

Atoms & Elements

Atomic Structure

- Atoms are made of
 - Protons
 - Symbol: p^+
 - Charge: positive
 - Neutrons
 - Symbol: n
 - Charge: neutral
 - Electrons
 - Symbol: e^-
 - Charge: negative

Element

- A pure substance that cannot be broken down into simpler substances
 - Elements are made of identical atoms

Chemical Symbol

- An abbreviation of the name of the element
- Naming rules
 - A single letter symbol is always capitalized
 - Carbon = C
 - The first letter of a two symbol is always capitalized while the second letter is lower case
 - Aluminum = Al

- Not all symbols are based on their English names
 - Gold = Au (Latin – aurum)
 - Silver = Ag (Latin – argentum)
 - Lead = Pb (Latin – plumbum)
 - Tungsten = W (German – wolfram)
 - Scandium = Sc (discovered in Scandinavia)
 - Berkelium = Bk (created at University of California at Berkeley)
 - Einsteinium = Es (named in honor of Einstein)

Atomic Structure

- Atomic Number
 - The number of protons in the nucleus of the atom
- Atomic Mass (Mass Number)
 - The average mass of an atom of the element
 - The total number of protons and neutrons in the nucleus of the atom

Standard Atomic Notation

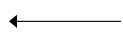
Mass Number or Atomic Mass



A

Z

X



Element symbol

Atomic Number

Example: ${}_{6}^{12}\text{C}$

Bohr Atomic Model

- Simple visual representation of the atom and its internal structure

Periodic Table

- First periodic table created by Dmitri Mendeleev
 - He used it to predict properties of elements not yet discovered

ОПЫТЪ СИСТЕМЫ ЭЛЕМЕНТОВЪ.

ОСНОВАННОЙ НА ИХЪ АТОМНОМЪ ВѢСѢ И ХИМИЧЕСКОМЪ СХОДСТВѢ.

			Ti = 50	Zr = 90	? = 180.
			V = 51	Nb = 94	Ta = 182.
			Cr = 52	Mo = 96	W = 186.
			Mn = 55	Rh = 104,4	Pt = 197,1.
			Fe = 56	Rn = 104,4	Ir = 198.
			Ni = 59	Co = 59	Pi = 106,8 O = 199.
H = 1			Cu = 63,4	Ag = 108	Hg = 200.
	Be = 9,4	Mg = 24	Zn = 65,2	Cd = 112	
	B = 11	Al = 27,1	? = 68	Ur = 116	Au = 197?
	C = 12	Si = 28	? = 70	Sn = 118	
	N = 14	P = 31	As = 75	Sb = 122	Bi = 210?
	O = 16	S = 32	Se = 79,4	Te = 128?	
	F = 19	Cl = 35,5	Br = 80	I = 127	
Li = 7	Na = 23	K = 39	Rb = 85,4	Cs = 133	Tl = 204.
		Ca = 40	Sr = 87,6	Ba = 137	Pb = 207.
			? = 45	Ce = 92	
			?Er = 56	La = 94	
			?Yt = 60	Di = 95	
			?In = 75,6	Th = 118?	

Д. Менделѣевъ

- Our modern periodic table is organized in a similar way
 - increasing atomic number and elements with similar properties grouped together
- Periodic Law
 - elements arranged according to atomic number resulting in a reoccurring pattern of similar properties in different elements

Period

- Horizontal rows (numbered 1–7) representing an electron shell or orbit in the Bohr model and an energy level in the quantum model of the atom

Groups or Families

- Vertical columns (numbered 1–18) containing elements with similar physical and chemical properties and the same number of electrons in their outermost shell/orbit (called valence electrons)

- The groups (or families) have names
 - Alkali Metals (1)
 - Alkaline Earth Metals (2)
 - Chalcogens (16)
 - Halogens (17)
 - Noble Gases (18)
- Hydrogen is really in its own group because of its special properties

Metals

- Constitute more than 75% of the elements
- Located to the left of the “staircase”
- Physical properties
 - Shiny
 - Malleable
 - Ductile
 - Conduct heat and electricity
 - Solid at room temperature (except mercury)

Non-metals

- Constitute about 15% of the elements
- Located on the right side of the “staircase”
- Physical properties
 - Dull
 - Brittle
 - Insulators of heat and electricity (except graphite)
 - Solid or gas at room temperature (except bromine)

Metalloids

- Constitute about 6% of the elements
- Located on the “staircase”
 - B, Si, As, Te, Po, At, Sb, Ge
- Have properties of both metals and nonmetals

- Physical properties
 - Solid at room temperature
 - Some have lustre (example: Si)
 - Tend to behave like nonmetals (except in terms of electrical conductivity)
 - Act as semiconductors

Reactivity

- The chemical reactivity of an element is determined by the number of electrons in its outer (valence) shell
- All atoms want to become structurally stable
 - Outer (valence) shell is full

- Noble gases have a full outer (valence) shell and are therefore unreactive
- The atoms of all other elements either gain (metals) or lose (non-metals) electrons to achieve a full outer (valence) shell
 - Sodium has one electron in its valence shell and it wants to lose that electron so that its valence shell will be full
 - Chlorine has seven electrons in its valence shell and it wants to gain an electron so that its valence shell will be full

- Hydrogen has one valence electron and will either lose, gain, or share one electron to fill its outer shell
- Elements in family 14 have 4 valence electrons and tend to share electrons to fill their outer shells

- Alkali metals are very reactive
 - Only need to get rid of one electron
- Halogens are very reactive
 - Only need to gain one electron
- Alkaline earth metals are less reactive
 - Need to get rid of two electrons
- Chalcogens are less reactive
 - Need to gain two electrons
- Reactivity increases as well as the period increases