____
- Organized elements by _____ (# of protons)
- Created the Periodic Law which states, "Properties of elements are periodic functions of their atomic numbers."
- This means –
    - The Result…

Organization of the Periodic Table

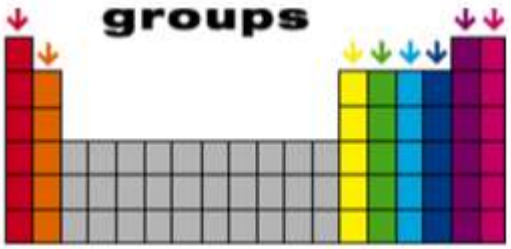
Periods
- Period number = _____

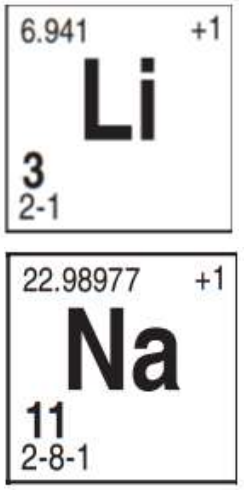




Groups
- Same group means same _____

resulting in _____

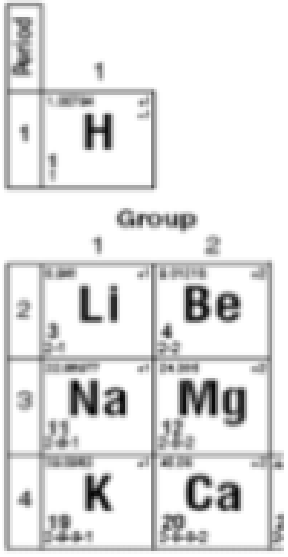




Reactivity of Elements

-
-
-

Example: Which two elements have similar chemical properties and why? *Na, K, Li, Be*



LESSON 9.2: Categories & Properties of Elements

Quick Definitions (helpful for later)

☆ Electronegativity –

☆ Ionization Energy –

☆ Electron Affinity –

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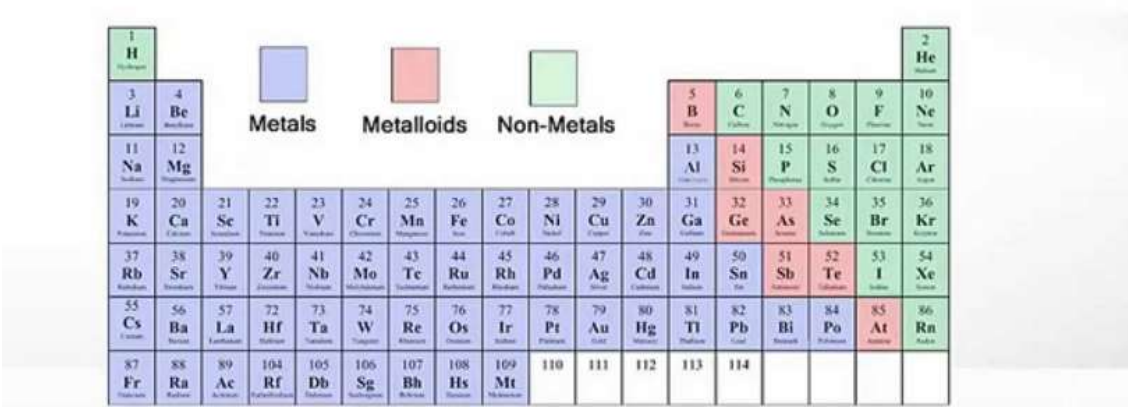
NEED TO KNOW!

Metals, Nonmetals, and Metalloids



PRACTICE!

Name: _____

1. On the present Periodic Table of the Elements, the elements are arranged according to increasing

(1) # of oxidation states
(2) # of neutrons
(3) atomic mass
(4) atomic number

2. The properties of elements are periodic functions of their

(1) mass numbers
(2) atomic masses
(3) atomic radii
(4) atomic numbers

3. Bromine has chemical properties most similar to

(1) fluorine
(2) potassium
(3) krypton
(4) mercury

4. Which element is in Group 2 and Period 7 of the Periodic Table?

(1) magnesium
(2) manganese
(3) radium
(4) radon

5. In which shell are the valence electrons of the elements in Period 2 found?

(1) 1 (2) 2 (3) 3 (4) 4

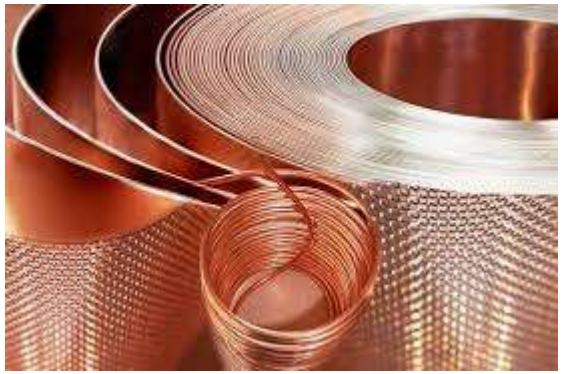
6. The atoms of the elements in Group 2 have the same

(1) mass number
(2) atomic number
(3) # of protons
(4) # of valence e-

7. In which list are the elements arranged in order of increasing atomic mass?

(1) Cl, K, Ar
(2) Fe, Co, Ni
(3) Te, I, Xe
(4) Ne, F, Na

PROPERTIES OF METALS



What makes metals malleable & ductile?

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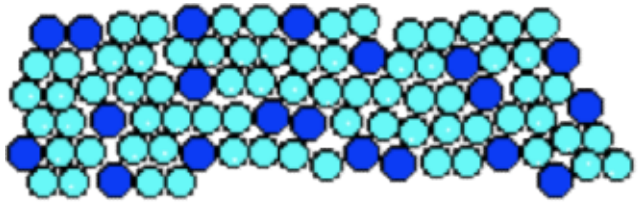
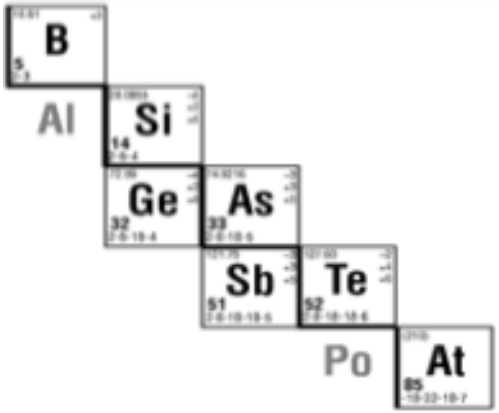
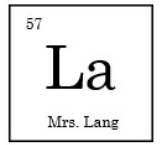
Metals & Metal Alloys



PROPERTIES OF METALLOIDS





PROPERTIES OF NONMETALS

Fun Facts & Element Groups (Metals)

Group 1: Alkali Metals

- Most reactive group of metals therefore they are _____
- Must be melted (aka_____) then decomposed to isolate the pure metal alone
- Only form _____ compounds NOT covalent
- 1 valence electron
- Lose 1 electron to form +1 ions

- Extremely reactive with water via single replacement producing an "alkali" solution & hydrogen gas

****HYDROGEN****

Group 2: Alkaline Earth Metals

- Do not exist uncombined in nature
- Also only form ionic compounds, NOT covalent compounds
- 2 valence electrons
- Lose 2 electrons to form +2 ions
- Fairly reactive with water via single replacement producing an "alkali" solution & hydrogen gas (not as reactive as group 1 metals)

The DOW Process:

Groups 3-12: Transition Metals

- AKA "d-block" on periodic table
- May be found in earth pure, in compounds, or in ores (minerals)
- Less reactive metals
- When reacting, they may LOSE electrons from their TWO outermost sublevels (__ & __)
- Form multiple + ions

- Form **COLORED IONS** in solution (aq)

  Examples:

- Copper-isolated from copper ores by electrolysis. Has wide usage because of its excellent thermal & electrical conductivity

- Iron - the most abundant transition element. SO SO important in manufacturing and construction because it is used to make

- Silver, Gold, Platinum are called "Noble" metals because

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Fun Facts & Element Groups (Nonmetals & Noble Gases)

Group 13: The Boron Family

Group 14: The Carbon Family

- Progresses from nonmetal to metalloid to metal therefore characteristics vary down the family
- Silicon – second most abundant element in earth's crust, most common metalloid
- Sands, soils, clays, and many minerals are composed of "silicates" (compounds containing silicon and oxygen)
- Carbon – natural form is _____. Also exists in _____– fundamental element of _____.

ALLOTROPY:

Group 15: The Nitrogen Family

- Progresses from nonmetal to metalloid to metal (again) therefore characteristics vary down the family
- Pure nitrogen makes up about 78% of the air we breathe
- AMMONIA (_____): this country produces TONS AND TONS of it for the purpose of making _____
- Pure nitrogen (N2 gas) contains a _____ _____ which is why N2 is not very reactive

- Nitrogen is essential to all living things

- Nitric Acid (_____): an important industrial compound of Nitrogen. Used to make explosives like TNT and nitroglycerine
- OSTWALD PROCESS: method to produce nitric acid

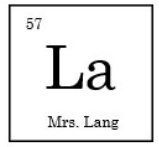
- Phosphorus – exists as a tetratomic molecule (P4). Also essential to life _____. Has 2 allotropes, red & white phosphorus.

- Arsenic – used in compounds that serve as poisons like weed killer, insecticides, etc.

Group 16: The Chalcogens

- Oxygen is a very reactive nonmetal due to its high _____
- Oxygen always has a negative oxidation # except in OF2
- Vital to life due to its role in cellular respiration
- about 20% of the earth's atmosphere

- Oxygen exhibits ALLOTROPY
- Sulfur – has 3 allotropic forms. All solids at room temperature
    - Octoatomic (S8)
    - FRASCH PROCESS: the method for isolating underground sulfur deposits
    - Less reactive than oxygen
    - Has positive and negative oxidation numbers
    - Important compounds with sulfur include:



Group 17: The Halogens

- MOST reactive nonmetals; they do _____ exist in nature in the free, pure, form. Only in compounds.
- 7 valence electrons
- Gain 1 electron to form -1 ions
- Most REACTIVE nonmetal is F
- Only column/group with ALL 3 phases due to increasing _____ as you go down group

- HF(aq) – used to etch glass, make Teflon & Freon

Group 18: The Noble Gases

- Unreactive or INERT
- Stable octet (8 valence electrons)
    - Exception is He which has 2 valence electrons
- Always **monoatomic**
    - Kr, Xe, and Rn can form bonds with F & O. he, Ne, and Ar will NOT do this….why?
    - This is why you see oxidation #s for Kr, Xe, and Rn
    - Example:
- Noble gases are widely used in welding where a non-reactive atmosphere is needed due to high temps

- They are used in light bulbs and advertising signs

REMINDERS:

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Periodic Trends

LESSON 9.3: Periodic Trends DOWN A GROUP

<u>Down a Group</u> (Don't Guess – Check Table S!)

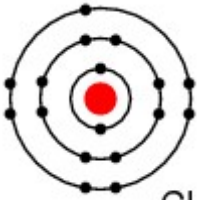
-Number of energy levels

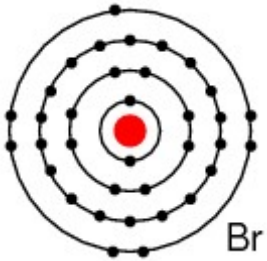
-Nuclear charge

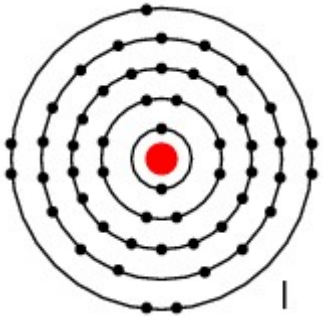
-Atomic radius (size of the atom)

-Ionization energy (how much energy it takes to lose valence e-)


F


Cl


Br


I

-Electronegativity (how strongly an atom attracts e-)

☆ What is Electron Shielding?

-Electron Affinity (amount of energy released when forming an anion -gaining e- to valence shell)

-Metallic character (how much it acts like a metal/how easily it loses e-)

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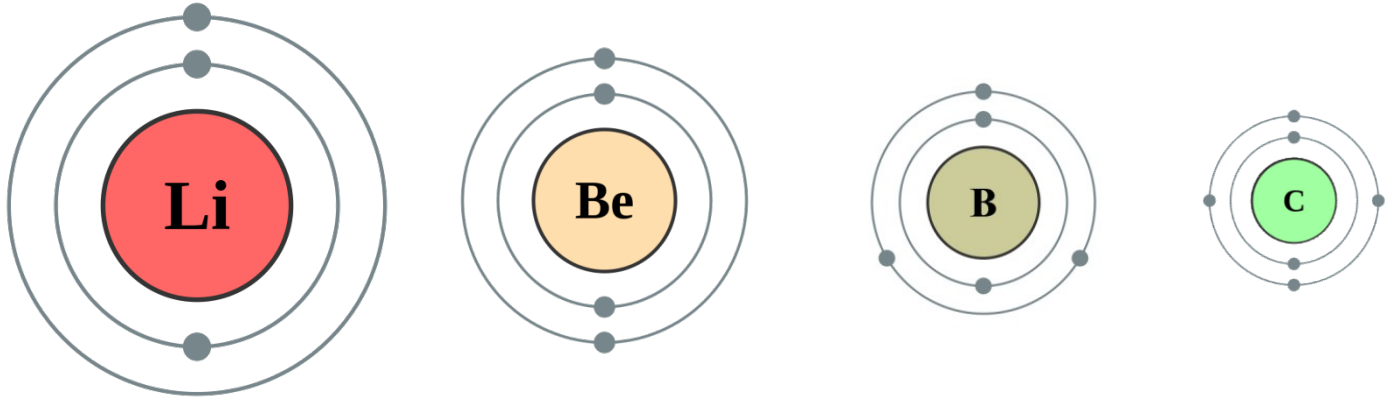
LESSON 9.4: Periodic Trends ACROSS A PERIOD

Across a Period (Don't Guess – Check Table S!)

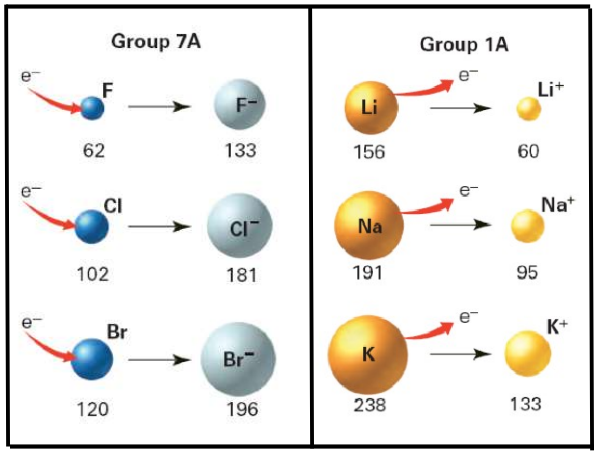


-Number of energy levels

-Nuclear charge

-Atomic radius (size of the atom)

Ionic vs. Atomic Radius

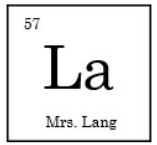


- Ion Size: Nonmetals

- Ion Size: Metals

- Comparing Ionic & Atomic Radii

-Ionization energy (how much energy it takes to lose valence e-)



-Electronegativity (how strongly an atom attracts e-)

-Electron Affinity (amount of energy released when forming an anion -gaining e- to valence shell)

-Metallic character (how much it acts like a metal/how easily it loses e-)

Best Metal on the Periodic Table: _____ Best Nonmetal on the Periodic Table: _____

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Periodic Table Graphic Organizer

Atomic Radius
Across a Period — Ionization Energy
Electronegativity
Why?

Down a Group
Atomic Radius
Ionization Energy
Electronegativity
Why?

Same group means same...

Alkali Metals

Alkaline Earth Metals

Same period means same...

Transition Metals

Purpose of this?

Halogens

Noble Gases

Reactivity of metals?

Reactivity of nonmetals?

Metals:
- ___ I.E.
- ___ electronegativity
- _____ e-
- Form _____ ions
- _____ conductors
- _____ (shiny)
- _____ (bendy)
- _____ (stretchy)
- _____ ionic radius

Nonmetals:
- _____ I.E.
- _____ electronegativity
- _____ e-
- Form _____ ions
- _____ conductors
- _____ (not shiny)
- _____ (not bendy)
- _____ ionic radius

Phases at STP:
Gases: ___, ___, ___, ___, ___, ___, ___, ___, ___, ___, ___, ___
Liquids: ___ and ___
Solids: Everything else