

Test III - Modern Atomic Theory

Elements in a family react similarly.
Why?

We want to know where the electrons are
found in atoms.

electrons in an atom = _____

Electrons are found in shells **PRINCIPAL
ENERGY LEVELS**

of electrons in a shell = _____

Shell	1	2	3	4	5	6	7
# e's							

Each shell is divided into subshells (sublevels)

of subshells in a shell = # of the shell

Shell (#e's)	#Subshells	Subshells present
1 ()		
2 ()		
3 ()		
4 ()		

Subshells are designated by letters

	# electrons	# orbitals

The electrons are found in orbitals
(2 electrons per orbital)

Shapes of orbitals

s - _____ electrons _____ orbital

1s

2s

p - _____electrons _____orbitals

d (10 e's) 5 orbitals

f (14 e's) 7 orbitals

Energy Diagram for electron filling in
atoms

E
n
e
r
y

Shell

Subshell

Electron Configurations

H (1)

He (2)

Li (3)

Be (4)

B (5)

O (8)

F (9)

Ne (10)

Na (11)

Mg (12)

Al (13)

S (16)

Cl (17)

Ar (18)

K (19)

Ca (20)

Sc (21)

Ti (22)

Zn (30)

Ga (31)

Last electron for Ca (20) went into

Zn (30)

As (33)

Pb (82)

Nb (60)

Md (101)

What element has the last electron added to:

$3d^7$

$6s^1$

$5f^{12}$

$6p^4$

$5s^3$

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Quiz 8 - Electron Configurations

Orbital Diagram

Box for each



orbital

electrons in an orbital is _____

If two electrons are in the same orbital they must have opposite spins on their own axis, this is indicated by _____

1s

2s

2p

3s

3p

3d

4s

It is easiest to do the electron configuration first and write the orbital diagram from it.

	Electron configuration	Orbital Diagram
H (1)		
He (2)		
K (19)		
Co (27)		

Which electrons determine how an element reacts?

Electron Dot Configuration - shows dots for the outer shell electrons only

X

Give electron dot configurations for:

Calcium

Chromium

Sulfur

Uranium

Aluminum

Argon

Answer the following about Pd (46)

Electron Configuration

electrons in each shell _____

Last electron went into _____

Orbital diagram for the outer shell and any unfilled inner subshells.

Electron Dot Configuration

The outer shell electrons determine how an element reacts

Family	Group Number	# outer shell e's	Outer shell configuration
Alkali Metals			
Alkaline Earths			
B-Al Family			
C-Si Family			
N-P Family			
Chalcogen			
Halogen			
Noble Gases			

PERIODIC CHART

Know the people responsible for the Periodic Chart (Dobereiner, Newlands, Meyer, Mendeleev, and Moseley).

Know names of families

PERIODIC CHART is an arrangement of the elements according to increasing atomic number in such a way that elements with similar chemical and physical properties lie below each other.

METALS

NONMETALS

METALLOIDS (SEMI-METALS)

Metals have a small # of outer shell e's (_____)

Nonmetals have a large # of outer e's (_____)

Ionization Energy - minimum amount of energy needed to remove an electron from a neutral atom

Li	Be	B	C	N	O	F	Ne
Na							
K							
Rb							
Cs							
Fr							

Size of Atoms

Li	Be	B	C	N	O	F
Na						
K						
Rb						
Cs						
Fr						

Metallic Reactivity

Nonmetallic Reactivity

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**Quiz 9 - Orbital Diagrams, Electron Dot
and the Periodic Chart**

Chapter 5 - Nomenclature

Natural States of Elements

Noble Gases

Noble Metals

Most elements are found in nature combined into compounds (except for the Noble Gases)

When writing equations, all elements by themselves are monatomic except for 7 which are diatomic.

Magnesium + Oxygen \longrightarrow Magnesium oxide

Ions - charged particles due to a gain or loss of electrons

Elements have a net charge of ``0'', but they want a filled outer shell (8 electrons)

Metals lose electrons producing + cations

Nonmetals gain electrons producing - anions

We can therefore look at the Periodic Chart and tell the charge of an ion in an ionic compound.

Ca

Na

S

Br

Al

P

Nomenclature of Ionic Compounds



Solids at room temperature

- crystalline

High M.P. and B.P.

Hard and brittle

Conductivity

Solid - ?

A compound must have a net charge of ''Zero''

Must use a Systematic Nomenclature method

Binary Ionic Compounds

- Metal + Nonmetal (ide)
(positive) (negative)

Na Cl

Ca Br

Li O

Mg N

Al S

Ba O

Some elements (cations) have more than one valence (oxidation number)

CuCl

CuCl₂

I Systematic - Roman Numeral to indicate the charge on the cation

II Older Method - Latin name with an ``-ous'' ending for the lower oxidation number, and ``ic'' ending for the higher oxidation number.

You must know the following by both methods

	Systematic	Older
Cu		
Cu		
Fe		
Fe		
Sn		
Sn		
Pb		
Pb		
Hg ₂		
Hg		

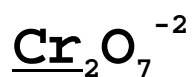
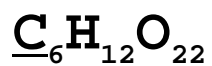
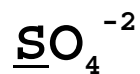
Some other elements occur in more than one oxidation number

Cr	Cr	Mn	Mn
Co	Co	Ti	Ti

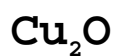
Rules for finding Oxidation Numbers

1. Oxidation number of an element in the free state is 0.
2. Oxidation number of a monatomic ion is equal to the charge on the ion.
3. Alkali Metals have oxid. no = +1
4. Alkaline Earths have oxid. no = +2
5. Oxygen is assigned an oxid. no of -2, except in peroxides (contain O_2^{-2}) where it is given an oxidation # of -1
6. Hydrogen is normally assigned a +1, unless it is combined with a reactive metal (then it is assigned a -1).
7. Sum of oxid no's in a compound = 0
8. Sum of oxid no's in a polyatomic ion = charge on the ion.

Find the oxidation number of the underlined element in each of the following



Practice - Name or give the formula for the following:



Chromium (!!!) sulfide

Mercuric chloride

Mercurous chloride

Manganese (II) phosphide

Cupric chloride

Stannous nitride

Titanium (!V) oxide

Nomenclature of Binary Covalent Compounds

Between two nonmetals - share electrons

Two methods of nomenclature

I Use prefixes to indicate how many of each element

1		6	
2		7	
3		8	
4		9	
5		10	

II IUPAC - Use Roman Numerals to indicate the charge on the cation.

Compound	Prefix method	Roman Numeral method
CO ₂		
N ₂ O		
NO		
NO ₂		
N ₂ O ₃		
N ₂ O ₅		

Properties of covalent compounds
 liquids, gases, or low melting
 solids
 lower MP's and BP's, and densities
 than ionic compounds
 poor conductors of heat and
 electricity

Practice: Give the correct name or formula for each of the following	
Carbon disulfide	
Rubidium oxide	
Carbon tetrabromide	
Chromium (III) oxide	
SnO_2	
Hg_2Cl_2	
CO_2	
Na_2O	
PbF_4	
VF_5	
K_2S	

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Complete Lab on Binary
 Nomenclature

Quiz 9 - Binary Nomenclature and
 Oxidation Numbers

Ternary Nomenclature - Compounds that contain polyatomic ions

YOU MUST LEARN THE FOLLOWING:

+1	NH_4^{+1}	
-1	NO_3^{-1}	
	NO_2^{-1}	
	$\text{C}_2\text{H}_3\text{O}_2^{-1}$	
	ClO_3^{-1}	
	CN^{-1}	
	OH^{-1}	
	MnO_4^{-1}	
-2	SO_4^{-2}	
	CO_3^{-2}	
	CrO_4^{-2}	
	$\text{Cr}_2\text{O}_7^{-2}$	
-3	PO_4^{-3}	

Practice: Ternary Nomenclature

Na OH

K NO₃

Ca OH

Al C₂H₃O₂

NH₄ S

Co(NO₂)₂

Sn(SO₄)₂

KMnO₄

Ferric chlorate

Stannous phosphate

Chromium (III)
sulfite

Cupric carbonate

Magnesium phosphite

Calcium hydrogen
carbonate

NaH₂PO₄

Potassium bicarbonate

Nomenclature of Acids

Substances which when dissolved in water produce _____

BINARY ACIDS - 2 elements - H + nonmetal

Hydro element ic Acid

HCl	
HBr	
HF	
HI	
H ₂ S	

TERNARY ACIDS - H + polyatomic ion

If polyatomic ion ends in:	Name of Acid
-ate	<u>element ic</u> <i>Acid</i>
-ite	<u>element ous</u> <i>Acid</i>

Examples of Nomenclature of Acids



HNO ₂	
H SO ₄	
H SO ₄	
H PO ₄	
H PO ₃	
H CO ₃	
H ClO ₃	
H ClO ₂	
H ClO ₄	
H ClO	

HW 10

Complete Lab on Ternary
Nomenclature

Quiz 10 - Ternary Nomenclature