Unit 1 - Physical Science: Chemical Reactions

The physical sciences are concerned with the study of inanimate natural objects.

Chemistry is the study of matter, its properties, how and why substances combine or separate to form other substances, and how substances interact with energy.

Periodic Table of the Elements

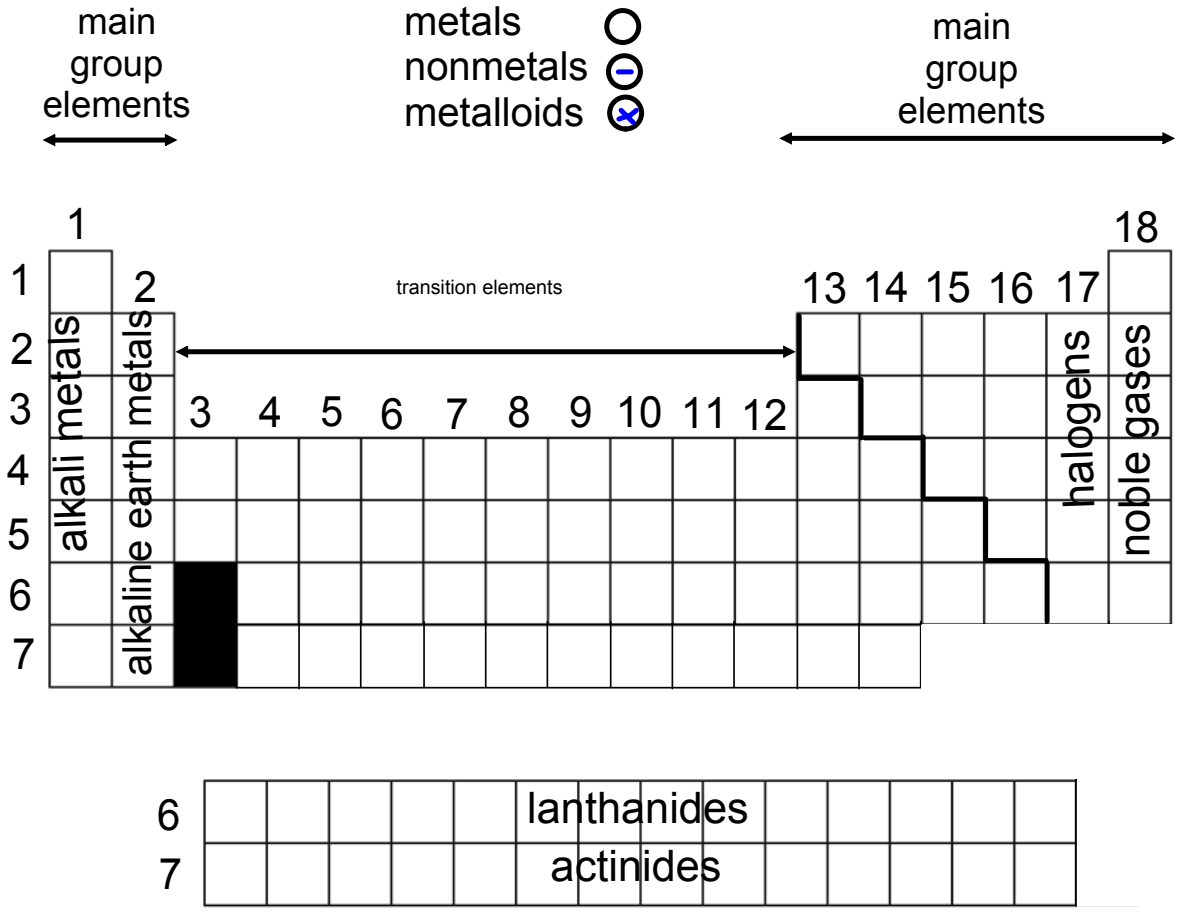
The periodic table of the elements is a structured arrangement of elements. Elements are ordered by their atomic number, electron configurations and recurring physical and chemical properties.

http://www.youtube.com/watch?v=r7hO-1ItqXw

Periodic Table of the Elements

Chemical Periods and Groups

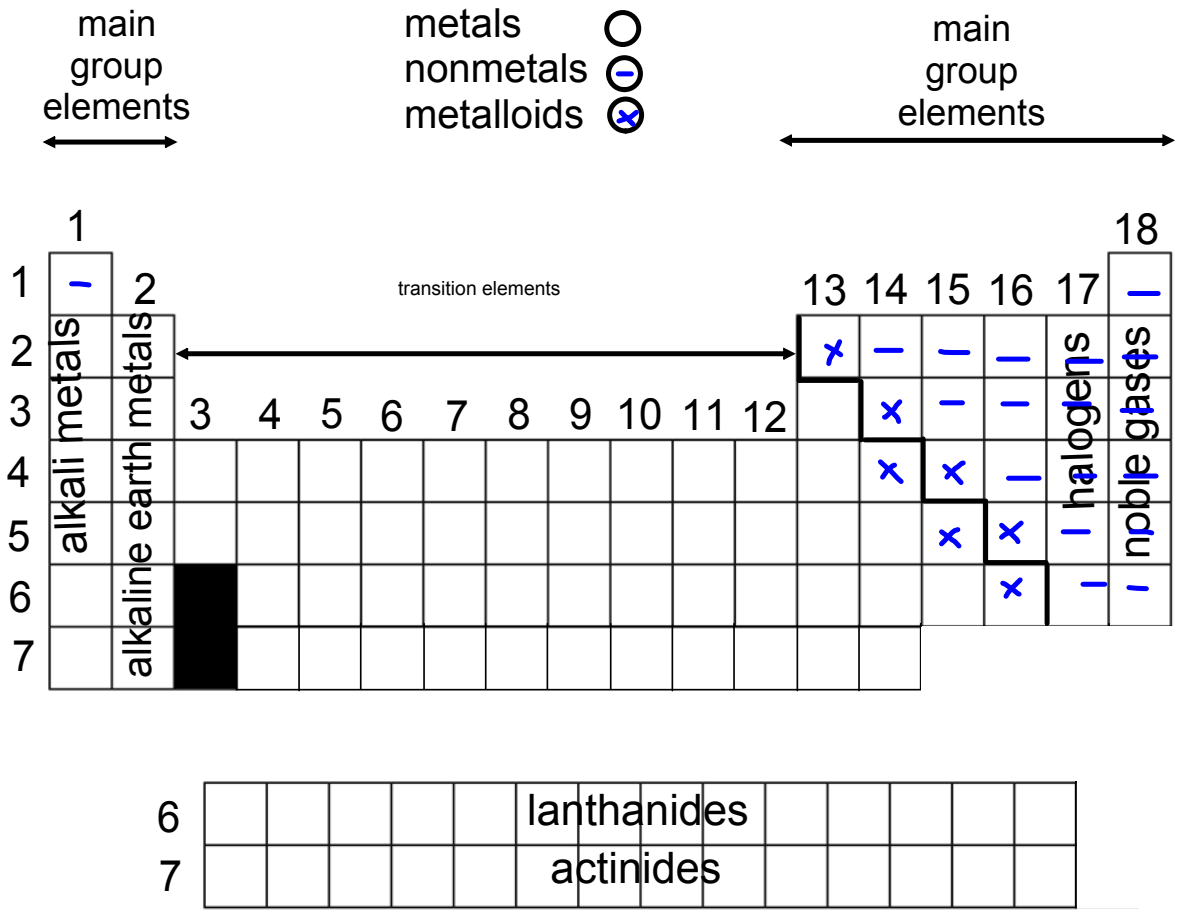
Elements in the periodic table are arranged in **periods** (rows) and **groups/families** (columns).



Periodic Table of the Elements

Chemical Periods and Groups

Elements in the periodic table are arranged in **periods** (rows) and **groups/families** (columns).



Periodic Table of Elements

Characteristics of Metals and Nonmetals (There are exceptions.)

Metals	Nonmetals
generally solids	found in all three states
hard and nonbrittle	hard but brittle
good conductors of heat and electricity	bad conductors of heat and electricity
ductile and malleable	neither ductile nor malleable
melting points and boiling points are generally high	melting points and boiling points are generally low
generally lustrous and can be polished	generally non-lustrous and cannot be polished

METALS	NONMETALS
Metals are generally solids. (exception : mercury, gallium)	Nonmetals are found in all three states.
Metals are heavy. (exception : sodium, potassium, magnesium)	Nonmetals are generally light in weight.
They are hard and nonbrittle. (exception : sodium, potassium and lead which are soft)	Solid nonmetals are hard but brittle.
They are good conductors of heat and electricity. (exception : lead)	They are bad conductors of heat and electricity.(except graphite)
They are ductile and malleable.	They are neither ductile nor malleable.
Their melting point and boiling point are generally high.	Their melting point and boiling point are generally low.
They generally produce ringing sound on collision.	They do not produce ringing sound.
They are generally lustrous and can be polished.	They are generally non-lustrous and cannot be polished.

Chemical Symbols and Chemical Formulas

A chemical symbol is an abbreviation of the name of an element. The names and symbols come from various sources (ie/ Greek and Latin).

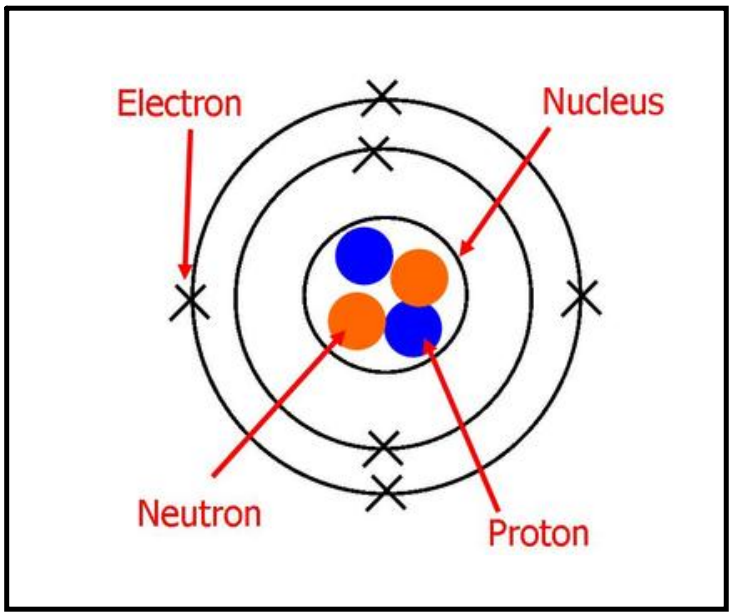
A chemical formula is the combination of symbols that represents a particular compound.

Atoms and Their Structure

Atoms are the basic building blocks of matter. They are made up of smaller particles called subatomic particles.

There are 3 subatomic particles:

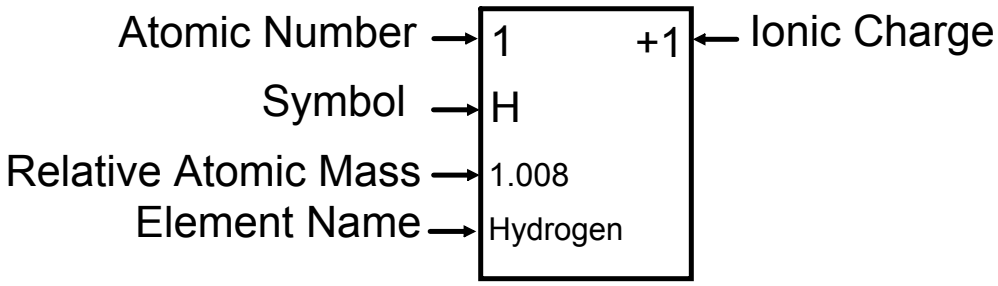
1) protons - found in the nucleus of the atom
   - have a positive charge
2) neutrons - found in the nucleus of the atom
   - are electrically neutral (no charge)
3) electrons - found in orbits (energy levels) around the nucleus
   - have a negative charge



https://sites.google.com/site/mrsinghs2pand2dsciencesite/atomic-structure-standard-atomic-notaion-and-bohr-rutherford-diagrams

Atomic Number

The atomic number of an element gives us the number of protons in an atom of that element.

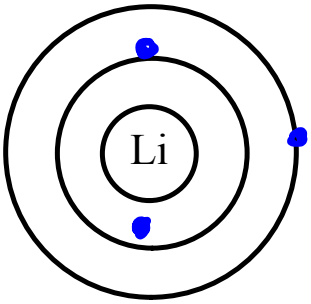


In an atom: # protons = # electrons

Reminder: Bohr Diagrams

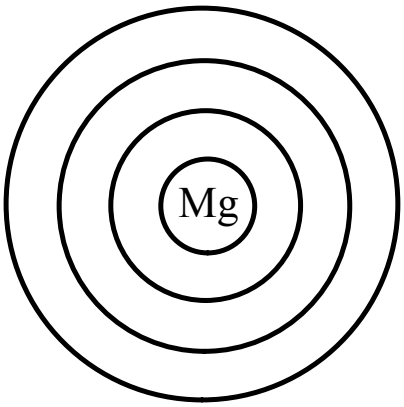
Li

atomic number = 3



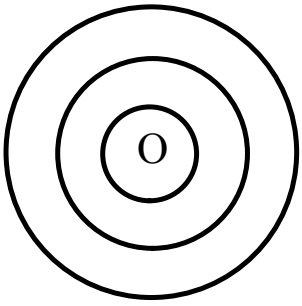
Mg

atomic number = 12



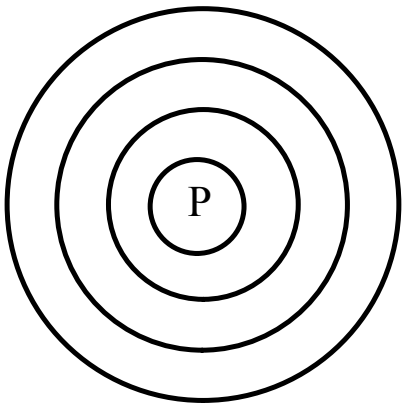
O

atomic number =



P

atomic number =



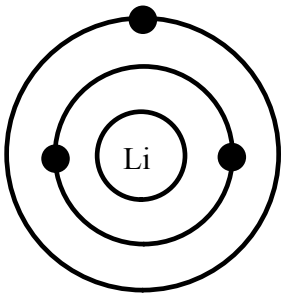
Ions

Atoms may lose or gain electrons to form ions in which the number of electrons is different from the number of protons. The numerical value of the electric charge of an ion with a plus (+) or minus (-) sign is called ionic charge.

Metals tend to lose electrons to produce cations (positive ions) and nonmetals tend to gain electrons to produce anions (negative ions).

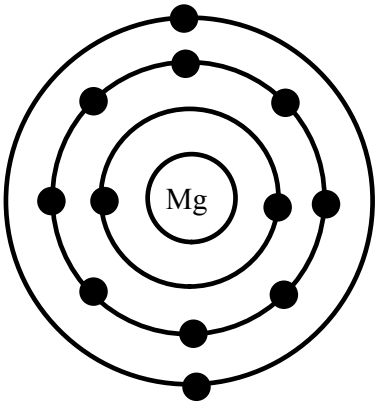
Li

atomic number = 3



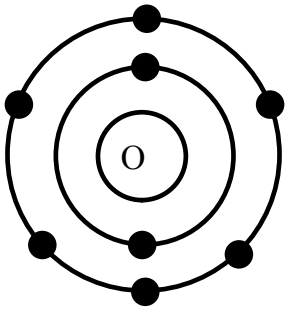
Mg

atomic number = 12



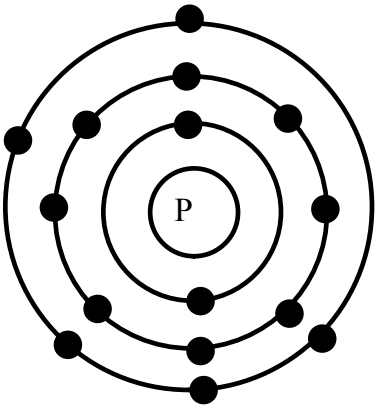
O

atomic number = 8



P

atomic number = 15



Worksheet - Chemistry: Ions and Subatomic Particles

Ion Symbol	Protons	Electrons *	Charge
S^{2-}	16	18	-2
K^{1+}	19	18	1+
Ba^{2+}			
Fe^{3+}			

Worksheet - Chemistry: Ions and Subatomic Particles Answer Key

Worksheet - Chemistry: Ions and Subatomic Particles Answer Key

Ion Symbol	Protons	Electrons	Charge
S^{2-}	16	18	2–
K^{1+}	19	18	1+
Ba^{2+}	56	54	2+
Fe^{3+}	26	23	3+
Fe^{2+}	26	24	2+
F^{1-}	9	10	1–
O^{2-}	8	10	2–
P^{3-}	15	18	3–
Sn^{4+}	50	46	4+
Sn^{2+}	50	48	2+
N^{3-}	7	10	3–
Br^{1-}	35	36	1–
Mg^{2+}	12	10	2+
Cu^{1+}	29	28	1+
Cu^{2+}	29	27	2+
U^{6+}	92	86	6+
Mn^{5+}	25	20	5+
Cl^{1-}	17	18	1–
Se^{2-}	34	36	2–

Naming Monatomic Ions

Simple cations are named by giving the element name and adding the word "ion".

Na^{1+} -> Sodium ion

Mg^{2+} -> Magnesium ion

Simple anions are named by dropping the ending off the element name, adding "ide" then "ion".

F^{1-} -> Fluoride ion

O^{2-} -> Oxide ion

N^{3-} -> Nitride ion

Periodic Table of Ions

7 BeO NM
Metal
Beryllium oxide

15. CuF ? I NM
M
Copper (I) Fluoride

14. Sodium fluoride

Na^{+1} F^{-1}

$\rightarrow NaF$

16. Copper (II) chloride

Cu^{+2} Cl^{-1}

$CuCl_2$

25. Lead (IV) Fluoride

Pb^{+4} F^{-1}

PbF_4

26. Lead (IV) Sulfide

Pb^{+4} S^{-2}

Not $\rightarrow Pb_2S_4$

PbS_2

Worksheet #1 - Monatomic Ions

1. Sodium	Na	Sodium ion	Na^+
2. bromine	Br	bromide ion	Br^-
6. boron	B	———	———

Ashley Robichaud

Name Arsenic

Arsenid ion

As^{3-}

Assignment - Your Name in Chemical Symbols

N a n c y S h e r r a r d

Example

Na	N	C	Y		S	H	Er	r	Ar	d
sodium	nitrogen	carbon	yttrium		sulfur	hydrogen	erbium		argon	
sodium ion	nitride ion	___	yttrium ion		sulfide ion	hydrogen ion or hydride ion	erbium ion		----	
Na^{1+}	N^{3-}	___	Y^{3+}		S^{2-}	H^{+} H^{1-}	Er^{3+}		___	

Chester Smith

Rubric

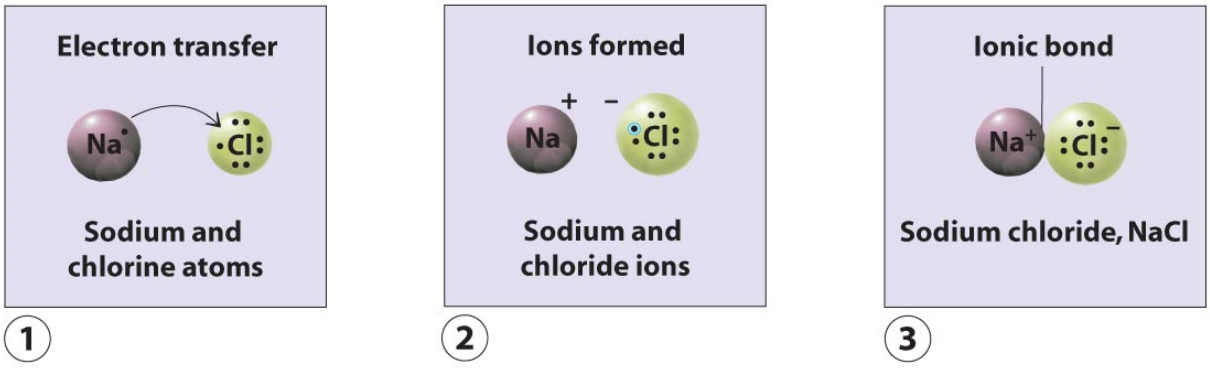
five chemical symbols – 5
five element names – 5
five ion names – 5
five ion symbols – 5

Total – 20

Ionic Bonds

http://safeshare.tv/w/DOYYHNayWO

When electrons are transferred from a metal to a nonmetal, an ionic bond results between the cation and anion.




The name's Bond...
IONIC BOND
Taken, not Shared

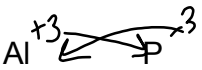
Simple Binary Ionic Compounds

Ionic compounds are formed by the combination of a cation and an anion and are electrically neutral. Binary compounds are compounds that contain only two elements.

Examples:

name - Sodium Chloride

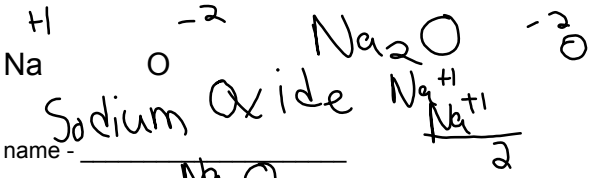
chemical formula - NaCl



name - Aluminum Phosphide

chemical formula - AlP

~~Al_3P_3~~

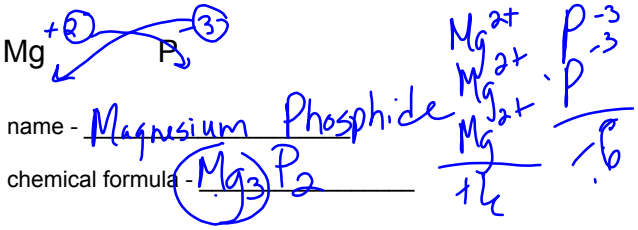


name -

chemical formula - Na_2O

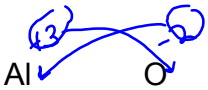
name - Aluminum chloride

chemical formula - $AlCl_3$



name - Magnesium Phosphide

chemical formula - Mg_3P_2



name - Aluminum Oxide

chemical formula - Al_2O_3

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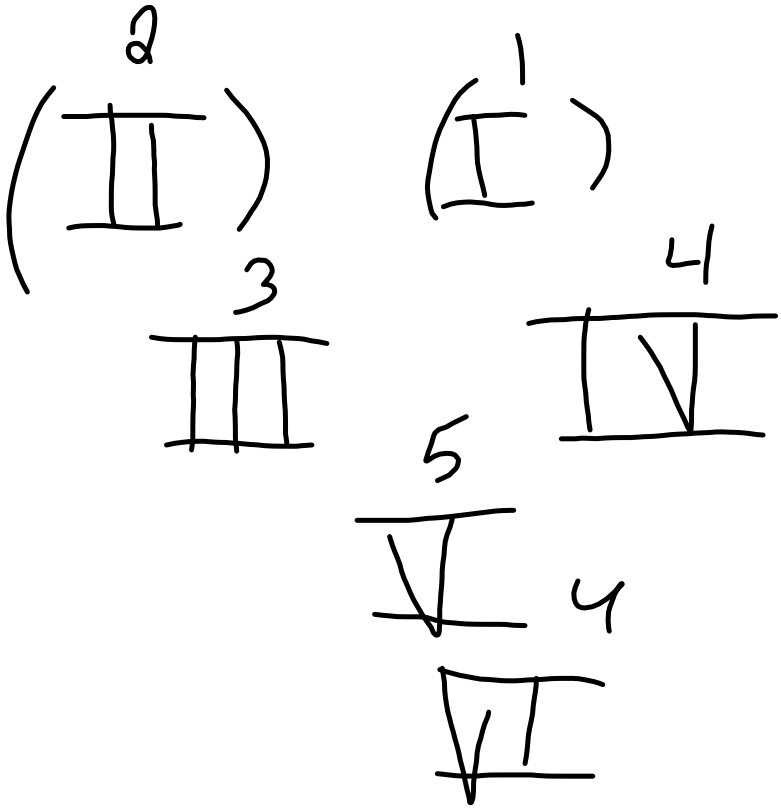
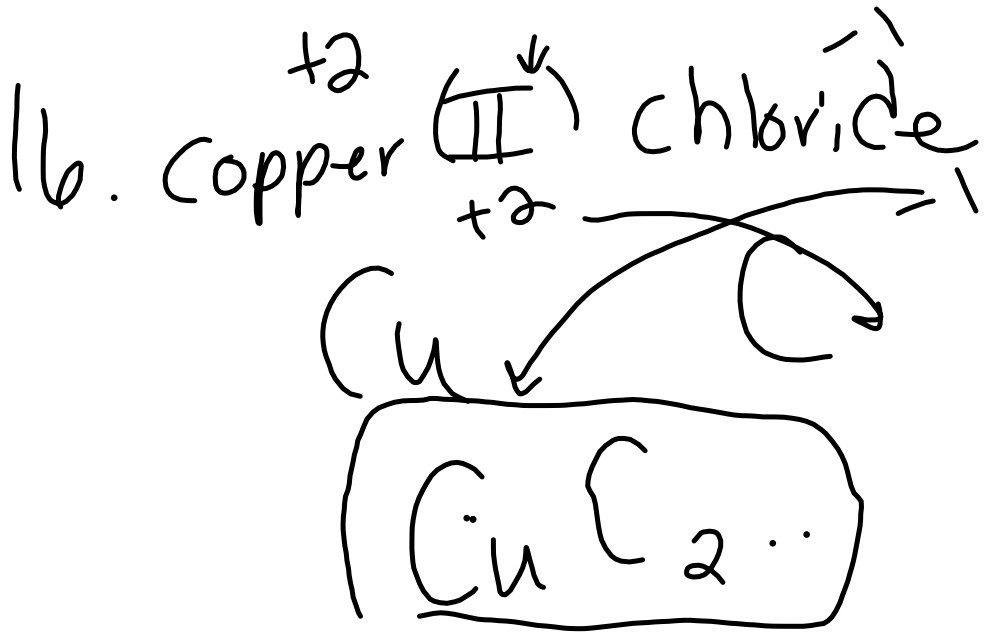

2
1
3
4
5
4

16. Copper (II) chloride



Simple Binary Ionic Compounds

Ionic compounds are formed by the combination of a cation and an anion and are electrically neutral. Binary compounds are compounds that contain only two elements.

Examples:

Na Cl

metal nonmetal

name - Sodium chloride

chemical formula - NaCl

Sodium Chloride

+1 -1 = 0

Al P

name - aluminum phosphide

chemical formula - AlP

aluminum phosphide

3+ 3- = 0

Na O

name - Sodium oxide

chemical formula - Na_2O

2+ 2- = 0

Al Cl

name - aluminum chloride

chemical formula - $AlCl_3$

Mg P

name - magnesium phoside

chemical formula - Mg_3P_2

magnesium

phosphide

Al O

name - aluminum oxide

chemical formula - Al_2O_3

aluminum

oxide

+6 -6

Mg_3P_2

Al_2O_3

http://safeshare.tv/w/mqC8gVvYAY

Simplify

$\frac{2}{4} = \frac{1}{2}$

X_4Y_2

X_2Y

Science 10

Quiz - Matter to Simple Binary Ionic Compounds

Topics:

1. Chemistry-The study of matter, its properties, how and why substances combine or separate to form other substances, and how substances interact with energy.

2. atoms -> building blocks of matter
   -> three subatomic particles: p^+, n, e^-
   -> electrically neutral: $\#p^+ = \#e^-$

3. atomic number = number of protons

4. periodic table of the elements - consist of periods (rows) and groups/families (columns)
   - be able to label family and period names
   - elements are represented by chemical symbols
   - be able to draw staircase line
   - locate metals, nonmetals and metalloids

5. characteristics of metals and nonmetals

6. ions -> atoms that have gained or lost electrons
   -> cations/positive ions/metallic ions
   -> anions/negative ions/nonmetallic ions
   -> be able to state ion names, number of protons, number of electrons and ion charges
   -> be able to name monatomic ions

You will need your two periodic tables.

Quiz

When you finish fill out "Compass" Worksheet. Sit quitely until time is up.

Polyatomic Ions

Polyatomic ions contain two or more different atoms. The atoms stay together as a single, charged unit.

Endings to look for: "ate", "ite"

nitrate NO_3^- nitrite NO_2^-

chlorate ClO_3^- chlorite ClO_2^-

sulfate SO_4^{2-} sulfite SO_3^{2-}

acetate CH_3COO^- or $CH_3CO_2^-$ or $C_2H_3O_2^-$

hydrogen carbonate or bicarbonate HCO_3^-

Note: hydroxide OH^-
cyanide CN^-

peroxide O_2^{2-}

Note: ammonium NH_4^+

See your periodic tables for more examples.

1) Sodium bromide

Na^{+1} Br^{-1}

NaBr

11. K_2O

Potassium oxide

Ionic Compounds Containing Polyatomic Ions

Like binary ionic compounds, ionic compounds containing polyatomic ions are electrically neutral.

When more than one polyatomic ion is required in an ionic compound, parentheses are used to enclose the ion with the subscript going outside the parentheses -> ( ).

Write the correct name for:

1) $AlPO_4$ Metal NM → Aluminum Phosphate

2) KNO_2 Potassium nitrite

3) $Ba(HCO_3)_2$ Barium Hydrogen carbonate

4) $Mg(OH)_2$ Magnesium Hydroxide

5) $(NH_4)_2SO_4$ Ammonium Sulfate

$Na^{+1}\swarrow CrO_4^{2-}$

Na_2CrO_4

1. $Na^{+1}Br^{-1}$
2. $CaCl_2$
3. $Mg_2S_2 \rightarrow MgS$
4. Al_2O_3
5. Li_3P
6. Cs_3N
7. KI
8. BaF_2
9. Rb_3N
10. BaO

11. Potassium oxide
12. Magnesium iodide
13. Aluminum chloride
14. Calcium bromide
15. Sodium nitride
16. Lithium Fluoride
17. Barium Phosphide
18. Cesium sulfide
19. Strontium fluoride
20. Sodium chloride

Warm Up

1) Magnesium Silicate

$Mg^{2+}SiO_3$

2) Beryllium Chlorite

$Be(ClO_2)_2$

3) Potassium Permanganate

$KMnO_4$

4) $Sr(CN)_2$ Strontium Cyanide

5) $LiClO_2$ Lithium Chlorite

6) YPO_4 Yttrium Phosphate

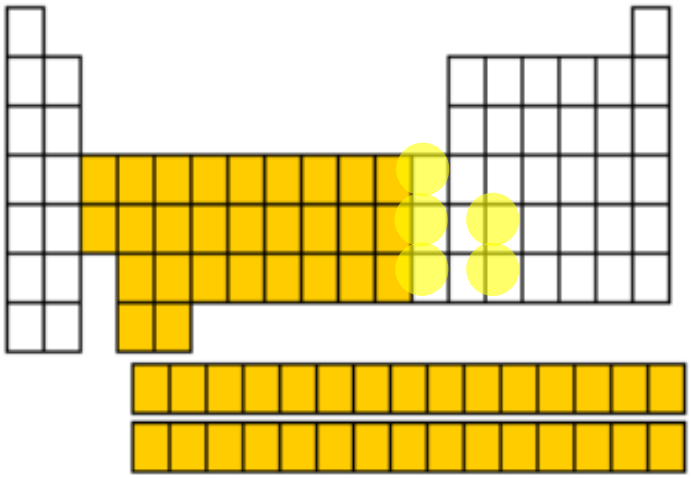
Homework Check
Worksheet - #3
Ionic Compounds Containing Polyatomic Ions

1. Na_2CrO_4
2. $CaCO_3$
3. Mg^{2+} NO_3^{-1} → $Mg(NO_3)_2$
4. Al^{+3} SO_4^{-2} → $Al_2(SO_4)_3$
5. Li^{+1} PO_4^{-3} → Li_3PO_4
6. NH_4 Cl → NH_4Cl
7. Cs^{+1} ClO_3^{-1} → $CsClO_3$
8. K^{+1} SO_4^{-2} → K_2SO_4
9. Ba^{2+} CH_3COO^{-1} → $Ba(CH_3COO)_2$
10. Rb^{+1} CN^{-1} → $RbCN$

11. Potassium acetate
12. Magnesium phosphate
13. Aluminum Chlorate
14. Calcium Sulfate
15. Strontium Hydrogen carbonate
16. Sodium nitrate
17. Lithium Carbonate
18. Barium nitrate
19. Cesium chromate
20. Ammonium hydroxide

Transition Elements

Transition elements are located in the middle of the periodic table.



Multivalent Metals and Their Ions

Many transition elements can form more than one ion. These elements are called multivalent metals.

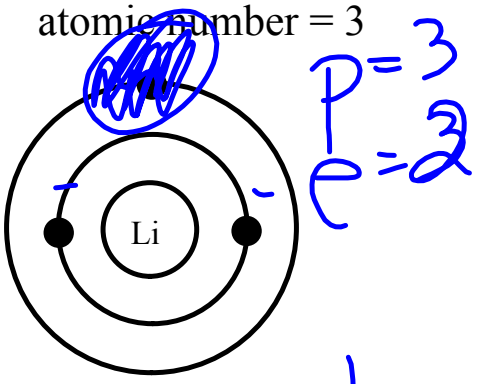
Valence electrons are the electrons in the outer shell of an atom.

They are the ones involved in forming bonds.

Remember:

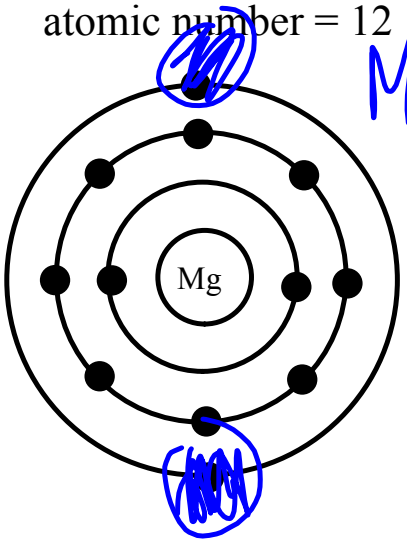
Li

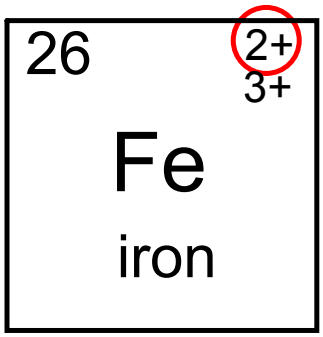
atomic number = 3



Mg

atomic number = 12





most common ion

When naming the ions of multivalent metals, you must include a roman numeral. The roman numeral is equal to the charge on the ion.

I II III IV V VI VII VIII IX X

1 2 3 4 5 6 7 8 9 10

Fe^{2+} = iron (II) ion

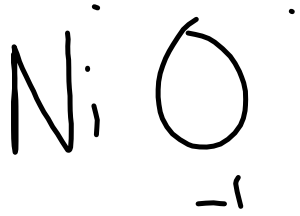
Pb^{4+} = lead (IV) ion

Cr^{3+} = chromium (III) ion

Ionic Compounds Involving Multivalent Metals

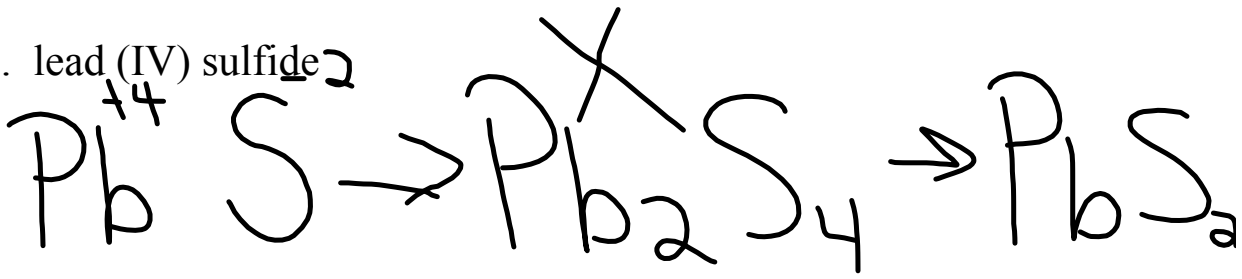
Write chemical formulas for the following:

1. nickel (II) oxide

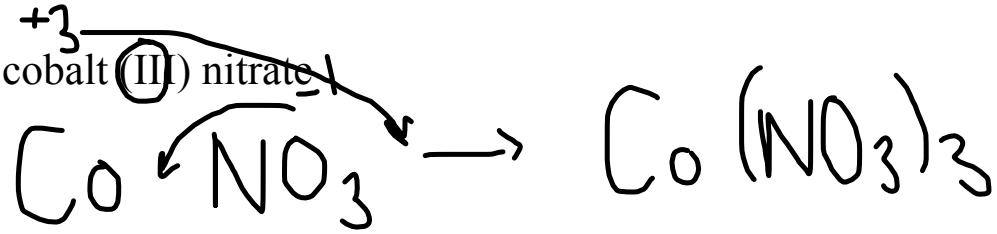


2. titanium (III) fluoride

3. lead (IV) sulfide



4. cobalt (III) nitrate



5. manganese (III) sulfate

Warm Up

1) Ruthenium (III) oxide

Ru^{+3} O^{-2} → Ru_2O_3

2) Chromium (II) Fluoride

Cr^{+2} F^{-} → CrF_2

3) Cobalt (II) Iodide

Co^{+2} I^{-} → CoI_2

4) $CuCl$ Copper (I) chloride

5) VBr_4 Vanadium (IV) Bromide

6) Nb_2S_3 Niobium (III) sulfide

Write the names of the following compounds:

1. $SnCl_4$

Tin (IV) chloride

2. TiO_2

$Ti_2O_4 \rightarrow TiO_2$

Titanium (IV) oxide

3. Fe_2O_3

Iron (III) oxide

4. $Ni_2(CO_3)_3$

Nickel (III) carbonate

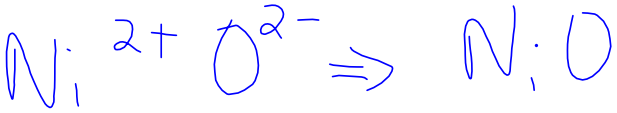
5. $Nb(NO_3)_5$

Niobium (V) nitrate

Ionic Compounds Involving Multivalent Metals

Write chemical formulas for the following:

1. nickel (II) oxide

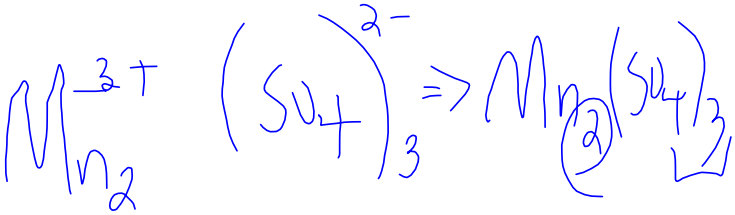


2. titanium (III) fluoride

3. lead (IV) sulfide

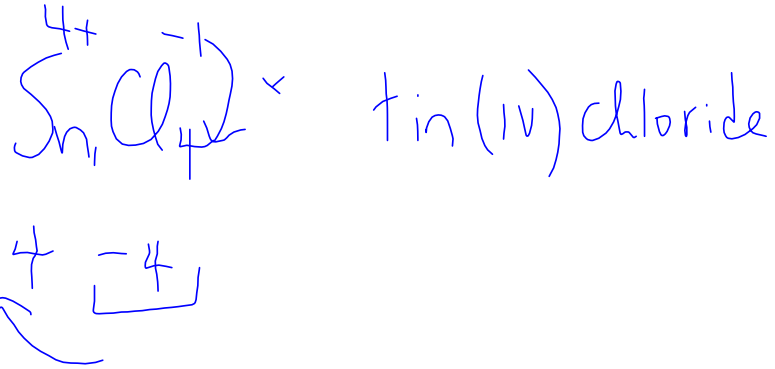
4. cobalt (III) nitrate

5. manganese (III) sulfate



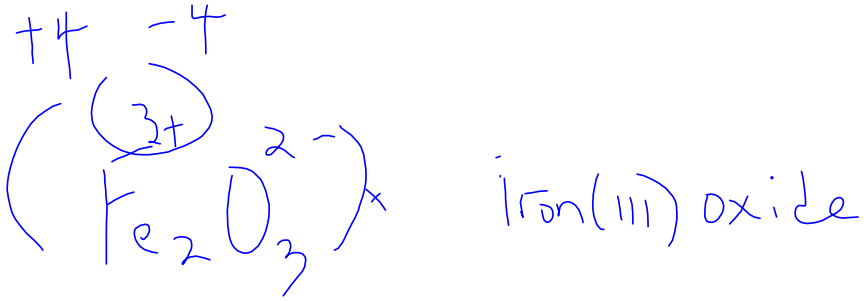
Write the names of the following compounds:

1. $SnCl_4$

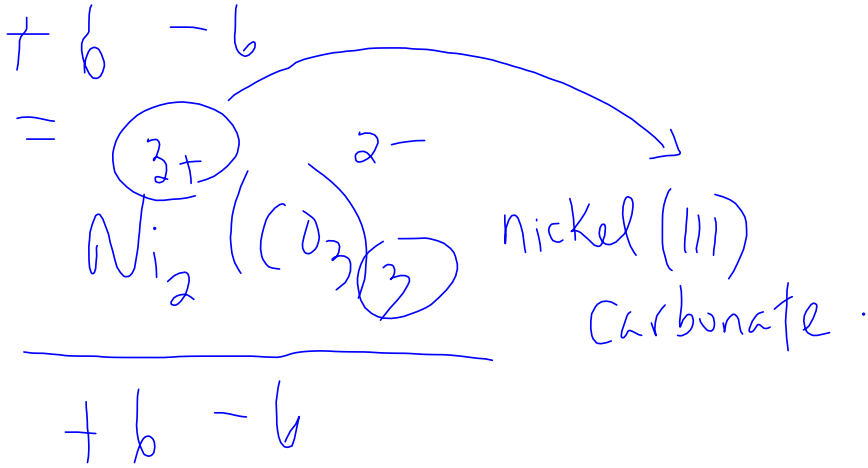


2. TiO_2

3. Fe_2O_3



4. $Ni_2(CO_3)_3$



5. $Nb(NO_3)_5$

Worksheet - #4

Ionic (−) → Non metal

Metal (+) → Transition metals → 2 charges

polyatomic ion (−) → PO_4^{3-}

Identify the charge:

1. $Cu^{+2}SO_4^{-2} \rightarrow CuSO_4$ NaCl
2. $Cu^{+1}O^{-2} \rightarrow Cu_2O$ Sodium chloride
3. $Cr^{+3}(CN)_3$
4. $Co(OH)_2$
5. AgBr
6. $Zn(NO_3)_2$
7. $Fe^{+3}(CH_3COO)_3$
8. $Pb^{+4}SO_4^{-2}$ ~~$Pb_2(SO_4)_4$~~ $Pb(SO_4)_2$
9. Iron (II) chloride
10. Lead (II) sulfite

$Pb^{+2}\ SO_3^{-2}$

$Pb(SO_3)$

11. Cobalt (II) carbonate
12. Silver nitrate
13. Zinc cyanide
14. Copper (I) chlorate
15. Chromium (III) hydroxide
16. Mercury (I) oxide

Hg_2O

Recap - Types of Ions

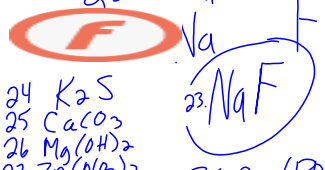
Identify each of the following as a monatomic ion (MI), a polyatomic ion (PI), or the monatomic ion of a multivalent metal (MIMM), by printing MI, PI or MIMM on the line provided.

PO_4^{3-}	PI
iron (II) ion	MIMM
fluoride ion	MI
Cu^{+}	MIMM
sulfite ion	PI
Ca^{2+}	MI
cyanide ion	PI
potassium ion	MI

Worksheet #5
Ionic Compounds Summary

Simple Binary Ionic Compound
Ionic Compounds Containing Polyatomic Ions
Ionics Compounds Containing Multivalent Metals
Ionic Compounds Containing Polyatomic Ions and Multivalent Metals

1. CaF_2
Calcium Fluoride
2. Na_2O
Sodium oxide
3. Barium Sulfide
4. Copper(II) Sulfate
$Cu(SO_4)$
5. Iron(III) oxide
6. Mercury (II) chloride
7. Silver nitrate
8. Magnesium carbonate
9. Potassium acetate $(C_2H_3O_2)$
10. " dichromate $\rightarrow C_2H_3CO.O$
11. Aluminum hydroxide
12. Lead (II) bromide
13. Zinc Sulfite
14. Sodium bicarbonate
15. Ammonium chloride
16. Lithium Phosphate
17. Tin(II) chloride
18. Aluminum nitrite
19. Rubidium chromate
20. Potassium Permanganate
21. Copper (I) chloride
22. Iron (II) sulfate
23. Sodium Fluoride



23. NaF

24. K_2S
25. $CaCO_3$
26. $Mg(OH)_2$
27. $Zn(NO_3)_2$
28. $AgC_2H_3O_2$
29. CuO
30. $FeCl_3$
31. $BaCrO_4$
32. Al_2O_3
33. $PbSO_4$
34. $Sn(C_2O_4)_2$
42. $Cu(ClO_3)_2$
43. SnO
44. Ag_2SO_3

35. $Ca_3(PO_4)_2$
36. $LiMnO_4$
37. $HgNO_3$
38. $RaSO_3$
39. $CrCl_3$
40. $(NH_4)_2S$
41. $Cu(C_2H_3O_2)$

Topics -> In Class Assignment: All Ionic Compounds

1. a) be able to identify monatomic ions

   b) be able to write the names of monatomic ions given their chemical symbols and vice versa

2. be able to write the names of simple binary ionic compounds given their formulas and vice versa

3. a) be able to identify polyatomic ions by their symbols and names ("ate", "ite" and some "ide" endings)

   b) know where to find the names and symbols of polyatomic ions on the pink periodic table

   c) be able to write the names of ionic compounds containing polyatomic ions given their formulas and vice versa

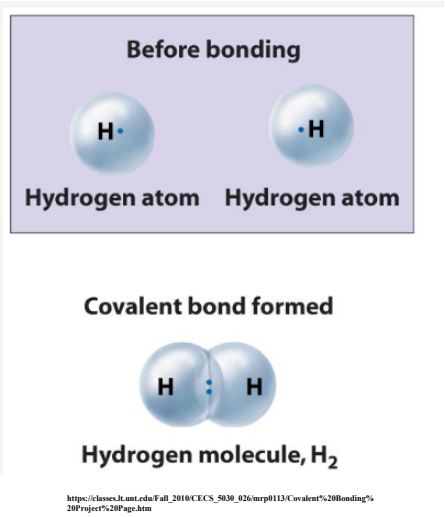
4. a) be able to identify multi-valent metals

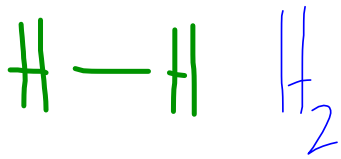
   b) be able to write the names of ionic compounds containing multivalent metals given their formulas and vice versa

   c) be able to write the names of ionic compounds containing multivalent metals and polyatomic ions given their formulas and vice versa

Covalent Bonds

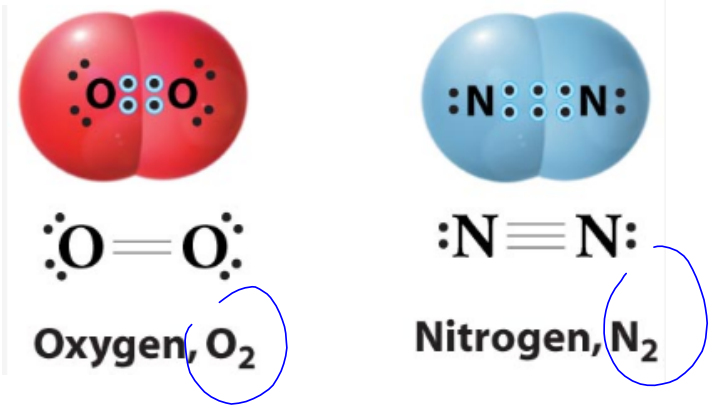
A covalent bond is a chemical bond that involves the sharing of **one or more electron pairs**between two nonmetals or between a nonmetal and a metalloid. Two or more atoms held together by covalent bonds are called molecular compounds, covalent compounds or molecules.





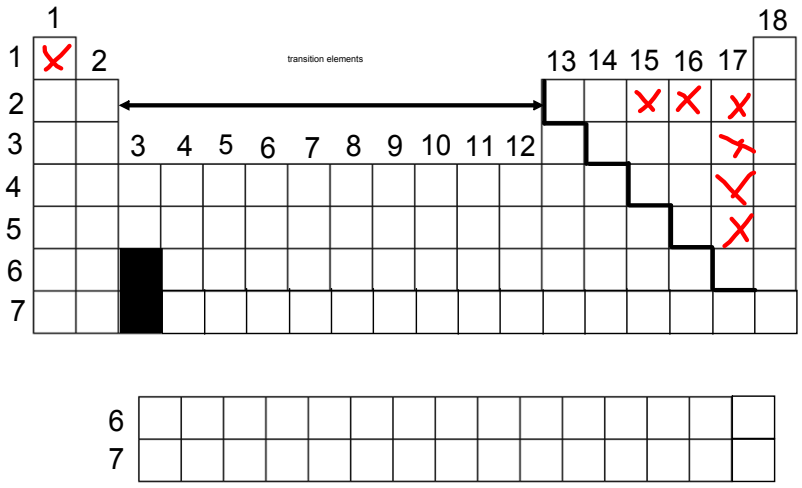
http://safeshare.tv/w/uwgbiOMIxO

The Hindenburg (1937) was an airship or "air blimp" that was filled with the highly flammable and combustible hydrogen gas, rather than an inert, non-flammable gas, such as, helium.



Diatomic Molecules

H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2



Other Special Molecules

molecular phosphorous -> P_4

molecular sulfur -> S_8

NOTE:

element symbol	ion symbol	molecular formula
F	F^-	F_2

Naming Binary Molecular Compounds

Chemists use prefixes to indicate the number of atoms in each compound. Prefixes are necessary because atoms can combine in any whole number ratio. Learn the prefixes below.

# of Atoms	Prefix
1	mono
2	di
3	tri
4	tetra
5	penta
6	hexa
7	hepta
8	octa
9	nona
10	deca

When naming binary molecular compounds, the first element name is given followed by the second element with an "ide" ending. The first element gets a prefix when there is more than one atom in the compound. The second always gets a prefix.

Compound	Name
NO	nitrogen monoxide
N_2O	dinitrogen monoxide
NO_2	nitrogen dioxide
N_2O_3	dinitrogen trioxide
N_2O_5	dinitrogen pentaoxide

Common Names

H_2O - water or _____

H_2O_2 - hydrogen peroxide or _____

NH_3 - ammonia or _____

organic compounds

CH_4 - methane or _____

C_2H_6 - ethane or _____

C_3H_8 - propane or _____

C_4H_{10} butane or _____

Naming Binary Molecular Compounds

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N_2O_3	dinitrogen trioxide
N_2O_5	dinitrogen pentaoxide

NH_4^+

Common Names

H_2O - water or dihydrogen monoxide

H_2O_2 - hydrogen peroxide or dihydrogen dioxide

NH_3 - ammonia or nitrogen trihydride

organic compounds

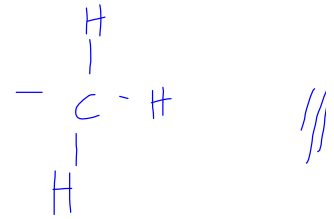
CH_4 - methane or carbon tetrahydride

C_2H_6 - ethane or dicarbon hexahydride

C_3H_8 - propane or tricarbon octahydride

C_4H_{10} butane or tetracarbon decahydride

C and H



Practice: Binary Covalent Compounds

Recap: Types of Compounds

Types of Compounds

Ionic Compounds	Molecular (Covalent) Compounds
transfer of electron(s) creates an ionic bond	sharing of electron pair(s) creates a covalent bond

---

metallic ion + nonmetallic ion	nonmetal + nonmetal
metallic ion + polyatomic ion	metalloid + nonmetal
NH_4^+ + nonmetallic ion	nonmetal + metalloid
NH_4^+ + polytomic ion	

Worksheet - Mixed Ionic/Covalent Compounds #1

Worksheet - Mixed Ionic/Covalent Compounds #2 (Optional)

Attachments

Science 10 - Grade 9 Chem Topics.docx

Science 10 - Grade 9 Chem - What Do You Know.docx

Science 10 - Activity - Molecular Models.docx

Science 10 - Answer Key - Ions and Subatomic Particles.pdf

Science 10 - What Do You Know.docx