Name: _____

Period: _____

Unit 3:1

Naming Compounds

How to use this chart— Determine what the compound is made of and follow the arrows. The chart will tell you how to name the compound.

What's it Made of?

- Metal and non-metal → ionic compound
- 2 non-metals → covalent compound
- 3 or more elements → polyatomic compound

Exception— O_2 is "peroxide" and can make polyatomic compounds with only 2 elements! O_2 with a non-metal is *dioxide*. O_2 with a metal OR Hydrogen (acting as a metal) is *peroxide*.

ionic compound

USE "- IDE" ENDING **(NO PREFIXES!)**

Name the metal and non-metal and change the ending to "ide".

Li_2S

Metal and non-metal— ***ionic***

Lithium Sulfide

(**not** dilithium sulfide—
no prefixes for ionic compounds)

Why are ionic compounds so easy to name? Because most ionic compounds can only form one way, using the oxidation numbers. In covalent compounds, though, non-metals can sometimes combine in multiple ways (carbon monoxide; carbon dioxide). So, covalent compounds use prefixes.

Transition Metals Can Have More Than One Oxidation Number

Iron (II) has an oxidation number of 2+
Iron (III) has an oxidation number of 3+.
When naming them you must specify WHICH ONE.

FeO—Iron (II) oxide
Fe_2O_3— Iron (III) oxide

covalent compound

USE GREEK PREFIXES

Put prefixes in front of element names to tell how many atoms are there.

Don't use "mono" for first name, but always for second name.

N_2O_4

2 non-metals— ***covalent***

(di =2 and tetra =4)

"Dinitrogen tetroxide"

Greek Prefixes

Mono - 1	Hexa – 6
Di – 2	Hepta – 7
Tri – 3	Octa – 8
Tetra – 4	Nona – 9
Penta – 5	Deca – 10

Hints to remember prefixes:

Monorail – one rail train
Monocle – glasses for one eye with only a single lens.

Dilemma – struggle between 2 choices.

Tricycle – 3 wheels

Pentagon – 5 five sided military building in Washington, D.C.

Octopus – 8 legs

Decade – 10 years

polyatomic compound

CHECK THE CHART BELOW **(NO PREFIXES!)**

Use the names on the chart.
If the polyatomic ion is the cation end the second name with "-ide".

$NaNO_3$

3 elements — ***polyatomic***

Check chart (*see below*)
Na - sodium
NO_3 - nitrate (on chart)

Sodium nitrate

Polyatomic Ions

Oxidation #	Name	Formula
1+	ammonium	NH_4^+
1-	acetate	$C_2H_3O_2^-$
2-	carbonate	CO_3^{2-}
2-	chromate	CrO_4^{2-}
1-	hydrogen carbonate	HCO_3^{1-}
1+	hydronium	H_3O^+
1-	hydroxide	OH^{1-}
1-	nitrate	NO_3^{1-}
2-	peroxide	O_2^{2-}
3-	phosphate	PO_4^{3-}
2-	sulfate	SO_4^{2-}
2-	sulfite	SO_3^{2-}

Name: _____ Unit 3:1

Period: _____

Metal or Non-metal?	**Ionic or Covalent?**
M N Iron Oxide	*Ionic*
Barium Chloride	
Carbon Dioxide	
Magnesium Oxide	
Aluminum Fluoride	
Nitrogen Tribromide	
Chromium Fluoride	
Potassium Oxide	

Name These Ionic Compounds	
MgF_2	Magnesium Fluor-*ide*
Li_2O	Lithium Ox-
NaCl	Sodium Chlor-
K_2O	Potassium Ox-
CaS	Sulf-
BeI_2	Iod-
$AlBr_3$	Brom-
CaF_2	
MgO	
LiCl	

Use the Polyatomic Ion Chart on the front of the worksheet to name these Polyatomic Ions:	
HCO_3^{1-}	*Hydrogen carbonate*
SO_4^{2-}	
O_2^{2-}	
SO_3^{2-}	
NO_3^{1-}	
NH_4^{+}	
CrO_4^{2-}	
OH^{1-}	
PO_4^{3-}	
CO_3^{2-}	

Define these Greek Prefixes

Penta = _____	Tetra = _____
Nona = _____	Hexa = _____
Mono = _____	Hepta = _____
Octa = _____	Deca = _____
Tri = _____	Di = _____

1. CO_2	A. Carbon monoxide
2. C_2O_4	B. Carbon dioxide
3. C_3O_5	C. Dicarbon monoxide
4. CO	D. Tricarbon pentoxide
5. C_2O	E. Dicarbon tetroxide
6. CO_8	F. Carbon octoxide

Name These Covalent Compounds	
Si_2O_3	Disilicon _____oxide
N_3Cl_4	_____nitrogen tetrachloride
SO_2	Sulfur _____oxide
PO_5	Phosphorous _____ox____
S_2F_4	____sulfur _____fluor____

Name these Polyatomic Compounds (Remember — no prefixes!)	
$CaSO_4$	Calcium _____
K_2CO_3	_____ carbonate
$CuNO_3$	Copper (I) _____
NH_4Cl	_____ chloride
$Mg(NO_3)_2$	Magnesium _____
K_3PO_4	Potassium _____
$Li_2(CrO_4)$	Lithium _____
$Mg(OH)_2$	M_____ H_____
$Al(PO_4)$	A_____ P_____
$K(NO_3)$	_____ _____
Ca_2SO_3	_____ _____

Classify and Name These Compounds

	Ionic, Covalent, or Polyatomic	**Name**
1. $BaCl_2$	*Ionic*	*Barium chloride*
2. CO		
3. Ag_2O		
4. K_2SO_4		
5. $MgBr_2$		
6. SO_3		
7. P_2O_4		
8. $Be(CrO_4)$		
9. LiF		
11. CO_2		
12. OF_2		

Name: _____

Period: _____

Metal or Non-metal?	Ionic or Covalent?
M N Iron Oxide	*Ionic*
M N Barium Chloride	Ionic
N N Carbon Dioxide	covalent
M N Magnesium Oxide	Ionic
M N Aluminum Fluoride	Ionic
N N Nitrogen Tribromide	covalent
M N Chromium Fluoride	Ionic
M N Potassium Oxide	Ionic

Name These Ionic Compounds	
MgF_2	Magnesium Fluor-*ide*
Li_2O	Lithium Ox- ide
NaCl	Sodium Chlor- ide
K_2O	Potassium Ox- ide
CaS	calcium Sulf- ide
BeI_2	beryllium Iod- ide
$AlBr_3$	Aluminum Brom- ide
CaF_2	calcium fluoride
MgO	magnesium oxide
LiCl	Lithium chloride

Use the Polyatomic Ion Chart on the front of the worksheet to name these Polyatomic Ions:	
HCO_3^{1-}	*Hydrogen carbonate*
SO_4^{2-}	sulfate
O_2^{2-}	peroxide
SO_3^{2-}	sulfite
NO_3^{1-}	nitrate
NH_4^{+}	ammonium
CrO_4^{2-}	chromate
OH^{1-}	hydroxide
PO_4^{3-}	phosphate
CO_3^{2-}	carbonate

Define these Greek Prefixes			
Penta = 5		Tetra = 4	
Nona = 9		Hexa = 6	
Mono = 1		Hepta = 7	
Octa = 8		Deca = 10	
Tri = 3		Di = 2	

1. CO_2	B	A. Carbon monoxide
2. C_2O_4	E	B. Carbon dioxide
3. C_3O_5	D	C. Dicarbon monoxide
4. CO	A	D. Tricarbon pentoxide
5. C_2O	C	E. Dicarbon tetroxide
6. CO_8	F	F. Carbon octoxide

Name These Covalent Compounds	
Si_2O_3	Disilicon tri oxide
N_3Cl_4	tri - nitrogen tetrachloride
SO_2	Sulfur di oxide
PO_5	Phosphorous penta oxide
S_2F_4	di sulfur tetra fluor ide

Name these Polyatomic Compounds (Remember — no prefixes!)	
$CaSO_4$	Calcium sulfate
K_2CO_3	Potassium carbonate
$CuNO_3$	Copper (I) nitrate
NH_4Cl	ammonium chloride
$Mg(NO_3)_2$	Magnesium nitrate
K_3PO_4	Potassium phosphate
$Li_2(CrO_4)$	Lithium chromate
$Mg(OH)_2$	Magnesium Hydroxide
$Al(PO_4)$	Aluminum Phosphate
$K(NO_3)$	Potassium nitrate
Ca_2SO_3	calcium sulfite

Classify and Name These Compounds		
	Ionic, Covalent, or Polyatomic	Name
1. $BaCl_2$	*Ionic*	*Barium chloride*
2. CO	covalent	carbon monoxide
3. Ag_2O	Ionic	silver oxide
4. K_2SO_4	polyatomic	potassium sulfate
5. $MgBr_2$	ionic	magnesium bromide
6. SO_3	covalent	sulfur trioxide
7. P_2O_4	covalent	diphosphorous tetroxide
8. $Be(CrO_4)$	polyatomic	beryllium chromate
9. LiF	ionic	lithium fluoride
11. CO_2	covalent	carbon monoxide
12. OF_2	covalent	oxygen difluoride

Name: _____

Period: _____

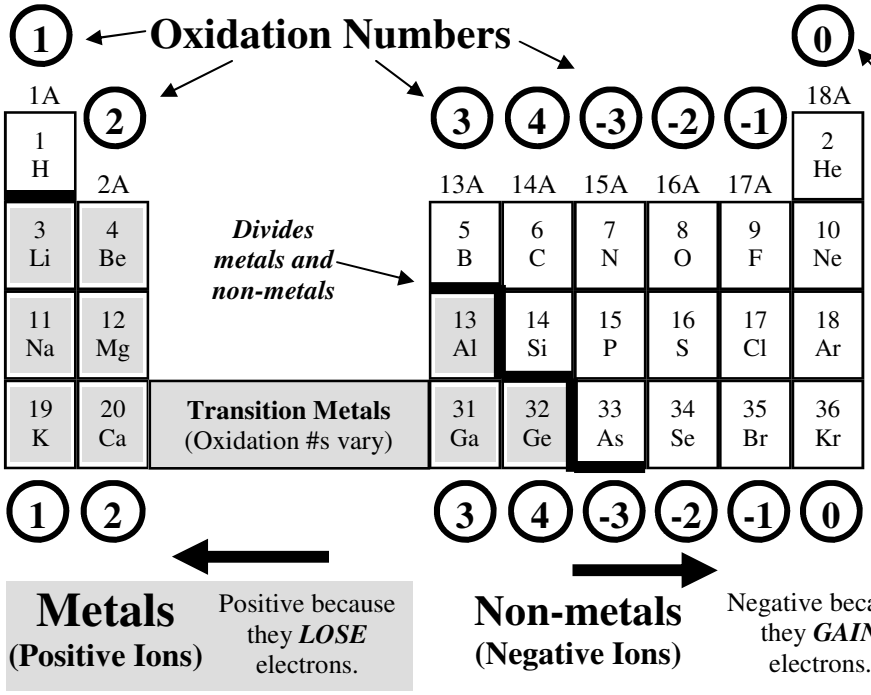
Unit 3:2

Oxidation Numbers, Notation, Lewis Dot Diagrams

Oxidation Numbers

The oxidation numbers tell you how many electrons an element will gain or lose. This tells you how it will combine with other elements.

Atoms gain or lose electrons when near certain other elements to fulfill the octet rule: "If I 8 I full". Full electron levels are more stable. If an atom has 1 or 2 valence electrons it will lose them to have a full inner level. If an atom has 6 or 7 valence electrons, it will gain electrons to fill an electron level.



The elements in column 18A (the Noble Gases) have an oxidation # of 0. This means they don't gain or lose electrons, so they don't react or form compounds. They are ***INERT***.

Metals (Positive Ions) — Positive because they ***LOSE*** electrons.

Non-metals (Negative Ions) — Negative because they ***GAIN*** electrons.

Notation

Chemical symbol → Na $^{1+}$ ← Charge (Oxidation #)

$_{2}$ ← Number of atoms

The above notation tells you that each of the Sodium atoms lost 1 electron. Since there are 2 Sodium atoms, there were 2 electrons lost (1 each). The charge is the oxidation number.

Losers of electrons become positive (a positive ion).
Electrons are negative, so losing negatives makes it more positive.

Mg^{2+} ***Lost*** 2 electrons

Gainers of electrons become negative (a negative ion).
Electrons are negative, so gaining negatives makes it more negative.

O^{2-} ***Gained*** 2 electrons

***Subscripts* tell you the number of atoms in a molecule.**

O_2 2 Oxygen atoms

No number means 1 atom

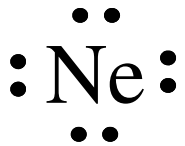
H_2O 2 Hydrogen atoms, 1 Oxygen atoms

SO_4 1 Sulfur atom, 4 Oxygen atoms

Lewis Dot Diagrams

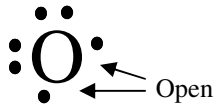
Dot Diagrams (sometimes known as Lewis dot diagrams) are a depiction of an atom's valence electrons. They are a powerful tool in helping you understand, see, and even predict molecular bonding.

The dots represent <u>valence electrons</u>



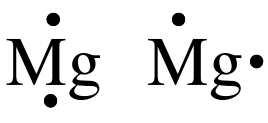
Neon has 8 valence electrons and no openings. Neon has fulfilled the octet rule and will not react with other atoms.

Openings show where electrons can be gained or shared from other atoms.



Oxygen has 6 valence electrons, so it wants 2 more to be full.

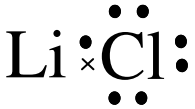
Electrons can move around for bonding.



Right **Also right**

Magnesium has 2 valence electrons. It will lose them to a non-metal and become a positive ion.

X's can be used to keep track of electrons from other atoms.



The x shows that Lithium gives its one valence electron to Chlorine. Chlorine now has 8 and is full.

Name: _____ Unit 3:2

Period: _____

1. Oxidation #s	A. Show the number of atoms in a molecule.	1. Metals	A. Elements in column 18A that don't combine into molecules.
2. Negative ion	B. An atom that lost electrons.	2. Nonmetals	B. The oxidation numbers of these elements can vary.
3. Positive ion	C. Shows the number of electrons commonly gained or lost.	3. Octet Rule	C. Elements that lose electrons.
4. Subscript	D. Way to show an atom's valence electrons to visualize bonding.	4. Noble Gases	D. Elements that gain electrons.
5. Lewis Dot Diagrams	E. An atom that gains electrons.	5. Transition Metals	E. Atoms tend to be more stable with 8 valence electrons.

Give abbreviations and oxidation numbers

Calcium (*Ca*) *+2* . Carbon (____) _____

Potassium (____)_____ Nitrogen (____)_____

Chlorine (____) _____ Hydrogen (____)_____

Helium (____) _____ Magnesium (____) _____

Aluminum (____) _____ Krypton (____) _____

Give these elements with oxidation # in ion notation

Oxygen (*O*) O^{2-} . Fluorine (____) _____

Nitrogen (____)_____ Lithium (____) _____

Beryllium (____) _____ Hydrogen (____)_____

Silicon (____) _____ Calcium (____) _____

Boron (____)_____ Bromine (____) _____

$MgCl_2$ How many Chlorines? _____

Li_2O How many Oxygen? _____

Al_2O_3 How many Aluminums? _____

$C_{12}H_{22}O_{11}$ How many Hydrogens? _____

CO_2 How many Carbons? _____

H_2O How many Hydrogens? _____

$MgCl_2$ How many total atoms? _____

Li_2O How many total atoms? _____

Al_2O_3 How many total atoms? _____

$C_6H_{12}O_6$ How many total atoms? _____

CO_2 How many total atoms? _____

H_2O How many total atoms? _____

How many electrons are gained or lost?

Na^{1+} *Lost 1* Cu^{2+} _____

Al^{3+} _____ Cl^{1-} _____

O^{2-} _____ N^{3-} _____

He^{0} _____ Si^{4+} _____

Give abbreviations and valence electrons

Oxygen (*O*) *6* . Silicon (____) _____

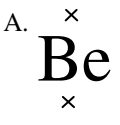
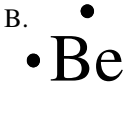
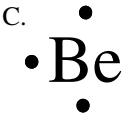
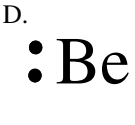
Lithium (____) _____ Nitrogen (____) _____

Bromine (____) _____ Hydrogen (____) _____

Helium (____) _____ Magnesium (____) _____

Aluminum (____) _____ Neon (____) _____

Which of these is incorrect?

A.  B.  C.  D. 

Put boxes around any electrons openings

Draw the Lewis Dot Diagrams for the following.

Carbon	Magnesium	Oxygen	Helium
Aluminum	Argon	Lithium	Fluorine

Draw 3 different Lewis Dot Diagrams for Nitrogen.

Draw Lewis Dot Diagrams for Lithium and Oxygen, then put them together to find how they combine.

Lithium Oxygen Combined

Name: _____

Period: _____

1. Oxidation #s C	A. Show the number of atoms in a molecule.
2. Negative ion E	B. An atom that lost electrons.
3. Positive ion B	C. Shows the number of electrons commonly gained or lost.
4. Subscript A	D. Way to show an atom's valence electrons to visualize bonding.
5. Lewis Dot Diagrams D	E. An atom that gains electrons.

1. Metals C	A. Elements in column 18A that don't combine into molecules.
2. Nonmetals D	B. The oxidation numbers of these elements can vary.
3. Octet Rule e	C. Elements that lose electrons.
4. Noble Gases A	D. Elements that gain electrons.
5. Transition Metals B	E. Atoms tend to be more stable with 8 valence electrons.

Give abbreviations and oxidation numbers

Calcium (*Ca*) +2 . Carbon (C) 4

Potassium (K) 1 Nitrogen (N) -3

Chlorine (Cl) -1 Hydrogen (H) 1

Helium (He) 0 Magnesium (Mg) 2

Aluminum (Al) 3 Krypton (Kr) 0

Give these elements with oxidation # in ion notation

Oxygen (*O*) O^{2+} . Fluorine (F) F^{1-}

Nitrogen (N) N^{3-} Lithium (Li) Li^{1+}

Beryllium (Be) Be^{2+} Hydrogen (H) H^{1+}

Silicon (Si) Si^{4+} Calcium (Ca) Ca^{2+}

Boron (B) B^{3+} Bromine (Br) Br^{1-}

$MgCl_2$ How many Chlorines? 2

Li_2O How many Oxygen? 1

Al_2O_3 How many Aluminums? 2

$C_{12}H_{22}O_{11}$ (sucrose) How many Hydrogens? 22

CO_2 How many Carbons? 1

H_2O How many Hydrogens? 2

$MgCl_2$ How many total atoms? 3

Li_2O How many total atoms? 3

Al_2O_3 How many total atoms? 5

$C_6H_{12}O_6$ (glucose) How many total atoms? 24

CO_2 How many total atoms? 3

H_2O How many total atoms? 3

How many electrons are gained or lost?

Na^{1+} *Lost 1* . Cu^{2+} lost 2

Al^{3+} lost 3 Cl^{1-} gained 1

O^{2-} gained 2 N^{3-} gained 3

He^0 none Si^{4+} lost 4

Give abbreviations and valence electrons

Oxygen (*O*) 6 . Silicon (Si) 4

Lithium (Li) 1 Nitrogen (N) 5

Bromine (Br) 7 Hydrogen (H) 1

Helium (He) 2 Magnesium (Mg) 2

Aluminum (Al) 3 Neon (Ne) 8

Which of these is incorrect?

A. Be B. Be C. Be D. Be

Put boxes around any electrons openings

O F C K

Draw the Lewis Dot Diagrams for the following.

Carbon	Magnesium	Oxygen	Helium
C	Mg	O	He
Aluminum	**Argon**	**Lithium**	**Fluorine**
Al	Ar	Li	F

Draw 3 different Lewis Dot Diagrams for Nitrogen.

N N N

Draw Lewis Dot Diagrams for Lithium and Oxygen, then put them together to find how they combine.

Lithium Oxygen Combined

Li O Li O Li

Name: _____

Period: _____

Unit 3:3

Ionic Compounds

Ion Charges Add

An ion is an atom with a positive or negative charge because it has gained or lost electrons. With multiple ions, their charges add together.

Oxidation Numbers

$Na^{1+} + Na^{1+} = 2+ \text{ charge}$

So $Na_2^{1+} = 2+ \text{ charge}$

Each Sodium atom gives up 1 electron, so 2 Sodium atoms (Na_2) will give up 2 electrons and have a charge of 2+.

Opposite Ions Attract

Just as with protons and electrons: oppositely charged atoms attract. Positive ions (metals) attract negative ions (nonmetals), forming ionic compounds.

Positive ions attract Negative ions

Positive ion of 2+ Mg^{2+} attracts F^{1-} *Negative ion of 1-*

Ions make ***ionic*** compounds. $\longrightarrow MgF_2$ Magnesium Fluoride

Two F^{1-} for every Mg^{2+}

Electron Arrows

Electron arrows are an easy way to visualize electrons being given or accepted by atoms.

The Symbols

→ Losing 1 electron

≻ Gaining 1 electron

→≻ An ionic bond

The number of electron arrows comes from the oxidation numbers. Positives give electrons; negatives receive.

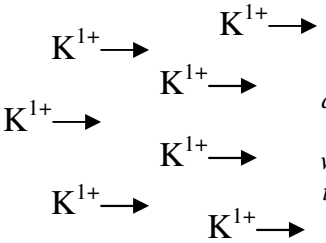
$Mg^{2+} \rightarrow \rightarrow$ *Magnesium's oxidation number is +2, so it will lose 2 electrons.*

$\succ F^{1-}$ *Sulfur's oxidation number is −1, so it will gain 1 electron.*

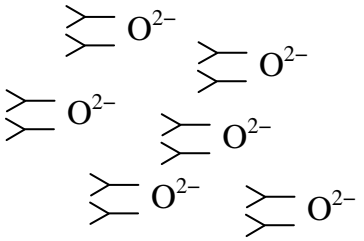
Ionic Compounds

How do elements combine to form compounds? Elements rarely occur naturally as individual atoms. Instead, each sample of an element contains a huge number of atoms! When placed together most elements will begin to lose electrons (becoming a positive ion) or gain electrons (becoming a negative ion). The positive ions are attracted to negative ions and combine into ionic compounds.

Ionic compounds always combine in a particular ratio (same number of each atom) so that they are ***balanced.***
The net charge must equal zero!

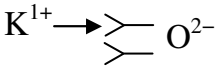


When elements combine there are a lot of atoms of each element. Each atom will gain or lose electrons according to its oxidation number.

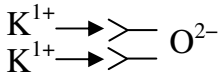


Each potassium loses 1 electron.

Each oxygen gains 2 electrons.



Oxygen is not full, so it will attract another K.



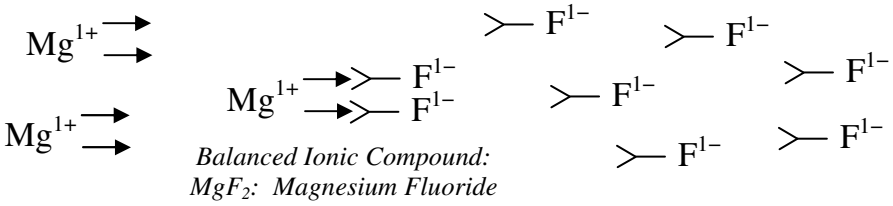
Oxygen is now full and the compound is balanced.

Each oxygen will attract two potassiums, so potassium and oxygen will always combine as K_2O.

Limiting Reactant

As atoms combine into compounds, eventually one element will run out first. This is the limiting reactant, the reactant that is limited in amount. When one element is gone, the reaction will stop.

When the wood is all burned, the fire will stop. Wood is the limiting reactant because there is still oxygen.



Balanced Ionic Compound: MgF_2: Magnesium Fluoride

Magnesium and fluorine combine in a 1 to 2 ratio: MgF_2. In this simplified example, the 8 fluorine atoms could combine with 4 magnesium atoms. Since there are only 3 magnesium atoms, the magnesium will run out first, making magnesium the limiting reactant. In the real world there are billions of atoms when they form compounds. Chemists are able to know how many atoms there are by the weight of the samples.

Name: _____ Unit 3:3

Period: _____

1. Oxidation #s	A. Attracted by a positive ion.
2. Zero	B. Tells you how many electrons will be gained or lost by an element.
3. Negative ion	C. Net charge of a balanced ionic compound.
4. Positive ion	D. When the number of electrons given equals the number taken.
5. Balanced	E. Attracted by a negative ion.

6. *Use the following symbols to answer the following.*

A. An electron being lost:

B. An ionic bond:

C. An electron being gained:

D. Used for a metal:

E. Used for a nonmetal:

7. *Give abbreviations with oxidation numbers and arrows*

Calcium	Ca^{2+}	Nitrogen	
Oxygen		Fluorine	
Sodium		Aluminum	

8. Give number of electrons gained or lost

Ca^{2+}	*2 lost*	Ca_3^{2+}	*6 lost*
F^{1-}	_____	F_3^{1-}	_____
Al^{3+}	_____	Al_2^{3+}	_____
O^{2-}	_____	O_3^{2-}	_____
Na^{1+}	_____	Na_3^{1+}	_____
N^{3-}	_____	N_2^{3-}	_____

For the following six examples, combine the two given atoms using electron arrows, then give the balanced ionic compound formula.

Combine Sodium and Oxygen	Give the balanced ionic formula for *Sodium Oxide*.	Combine Beryllium and Fluorine	Give the balanced ionic formula for *Beryllium Fluoride*.
Combine Magnesium and Sulfur	Give the balanced ionic formula for *Magnesium Sulfide*	Combine Lithium and Phosphorus	Give the balanced ionic formula: *Compound name:*
Combine Calcium and Nitrogen	Give the balanced ionic formula: *Compound name:*	Combine Aluminum and Oxygen	Give the balanced ionic formula for Beryllium Fluoride. *Compound name:*

Write the balanced ionic compounds for the following:

Be^{2+} and O^{2-} : _____ Na^{1+} and S^{2-} : _____

Li^{1+} and N^{3-} : _____ Ca^{2+} and N^{3-} : _____

Al^{3+} and Cl^{1-} : _____ K^{1+} and $(SO_4)^{2-}$: _____

Write the balanced ionic formulas for the following:

Lithium and Oxygen: _____

Magnesium and Iodine: _____

Calcium and Sulfur: _____

Aluminum and Oxygen: _____

Name: _____ Unit 3:3

Period: _____

1. Oxidation #s B	A. Attracted by a positive ion.
2. Zero C	B. Tells you how many electrons will be gained or lost by an element.
3. Negative ion A	C. Net charge of a balanced ionic compound.
4. Positive ion E	D. When the number of electrons given equals the number taken.
5. Balanced D	E. Attracted by a negative ion.

6. *Use the following symbols to answer the following.*

A. An electron being lost: →

B. An ionic bond: →—

C. An electron being gained: —< or >—

D. Used for a metal: →

E. Used for a nonmetal: >—

7. *Give abbreviations with oxidation numbers and arrows*

Calcium Ca^{2+} →→ Nitrogen N^{3-}

Oxygen O^{2-} Fluorine F^{1-}

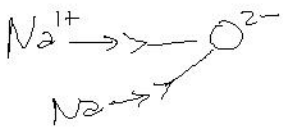
Sodium Na^{+1} → Aluminum Al^{3+} →→→

8. Give number of electrons gained or lost

Ca^{2+}	2 lost	Ca_3^{2+}	6 lost
F^{1-}	1 gained	F_3^{1-}	3 gained
Al^{3+}	3 lost	Al_2^{3+}	6 gained
O^{2-}	2 gained	O_3^{2-}	6 gained
Na^{1+}	1 lost	Na_3^{1+}	3 lost
N^{3-}	3 gained	N_2^{3-}	6 gained

For the following six examples, combine the two given atoms using electron arrows, then give the balanced ionic compound formula.

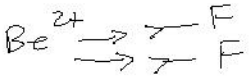
Combine Sodium and Oxygen



Give the balanced ionic formula for *Sodium Oxide*.

Na_2O

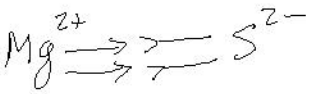
Combine Beryllium and Fluorine



Give the balanced ionic formula for *Beryllium Fluoride*.

BeF_2

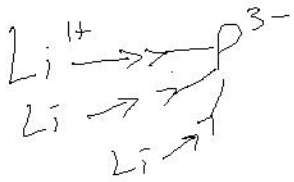
Combine Magnesium and Sulfur



Give the balanced ionic formula for *Magnesium Sulfide*

MgS

Combine Lithium and Phosphorus



Give the balanced ionic formula:

Compound name:

Lithium phosphide

Combine Calcium and Nitrogen

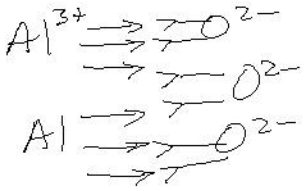
Give the balanced ionic formula

Ca_3N_2

Compound name:

Calcium Nitride

Combine Aluminum and Oxygen



Give the balanced ionic formula for Beryllium Fluoride.

Al_2O_3

Compound name:

Aluminum oxide

Write the balanced ionic compounds for the following:

Be^{2+} and O^{2-} : BeO

Na^{1+} and S^{2-} : Na_2S

Li^{1+} and N^{3-} : Li_3N

Ca^{2+} and N^{3-} : Ca_3N_2

Al^{3+} and Cl^{1-} : $AlCl_3$

K^{1+} and $(SO_4)^{2-}$: $K_2(SO_4)$

Write the balanced ionic formulas for the following:

Lithium and Oxygen: Li_2O

Magnesium and Iodine: MgI_2

Calcium and Sulfur: CaS

Aluminum and Oxygen: Al_2O_3

Name: _____

Period: _____

Unit 3:4

Covalent Compounds

When two nonmetals bond neither one is willing to lose their electrons. Why? Because they are too close to having a full octet of valence electrons. So they share.

Use x's or dots for different atoms

If you use only dots you won't be able to see where the electrons came from.

Hard to read

Easy to read

Remember the dots are Valence Electrons

Chlorine has 7 valence electrons
Chlorine needs 1 more to be full.

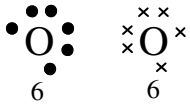
Phosphorus has 5 valence electrons
Phosphorus needs 3 more to be full.

And the dots can be moved to wherever you need them.

Covalent Bonding

You must fulfill two criteria when making covalent bonds:
1) the individual atoms must have the proper number of valence electrons;
2) when bonded each atom must have 8 electrons through sharing.

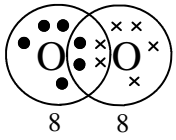
Oxygen does not exist as an individual atom.



Each oxygen has only 6 valence electrons and needs 2 more.

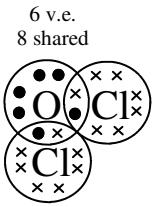
Oxygen is a *diatomic molecule*: it is found as a molecule of 2 atoms.

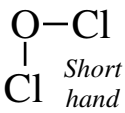
Molecular Oxygen: O_2



Together each oxygen has 8 valence electrons thru *sharing*.

Oxygen dichloride: OCl_2





Short hand

Short Hand

Though Lewis Dot Diagrams are a powerful tool to determine how elements bond, they take a long time to draw. Chemists use lines to show bonds.

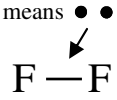
A Covalent Bond

—

Each line means 2 electrons are shared

Single bond—each atom shares 1 electron (2 total)

means

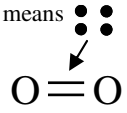


A *single* covalent bond.

Each Fluorine has 7 v.e. plus 1 for the 1 bond = 8!

Double bond—each atom shares 2 electrons (4 total)

means

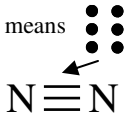


A *double* covalent bond.

Each Oxygen has 6 v.e. plus 2 for the 2 bonds = 8!

Triple bond—each atom shares 3 electrons (6 total)

means



A *triple* covalent bond.

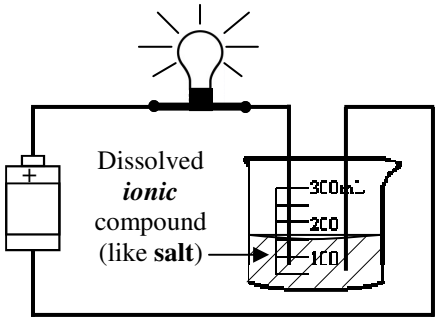
Each Nitrogen has 5 v.e. plus 3 for the 3 bonds = 8!

Electrolytes

Electrolytes are compounds that allow electricity to flow when they are dissolved in water. Ionic compounds are good electrolytes. Covalent compounds are not.

Ionic Compounds are Electrolytes

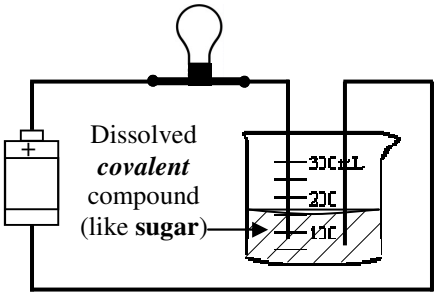
Ionic compounds dissolve into ions. Ions conduct electricity.



Dissolved ***ionic*** compound (like **salt**)

Covalent Compounds are NOT Electrolytes

Covalent compounds do not dissolve into ions and do not conduct electricity.



Dissolved ***covalent*** compound (like **sugar**)

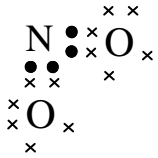
Name: _____ Unit 3:4

Period: _____

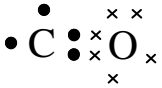
1. X's	A. A bond of negatively and positively charged atoms.	1. Electrolyte	A. When 4 valence electrons are shared.
2. Covalent	B. Used instead of dots to show a different atom's valence electrons.	2. Double Bond	B. Used instead of dots to simplify the writing on bonds. Means 2 electrons.
3. Ionic	C. A bond where electrons are shared.	3. Triple Bond	C. Shows 6 valence electrons being shared.
4. Diatomic Molecule	D. Number of electrons each atom in a covalent compound has after sharing.	4. Line (—)	D. Something dissolved in water that allows electricity to flow.
5. 8 Valence Electrons	E. A molecule of two atoms of the same element.	5. Single Bond	E. Occurs when 2 valence electrons are shared in a covalent compound.

Decide what's wrong with these covalent compounds and then draw them correctly..

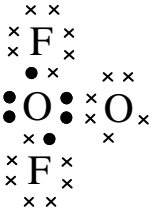
Wrong *Right*



Wrong *Right*



Wrong *Right*



Using the short hand notation, count how many electrons the atoms have and if they have a full number of valence electrons.

P ≡ # of electrons: ___*8*___ Full? ___*Yes*___.

O — # of electrons: _____ Full? _____

C = # of electrons: _____ Full? _____

N = # of electrons: _____ Full? _____

Cl — # of electrons: _____ Full? _____

=Si— # of electrons: _____ Full? _____

I = # of electrons: _____ Full? _____

—S— # of electrons: _____ Full? _____

Draw the Lewis Dot Diagram for molecular Chlorine (Cl_2).

Short hand

Draw the Lewis Dot Diagram for molecular Oxygen (O_2).

Short hand

Using Lewis Dot Diagrams to predict how Oxygen and Fluorine will combine.

Short hand

Using Lewis Dot Diagrams to predict how Nitrogen and Bromine will combine.

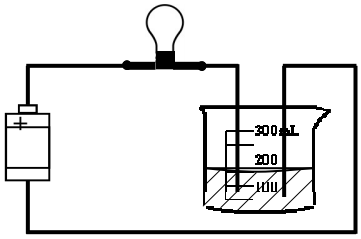
Short hand

Are these Electrolytes? Yes or No?

NaCl	_____	Li_2S	_____
CO_2	_____	Al_2O_3	_____
$MgCl_2$	_____	SeO	_____
NBr_3	_____	FeO	_____
BeO	_____	$Li(NO_3)$	_____

In this setup, is the dissolved compound ionic or covalent?

How do you know?



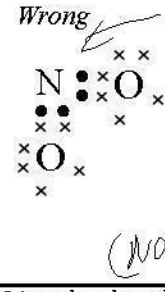
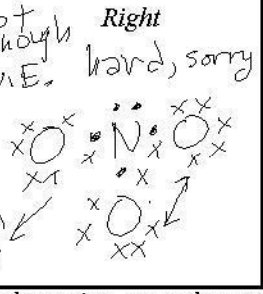
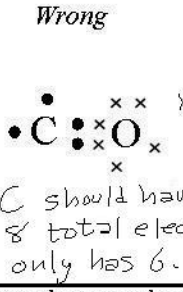
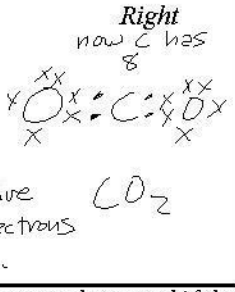
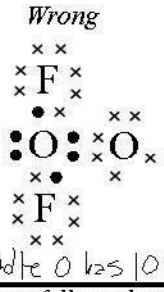
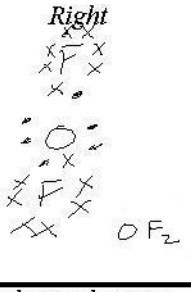
Name: _____

Period: _____

COM4

1. X's B	A. A bond of negatively and positively charged atoms.	1. Electrolyte D	A. When 4 valence electrons are shared.
2. Covalent C	B. Used instead of dots to show a different atom's valence electrons.	2. Double Bond A	B. Used instead of dots to simplify the writing on bonds. Means 2 electrons.
3. Ionic A	C. A bond where electrons are shared.	3. Triple Bond C	C. Shows 6 valence electrons being shared.
4. Diatomic Molecule E	D. Number of electrons each atom in a covalent compound has after sharing.	4. Line (—) B	D. Something dissolved in water that allows electricity to flow.
5. 8 Valence Electrons D	E. A molecule of two atoms of the same element.	5. Single Bond E	E. Occurs when 2 valence electrons are shared in a covalent compound.

Decide what's wrong with these covalent compounds and then draw them correctly..

Wrong	Right
 not enough VE.	 hard, sorry $(NO_3)^{-1}$
 C should have 8 total electrons only has 6.	 now C has 8 CO_2
 middle O has 10	 OF_2

Using the short hand notation, count how many electrons the atoms have and if they have a full number of valence electrons.

P ≡ # of electrons: 8 Full? Yes.

C = # of electrons: 6 Full? N

Cl — (+1) # of electrons: 8 Full? Y

I = (7, +7) # of electrons: 9 Full? overfull (won't happen)

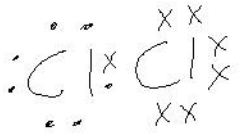
O — (6, +1) # of electrons: 7 Full? No

N = (5, +7) # of electrons: 7 Full? No

=Si— (2, +5, +1) # of electrons: 7 Full? NO

—S— (1, +6, +1) # of electrons: 8 Full? Yes

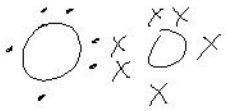
Draw the Lewis Dot Diagram for molecular Chlorine (Cl_2).



Short hand

Cl — Cl

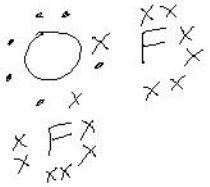
Draw the Lewis Dot Diagram for molecular Oxygen (O_2).



Short hand

O = O

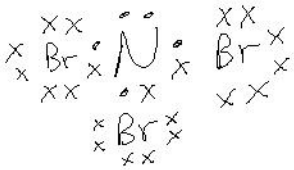
Using Lewis Dot Diagrams to predict how Oxygen and Fluorine will combine.



Short hand

O — F
|
F

Using Lewis Dot Diagrams to predict how Nitrogen and Bromine will combine.



Short hand

Br — N — Br
|
Br

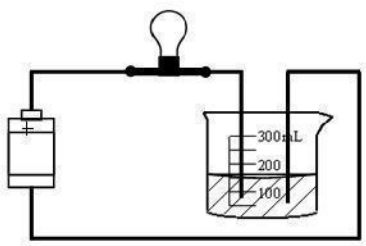
Are these Electrolytes? Yes or No?

NaCl	Y	Li_2S	Y
CO_2	N	Al_2O_3	Y
$MgCl_2$	Y	SeO	N
NBr_3	N	FeO	Y
BeO	Y	$Li(NO_3)$	Y

In this setup, is the dissolved compound ionic or covalent?

How do you know?

Light is off — so not ionic.



Name: _____

Period: _____

Unit 3:5

Changes of Matter Review

1. Transition Metals	A. Become positive ions.
2. Noble Gases	B. Gain electrons, becoming negative ions.
3. Metals	C. Compounds formed when electrons are shared.
4. Nonmetals	D. Do not have consistent oxidation numbers.
5. Ionic	E. Do not combine into compounds.
6. Covalent	F. Compounds formed between positively and negatively charged atoms.

1. Oxidation #s	A. Tells you that atoms are more stable with 8 valence electrons.
2. Octet Rule	B. A molecule of two atoms of the same element.
3. Diatomic Molecule	C. When dissolved in water, a compound that allows electricity to pass.
4. Electrolyte	D. How many electrons are gained or lost.
5. Valence Electrons	E. Outermost electrons of an atom.

Give the symbol and atomic number of these elements.

Oxygen (O) 8 . Boron (___) _____

Nitrogen (___) _____ Bromine (___) _____

Helium (___) _____ Iron (___) _____

Sodium (___) _____ Mercury (___) _____

Give symbols and number of valence electrons for these:

Aluminum (Al) 13 . Beryllium (___) _____

Neon (___) _____ Sodium (___) _____

Chlorine (___) _____ Calcium (___) _____

Boron (___) _____ Sulfur (___) _____

Give the symbol and number of protons for these elements.

Aluminum (Al) 13 . Lithium (___) _____

Phosphorus (___) _____ Magnesium _____

Argon (___) _____ Silver (___) _____

Copper (___) _____ Gold (___) _____

Give these elements with oxidation # in ion notation

Oxygen O^{2-} . Boron _____

Nitrogen _____ Bromine _____

Helium _____ Potassium _____

Carbon _____ Hydrogen _____

How many Aluminums in Al_2O_3? _____

How many Magnesiums in $MgCl_2$? _____

How many Sodiums in Na_3N? _____

How many Oxygens in $Li(NO_3)$? _____

How many total atoms in Al_2O_3? _____

How many total atoms in $MgCl_2$? _____

How many total atoms in Na_3N? _____

How many total atoms in $Li(NO_3)$? _____

How many electrons are gained or lost?

K^{1+} *Lost 1* Fe^{2+} _____

B^{3+} _____ F^{1-} _____

S^{2-} _____ N^{3-} _____

He^{0} _____ Si^{4+} _____

How many electrons will be gained or lost by:

K *Lost 1* Ar _____

Al _____ Br _____

O _____ Ca _____

Be _____ H _____

Draw the Lewis Dot Diagrams for the following.

Carbon	Lithium	Sulfur	Argon
Aluminum	**Nitrogen**	**Magnesium**	**Chlorine**

Draw 3 different Lewis Dot Diagrams for Aluminum.

Use Electron Arrows to Combine Magnesium and Fluorine

Name: _____ Unit 3:5

Period: _____

		Ionic, Covalent, or Polyatomic?	*Use Prefixes?*	*Compound Name*
1.	Al_2O_3	*Ionic*	*No*	*Aluminum Oxide*
2.	O_2F_2			
3.	BeF_2			
4.	$K_2(CO_3)$			
5.	N_2F_3			
6.	SF_6			
7.	$Al_2(CrO_4)_3$			
8.	P_4S_3			
9.	NaN_3			
10.	MgO			
11.	PF_3			
12.	CO_2			

Metal or Non-metal?

____ Cobalt (___)

____ Sodium (___)

____ Fluorine (___)

____ Argon (___)

____ Magnesium (___)

____ Nickel (___)

Give the total charge

Ca_3^{2+} *+6*

$Ca^{2+}\,O^{2-}$ _____

$Mg^{2+}\,F^{1-}$ _____

$Na^{1+}\,F_2^{1-}$ _____

$Al^{3+}S_2^{2-}$ _____

$Al^{3+}O_2^{2-}$ _____

O_3^{2-} _____

$Mg^{2+}\,(NO_3)^{1-}$ _____

Write the balanced ionic compounds for the following:

Li^{2+} and O^{2-} : _____ K^{1+} and S^{2-} : _____

Na^{1+} and N^{3-}: _____ Li^{1+} and F^{1-} : _____

Al^{3+} and O^{1-} : _____ Ca^{2+} and P^{3-}: _____

Mg^{2+} and Cl^{1-} : _____ Al^{3+} and $(NO_3)^{1-}$:_____

Write the balanced ionic formulas for the following:

Li and Cl: _____

Mg and O: _____

Al and S: _____

Mg and N: _____

K and (CrO_4) _____

Draw the Lewis Dot Diagram for molecular Fluorine (F_2).

Short hand

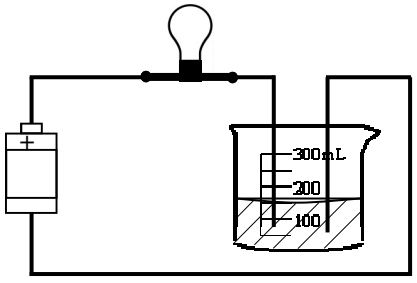
— C —

# of electrons: _____

N≡

# of electrons: _____

Using shorthand, make Oxygen Dichloride



For the light to come on, what kind of compound would need to be dissolved: ionic or covalent?

What do we call a compound that will allow electricity to flow?

Are these Electrolytes: yes or no?

NaCl	_____	Li_2S	_____
CO_2	_____	Al_2O_3	_____
$MgCl_2$	_____	SeO	_____
NBr_3	_____	FeO	_____
BeO	_____	$Li(NO_3)$	_____

Name: _____

Period: _____

COM:5

Changes of Matter Review

1. Transition Metals D	A. Become positive ions.
2. E Noble Gases	B. Gain electrons, becoming negative ions.
3. Metals A	C. Compounds formed when electrons are shared.
4. Nonmetals B	D. Do not have consistent oxidation numbers.
5. Ionic F	E. Do not combine into compounds.
6. Covalent C	F. Compounds formed between positively and negatively charged atoms.

1. Oxidation #s D	A. Tells you that atoms are more stable with 8 valence electrons.
2. Octet Rule A	B. A molecule of two atoms of the same element.
3. Diatomic Molecule B	C. When dissolved in water, a compound that allows electricity to pass.
4. Electrolyte C	D. How many electrons are gained or lost.
5. Valence Electrons E	E. Outermost electrons of an atom.

Give the symbol and atomic number of these elements.

Oxygen (O) 8 . Boron (B) 5

Nitrogen (N) 7 Bromine (Br) 35

Helium (He) 2 Iron (Fe) 26

Sodium (Na) 11 Mercury (Hg) 80

Give symbols and number of valence electrons for these:

Aluminum (Al) 3 . Beryllium (Be) 2

Neon (Ne) 8 Sodium (Na) 1

Chlorine (Cl) 7 Calcium (Ca) 2

Boron (B) 3 Sulfur (S) 6

Give the symbol and number of protons for these elements.

Aluminum (Al) 13 . Lithium (Li) 3

Phosphorus (P) 15 Magnesium (Mg) 12

Argon (Ar) 18 Silver (Ag) 47

Copper (Cu) 29 Gold (Au) 79

Give these elements with oxidation # in ion notation

Oxygen O^{2-} . Boron B^{3+}

Nitrogen N^{3-} Bromine Br^{1-}

Helium He^{0} Potassium K^{1+}

Carbon C^{4+} Hydrogen H^{1+}

How many Aluminums in Al_2O_3? 2

How many Magnesiums in $MgCl_2$? 1

How many Sodiums in Na_3N? 3

How many Oxygens in $Li(NO_3)$? 3

How many total atoms in Al_2O_3? 5

How many total atoms in $MgCl_2$? 3

How many total atoms in Na_3N? 4

How many total atoms in $Li(NO_3)$? $1+1+3$ 5

How many electrons are gained or lost?

K^{1+} *Lost 1* Fe^{2+} lost 2

B^{3+} lost 3 F^{1-} gained 1

S^{2-} gained 2 N^{3-} gained 3

He^{0} none Si^{4+} lost 4

How many electrons will be gained or lost by: (oxid. #)

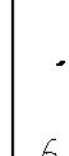
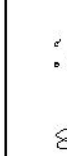
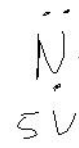
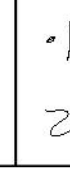
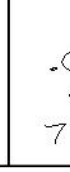
K *Lost 1* Ar 0

Al lost 3 Br gain 1

O gained 2 Ca lost 2

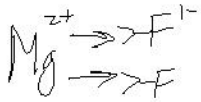
Be lost 2 H lost 1

Draw the Lewis Dot Diagrams for the following.

Carbon	Lithium	Sulfur	Argon
			
4 V.E.	1 V.E.	6 V.E.	8 V.E.
Aluminum	**Nitrogen**	**Magnesium**	**Chlorine**
			
3 V.E.	5 V.E.	2 V.E.	7 V.E.

Draw 3 different Lewis Dot Diagrams for Aluminum.

Use Electron Arrows to Combine Magnesium and Fluorine



MgF_2

Name: _____

Period: _____

COM:5

		Ionic, Covalent, or Polyatomic?	Use Prefixes?	Compound Name
1.	Al_2O_3	Ionic	No	Aluminum Oxide
2.	O_2F_2	C	Y	dioxygen difluoride
3.	BeF_2	I	N	Beryllium fluoride
4.	$K_2(CO_3)$	P	N	Potassium Carbonate
5.	N_2F_3	C	Y	dinitrogen trifluoride
6.	SF_6	C	Y	sulfur hexafluoride
7.	$Al_2(CrO_4)_3$	P	N	Aluminum Chromate
8.	P_4S_3	C	Y	tetra Phosphorus trisulfide
9.	NaN_3	I	N	sodium nitride
10.	MgO	I	N	magnesium oxide
11.	PF_3	C	Y	Phosphorus trifluoride
12.	CO_2	C	Y	carbon dioxide

Metal or Non-metal?

- M Cobalt (Co)
- M Sodium (Na)
- N Fluorine (F)
- N Argon (Ar)
- M Magnesium (Mg)
- M Nickel (Ni)

Give the total charge

Ca_3^{2+}	+6
$Ca^{2+}\ O^{2-}$	0
$Mg^{2+}\ F^{1-}$	+1
$Na^{1+}\ F_2^{1-}$	−1 (1−1−1)
$Al^{3+}S_2^{2-}$	−1
$Al^{3+}O_2^{2-}$	−1
O_3^{2-}	−6
$Mg^{2+}\ (NO_3)^{1-}$	+1

Write the balanced ionic compounds for the following:

Li^{2+} and O^{2-}:	LiO	K^{1+} and S^{2-}:	K_2S
Na^{1+} and N^{3-}:	Na_3N	Li^{1+} and F^{1-}:	LiF
Al^{3+} and O^{2-}:	Al_2O_3	Ca^{2+} and P^{3-}:	Ca_3P_2
Mg^{2+} and Cl^{1-}:	$MgCl_2$	Al^{3+} and $(NO_3)^{1-}$:	$Al(NO_3)_3$

★ ***Write the balanced ionic formulas for the following:*** ★

Li^{1+} and Cl^{1-}:	$Li^{1+}Cl^{1-}$	LiCl
Mg and O:	$Mg^{2+}O^{-2}$	MgO
Al and S:	$Al^{3+}S^{2-}$	Al_2S_3
Mg and N:	$Mg^{2+}N^{3-}$	Mg_3N_2
K and (CrO_4)	$K^{1+}(CrO_4)^{2-}$	$K_2(CrO_4)$

Draw the Lewis Dot Diagram for molecular Fluorine (F_2).

Short hand

F−F

+1 4 +1

—C—

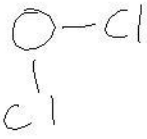
# of electrons: 6

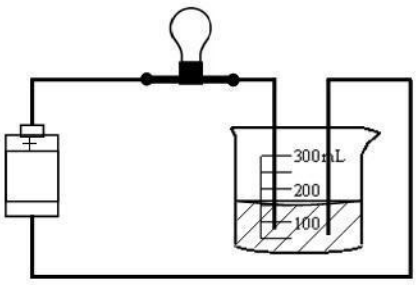
5 +3

N≡

# of electrons: 8

Using shorthand, make Oxygen Dichloride





For the light to come on, what kind of compound would need to be dissolved: ionic or covalent?

What do we call a compound that will allow electricity to flow? electrolyte

Are these Electrolytes? Yes or No? must be ionic

NaCl	Y	Li_2S	Y
CO_2	N	Al_2O_3	Y
$MgCl_2$	Y	SeO	N
NBr_3	N	FeO	Y
BeO	Y	$Li(NO_3)$	Y

Name: _____

Period: _____

Unit 3:3

Ionic Compounds

Ion Charges Add

An ion is an atom with a positive or negative charge because it has gained or lost electrons. As ions add together, so do their charges.

Oxidation Numbers

$Na^{1+} + Na^{1+} = 2+$ charge

So $Na_2^{1+} = 2+$ charge

Each Sodium atom gives up 1 electron, so 2 Sodium atoms (Na_2) will give up 2 electrons and have a charge of 2+.

Opposites Ions Attract

Just as with protons and electrons: oppositely charged atoms attract. Positive ions (metals) attract negative ions (nonmetals), forming ionic compounds.

Positive ions attract Negative ions

Positive ion of 2+ Mg^{2+} attracts F^{1-} *Negative ion of 1-*

Ions make ***ionic*** compounds. → MgF_2 Magnesium Fluoride

Two F^{1-} for every Mg^{2+}

Balanced Ionic Compounds

Ionic compounds always combine in a particular ratio (same number of each atom) so that they are ***balanced. The net charge must equal zero!***

If Lithium atoms are placed near Oxygen atoms they will combine and form ionic bonds *in a certain ratio.*

$Li^{1+}\ Li^{1+}\ O^{2-}\ O^{2-}$
$Li^{1+}\ Li^{1+}\ O^{2-}\ O^{2-}$
$Li^{1+}\ Li^{1+}\ O^{2-}\ O^{2-}$

A Lithium attracts an Oxygen, but is not balanced.

$Li^{1+}O^{2-} = 1-$ charge

Still negative, so it will attract another positive.

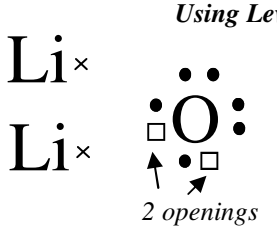
Each Oxygen will attract 2 Lithium ions to be balanced.

$Li^{1+}\ Li^{1+}\ O^{2-} = 0$ charge

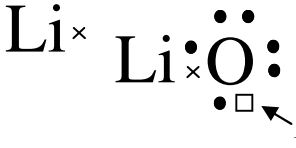
BALANCED

Li_2O

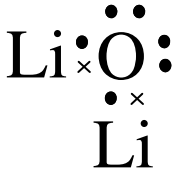
Using Lewis Dot Diagrams



Oxygen needs 2 more electrons to be full. It attracts a Lithium atom and its 1valence electron.



With only 1 Lithium, Oxygen is still not full, so it attracts *one more* Lithium atom.



Oxygen is now full, having gained 2 valence electrons from 2 Lithium atoms.

Li_2O

Lithium and Oxygen will **ALWAYS** combine in a 2:1 ratio.

Electron Arrows — An easy visual aid for you.

The Symbols

→ Losing 1 electron

>— Gaining 1 electron

→>— An ionic bond

Magnesium loses 2 electrons

Mg^{2+} →→

Chlorine gains 1 electron

>— Cl^{1-}

Magnesium will combine with 2 Chlorines

Mg^{2+} →>— Cl^{1-}
→>— Cl^{1-}

Magnesium Chloride: **$MgCl_2$ (a 1:2 ratio)**

Magnesium Sulfide: **MgS**

Mg^{2+} →→ *Loses 2*

>>— S^{2-} *Gains 2*

Mg^{2+} →>>— S^{2-} **MgS**

How to Balance Ionic Compounds

Step 1: Write the symbols for each element.
Step 2: Write the oxidation numbers on each symbol.
Step 3: Balance so the # of electrons lost = # gained.
If you need to, use visual aid like Lewis Dot Diagrams or Electron Arrows to help you.

Ex. Find the balanced ionic formula for Calcium Bromide.

Step 1: Ca Br

Step 2: $Ca^{2+}\ Br^{1-} = 1+$ charge ← Not balanced: attracts another Br^{1-}

Step 3: $Ca^{2+}\ Br_2^{1-} = 0$ charge Balanced!

Calcium Bromide is ALWAYS: $CaBr_2$

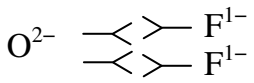
Name: _____

Period: _____

TEACHER NOTES:

p. 13 is the older "Ionic Compounds" page, which has multiple ways of showing multiple methods. The newer page (p.7) uses the electron arrows, which I believe to be superior and much easier for the students. I will try to get the keys done when I can.

I haven't had time to complete the rewrite of "Covalent Compounds" using electron arrows, but you can show this method very easily and students will make the connection very fast. See below:



Students easily see that neither element will give up electrons. The idea that they "share" electrons is a simple step. In the past teaching covalent compounds with Lewis Dot Diagrams was always a struggle and successful for very few students (since I didn't have enough time to push thru it for everyone). Covalent compounds works for everyone easily with the electron arrows.

