Chemical Reactions

All chemical reactions can be written as chemical equations.

What is a Chemical Reaction?

- Chemical reactions represent chemical changes
  - A chemical change occurs when a substance has changed its identity
    - For example: Combustion of propane in a barbeque
- Chemical reactions are represented in chemical equations.

$$C_3H_8(g) + O_2 \rightarrow CO_2(g) + H_2O(l)$$

Describing chemical reaction

- The way atoms are joined is changed
- Atoms aren't created or destroyed.
- Can be described several ways
- In a sentence
- Copper reacts with chlorine to form copper (II) chloride.
- In a word equation
- Copper + chlorine $\rightarrow$ copper (II) chloride
- $Cu_{(s)} + Cl_{2(g)} \rightarrow CuCl_{2(aq)}$

Symbols used in equations

- (s) after the formula –solid $Cu_{(s)}$
- (g) after the formula –gas $H_{2\,(g)}$
- (l) after the formula -liquid $H_2O_{(l)}$
- (aq) after the formula - dissolved in water, an aqueous solution. $CaCl_{2\,(aq)}$
- used after a product indicates a gas (same as (g)) O_2
- ↓ used after a product indicates a solid (same as (s)) $CaCo_3\downarrow$

Parts of a chemical reaction and symbols

$CH_{4\,(g)} + 2O_{2(g)} \rightarrow CO_{2\,(g)} + 2\,H_2O_{(g)}$

Reactants- starting materials yeilds/ makes Products- ending materials

(g) Gas (s) solid (l) liquid (aq) aqueous- dissolved in water

gas product solid product (when above the arrow) heated

Anything written above the arrow is a catalyst (makes reaction go faster)

Subscripts represent # atoms in molecule and CAN NOT be changed

Coefficent- number in front of formula represents number of molecules in reaction

Summary of Symbols

Reactants and Products	
Symbol	***Meaning***
(*s*) or (*cr*)	solid or crystal
(*l*)	liquid
(*g*)	gas
(*aq*)	in aqueous solution (dissolved in water)
$\downarrow$	solid precipitate product forms
$\uparrow$	gaseous product forms

Reaction Conditions	
Symbol	***Meaning***
$\longrightarrow$	"produces" or "yields," indicating result of reaction
$\rightleftharpoons$	reaction in which products can re-form into reactants; final result is a mixture of products and reactants
$\xrightarrow{\Delta}$ or $\xrightarrow{\text{heat}}$	reactants are heated
$\xrightarrow{1.0 \times 10^8\ \text{kPa}}$	pressure at which reaction is carried out
$\xrightarrow{0^\circ\text{C}}$	temperature at which reaction is carried out
$\xrightarrow{\text{Pd}}$	chemical formula of a catalyst added to speed up a reaction
$\xrightarrow{e^-}$	electrolysis

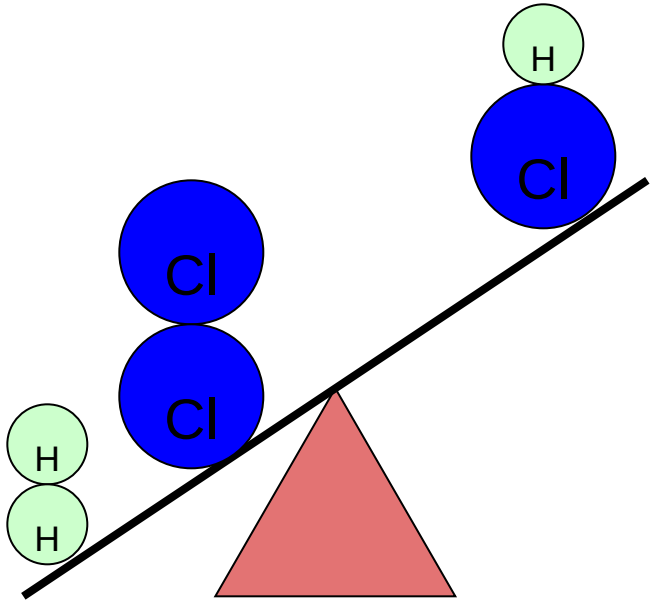
Law of Conservation of Mass

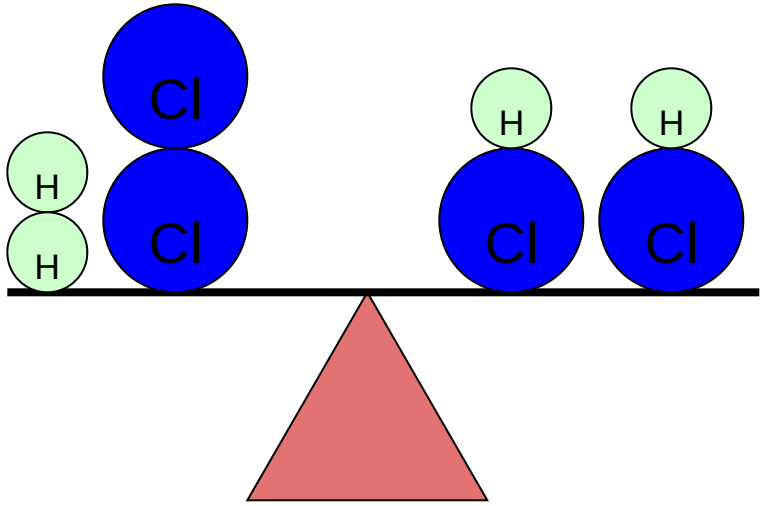
- States that *matter is neither created nor destroyed in a chemical reaction*
  - Means that all atoms present in the reactants must be accounted for among the products
    - There must be the same number and type of atom on each side of the chemical equation
- This means that we must balance chemical equations

$$C_3H_8(g) + O_2 \rightarrow CO_2(g) + H_2O(l)$$

$$C_3H_8(g) + \mathbf{5}O_2 \rightarrow \mathbf{3}CO_2(g) + \mathbf{4}H_2O(l)$$

Unbalanced and Balanced Equations





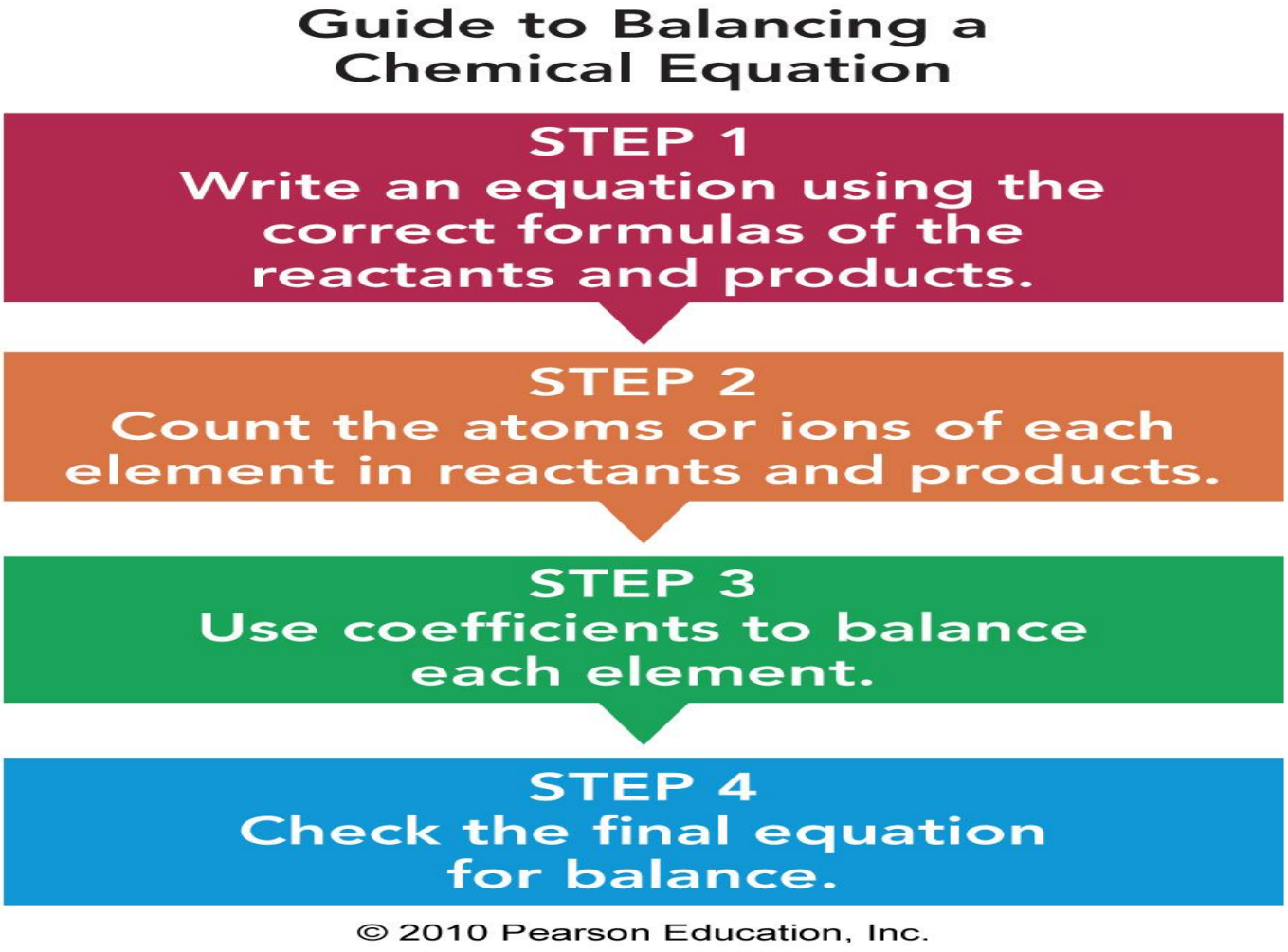
H2 + Cl2 → HCl (unbalanced)

H2 + Cl2 → 2 HCl (balanced)

	reactants	products
H	2	1
Cl	2	1

	reactants	products
H	2	2
Cl	2	2

Guide to Balancing Equations



Balancing Chemical Equations

STEP 1 Write the equation with the correct formulas.

$N_2(g) + H_2(g) \longrightarrow NH_3(g)$

STEP 2 Determine if the equation is balanced.

No, not all of the atoms are balanced.

2N	1N
2H	3H

STEP 3 Balance with coefficients in front of formulas.

Balance N

$N_2(g) + H_2(g) \longrightarrow \mathbf{2}NH_3(g)$

Balancing Chemical Equations (continued)

STEP 3 (continued)

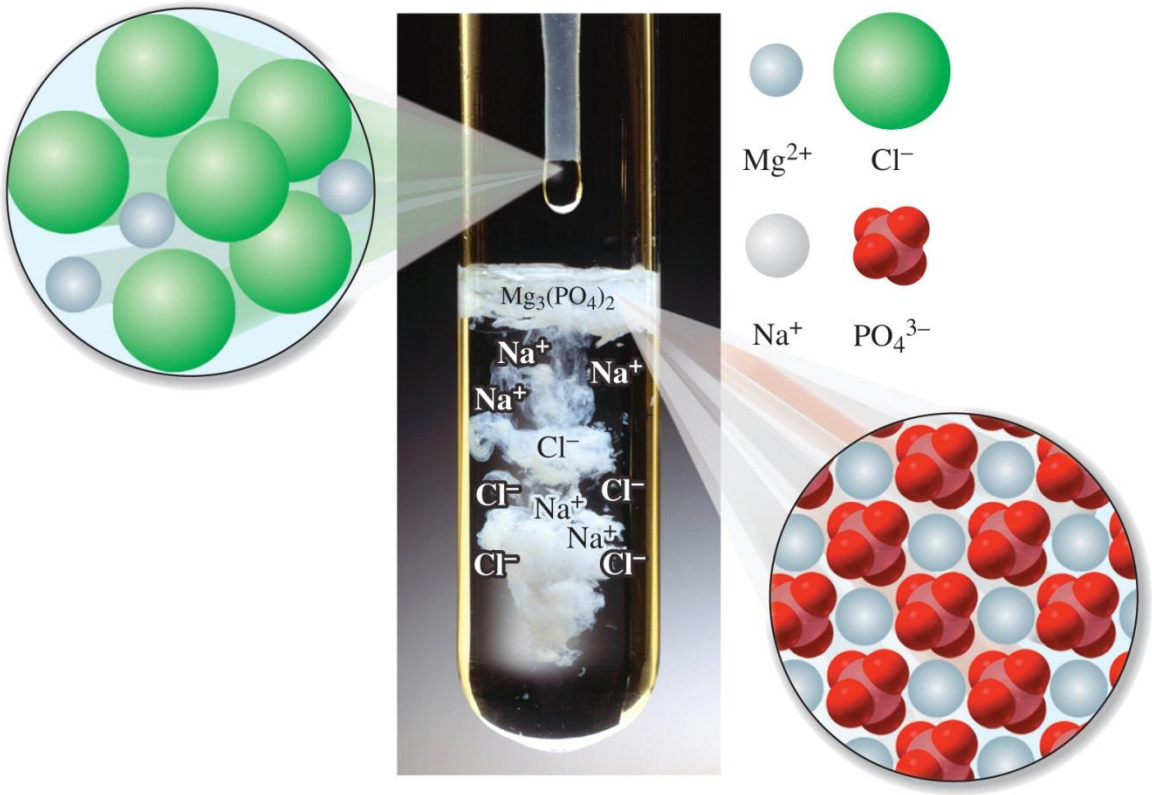
Balance H

$N_2(g) + \mathbf{3}H_2(g) \rightarrow 2NH_3(g)$

STEP 4 Check that atoms of each element are equal in reactants and products.

2N	=	2N
6H	=	6H

Equations with Polyatomic Ions



$$2Na_3PO_4(aq) + 3MgCl_2(aq) \longrightarrow 1Mg_3(PO_4)_2(s) + NaCl(aq)$$

Example 1

Please balance the following equations:

$N_2(g) + F_2(g) \rightarrow NF_3(g)$

$KI(aq) + Pb(NO_3)_2(aq) \rightarrow KNO_3(aq) + PbI_2(s)$

$N_2(g) + \mathbf{3}F_2(g) \rightarrow \mathbf{2}NF_3(g)$

$\mathbf{2}KI(aq) + Pb(NO_3)_2(aq) \rightarrow \mathbf{2}KNO_3(aq) + PbI_2(s)$

Coefficients & Moles

- Coefficients in a chemical equation represent the mole ratio of the reactants and products in a chemical reaction.
  - One can think if it as representing the *recipe* of the chemical reaction.
- More on this in Unit 9 on Stoichiometry

–Making a bicycle requires all parts to be placed in the correct order without losing or gaining parts

–The numbers are called **coefficients**—small whole numbers that are placed in front of the formulas in an equation in order to balance it.

–This is a balanced equation for making a bicycle.

$$F + 2W + H + 2P \longrightarrow FW_2HP_2$$

Converting Word Equations into Balanced Formula Equations

- Chemical equations can be represented in words and as formulas.
- If a word equation is given, it should be converted into a *balanced* formula equation.

Solid ammonium carbonate decomposes to yield ammonia gas, water vapor, and carbon dioxide gas

$$(NH_4)_2CO_3(s) \rightarrow NH_3(g) + H_2O(g) + CO_2(g)$$

$$(NH_4)_2CO_3(s) \rightarrow 2NH_3(g) + H_2O(g) + CO_2(g)$$

Types of Reactions

- There are five types of chemical reactions we will talk about:
  1. Synthesis reactions
  2. Decomposition reactions
  3. Single displacement reactions
  4. Double Replacement reactions
  5. Combustion reactions
- You need to be able to identify the type of reaction and predict the product(s)

Steps to Writing Reactions

- Some steps for doing reactions

Identify the type of reaction

Predict the product(s) using the type of reaction as a model

Write the formulas for the compounds

Use Coefficients to Balance it ☺

Don’t Forget>Diatomic Elements

- Certain elements exist in pairs- diatomic elements
- Super 7-
- Form a seven, there are seven of them, and it begins with nitrogen with the atomic number of 7

  In a compound, it can’t be a diatomic element because it’s not an element anymore, it’s a compound!

- H_2

  N_2 O_2 F_2

  Cl_2

  Br_2

  I_2

How to recognize which type

- Look at the reactants
  - Element(E), Compound(C)
- E + E — Synthesis
- C — Decomposition
- E + C — Single replacement
- C + C — Double replacement

Redox

- Look at the Products
- $CO_2 + H_2O$ — Combustion

Examples

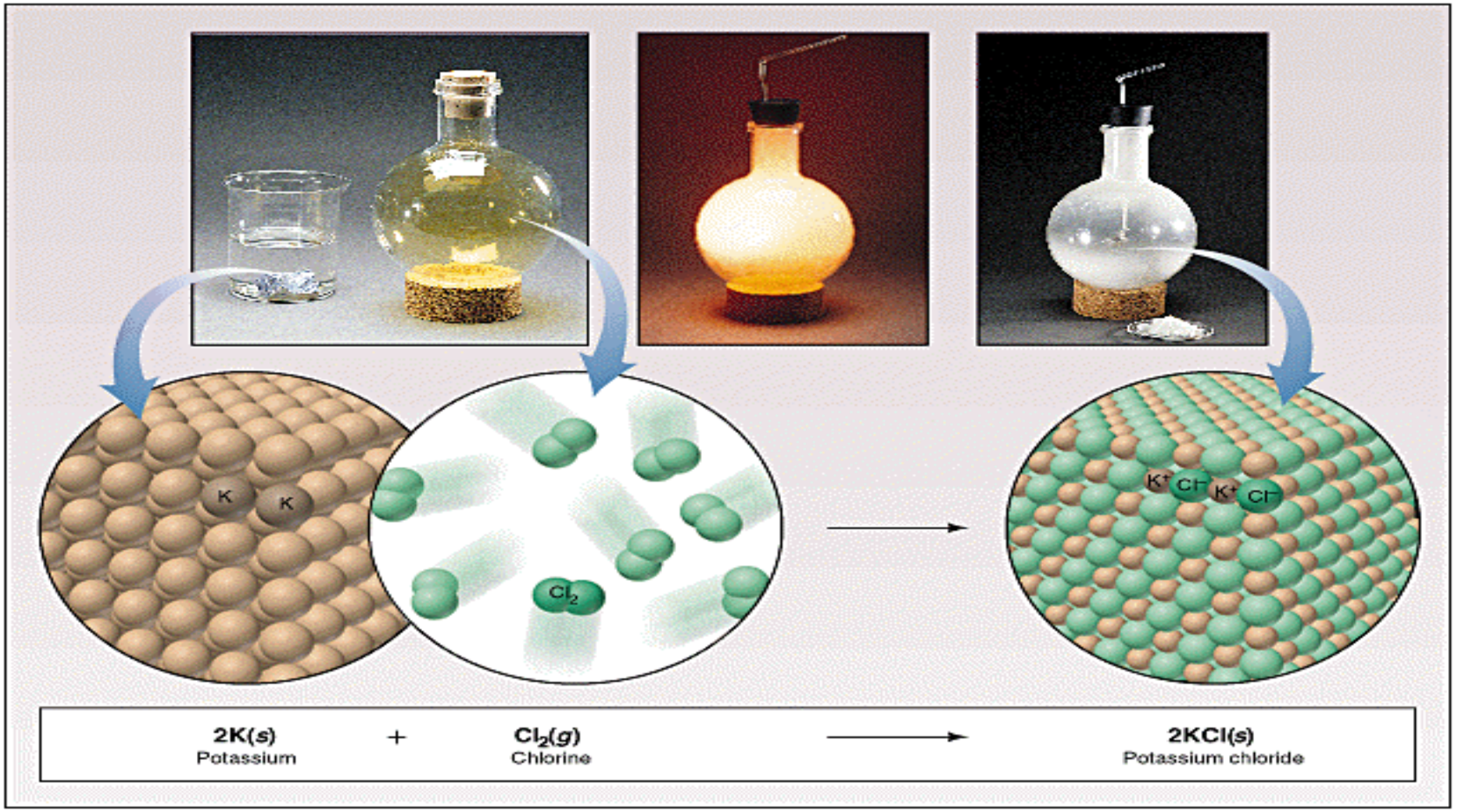
- $H_2 + O_2 \rightarrow$ Synthesis
- $H_2O \rightarrow$ Decomposition
- $AgNO_3 + NaCl \rightarrow$ Double replacement
- $Zn + H_2SO_4 \rightarrow$ Single replacement
- $HgO \rightarrow$ Decomposition
- $KBr + Cl_2 \rightarrow$ Single replacement
- $Mg(OH)_2 + H_2SO_3 \rightarrow$ Double replacement

Examples

- $HNO_3 + KOH \rightarrow$ Double replacement
- $CaPO_4 \rightarrow$ Decomposition
- $AgBr + Cl_2 \rightarrow$ Single replacement
- $Zn + O_2 \rightarrow$ Synthesis
- $HgO + Pb \rightarrow$ Single replacement
- $Cu(OH)_2 + KClO_3 \rightarrow$ Double replacement

Synthesis Reactions

- A + B → AB



1. Synthesis Reactions

- **Synthesis reactions** occur when two substances (generally **elements**) combine and form a compound.
  (Sometimes these are called combination, direct union or addition reactions.)

reactant + reactant → 1 product

- Basically: A + B → AB

- Example: $2H_2 + O_2 \rightarrow 2H_2O$
- Example: $C + O_2 \rightarrow CO_2$

Practice

- *Predict the products. Write and balance the following synthesis reaction equations.*
- Sodium metal reacts with chlorine gas

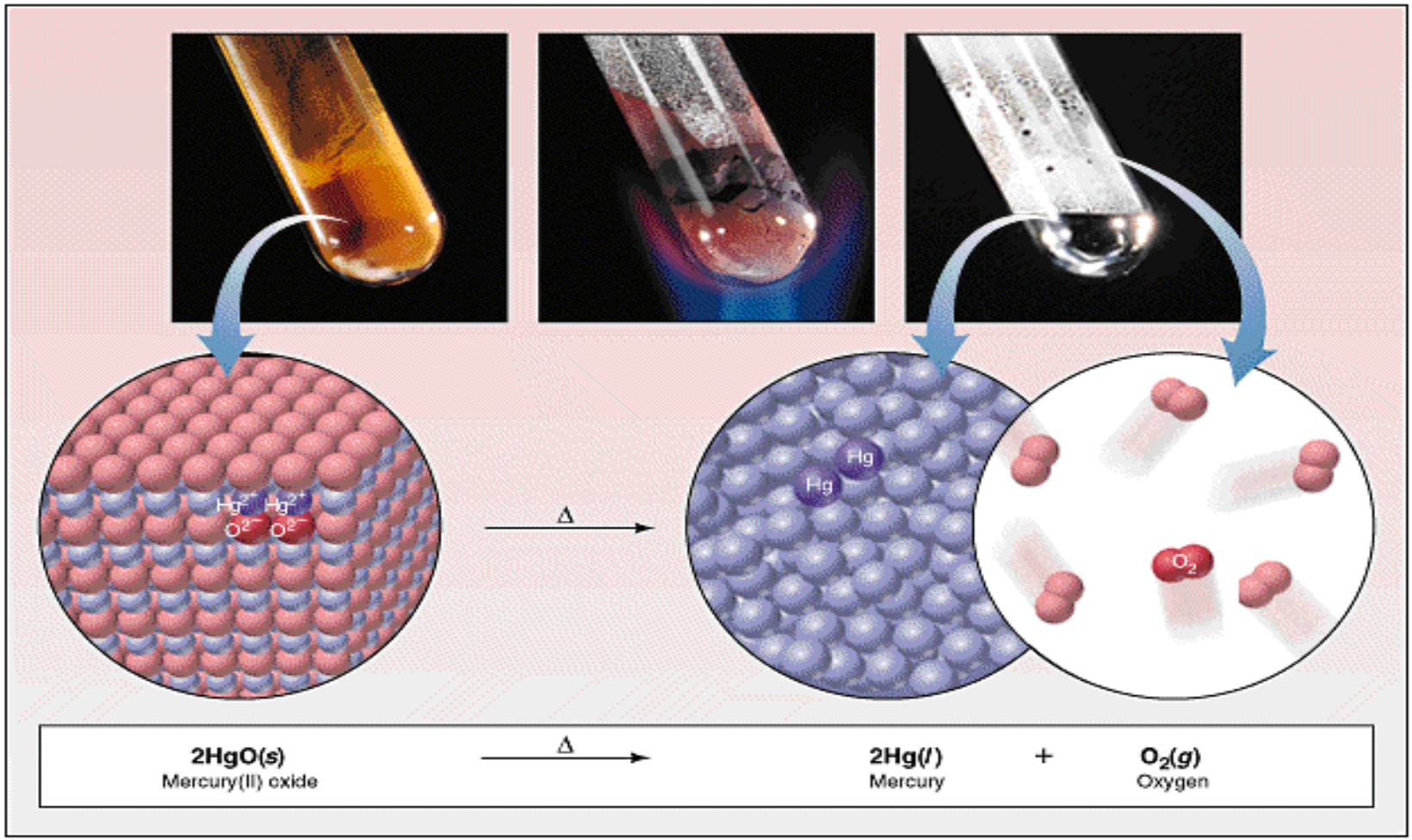
  $Na_{(s)} + Cl_{2(g)} \rightarrow$
- Solid Magnesium reacts with fluorine gas

  $Mg_{(s)} + F_{2(g)} \rightarrow$
- Aluminum metal reacts with fluorine gas

  $Al_{(s)} + \ F_{2(g)} \rightarrow$

Decomposition Reactions

AX→ A + X

- 

3. Decomposition Reactions

- **Decomposition reactions** occur when a compound breaks up into the elements or in a few to simpler compounds

    - **1 Reactant → Product + Product**
        - In general: AB → A + B
- Example: $2\ H_2O \rightarrow 2H_2 + O_2$

- Example: $Mg(ClO_3)_2 \rightarrow MgCl_2 + 3\ O_2$

Decomposition Exceptions

- Carbonates and chlorates are special case decomposition reactions that do not go to the elements.
  - Carbonates (CO_3^{2-}) decompose to carbon dioxide and a metal oxide
    - Example: $CaCO_3 \rightarrow CO_2 + CaO$

Chlorate Decomposition

- Chlorates (ClO_3^-) decompose to oxygen gas and a metal chloride

- Example: $2\ Al(ClO_3)_3 \rightarrow 2\ AlCl_3 + 9\ O_2$

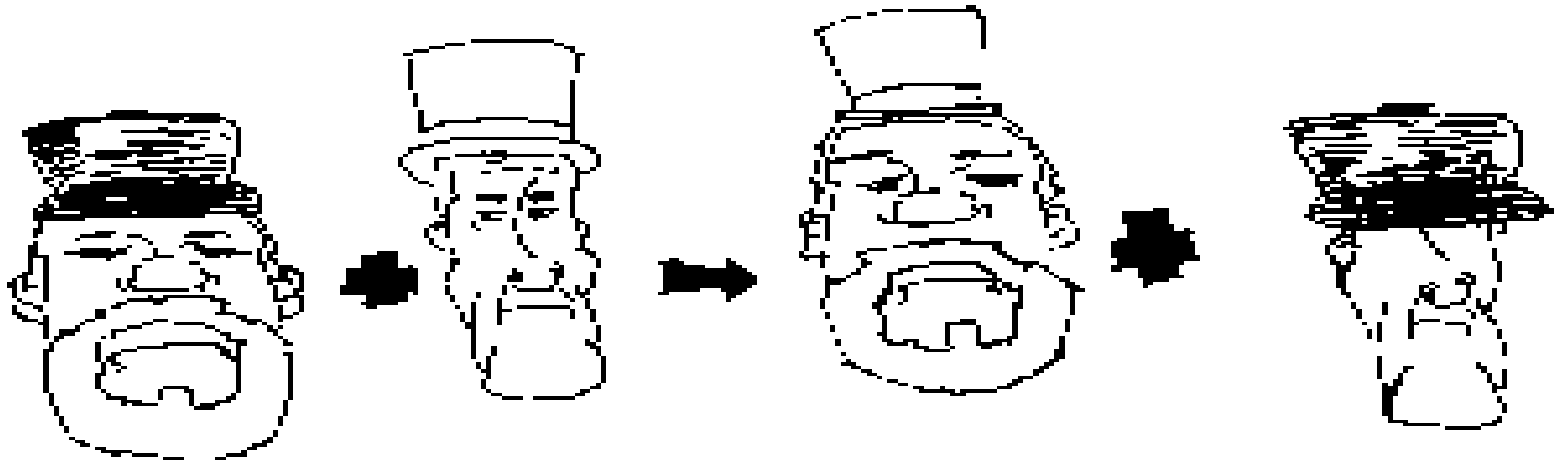
Note:

- There are other special cases, but we will not explore those in Chemistry I

4. Double Replacement Reactions

- **Double Replacement Reactions** occur when a metal replaces a metal in a compound and a nonmetal replaces a nonmetal in a compound

- $Ax + By \rightarrow Ay + Bx$



To Double Replace or Not to Double Replace? That is the Question?

- Will only happen if one of the products
  - doesn't dissolve in water and forms an insoluble solid (s), precipitate (ppt).
  - or is a gas that bubbles out.
  - or water forms, H_2O (neutralization reaction).

Practicing the Replacement

Lead(II) Nitrate(aq) + Calcium Bromide(aq) ➔

Potassium Sulfate(aq) + Silver Nitrate(aq) ➔

Hydrogen Chlorate(aq) + Sodium Hydroxide(aq) ➔

Practicing the Replacement

Lead(II) Nitrate(aq) + Calcium Bromide(aq) ➔Calcium Nitrate + Lead(II) Bromide

Potassium Sulfate(aq) + Silver Nitrate(aq) ➔ Silver Sulfate + Potassium Nitrate

Hydrogen Chlorate(aq) + Sodium Hydroxide(aq) ➔ Sodium Chlorate + Hydrogen Hydroxide

Solubility Rules Practice

Predict whether each of the following will be soluble (aq) or an insoluble ppt (s):

- KCl
- Na_2SO_4
- $CaSO_4$
- $AgSO_4$
- Na_2CO_3
- MgS

Solubility Rules Practice

- $KCl_{(aq)}$
- $Na_2SO_{4(aq)}$
- $CaSO_{4(s)}$
- $AgSO_{4(s)}$
- $Na_2CO_{3(aq)}$
- $MgS_{(s)}$

Predicting Phases

Lead(II) Nitrate(aq) + Calcium Bromide(aq) ➔Calcium Nitrate + Lead(II) Bromide

Potassium Sulfate(aq) + Silver Nitrate(aq) ➔ Silver Sulfate + Potassium Nitrate

Hydrogen Chlorate(aq) + Sodium Hydroxide(aq) ➔ Sodium Chlorate + Hydrogen Hydroxide

Predicting Phases

Lead(II) Nitrate(aq) + Calcium Bromide(aq) ➔ Calcium Nitrate(aq) + Lead(II) Bromide(s)

Potassium Sulfate(aq) + Silver Nitrate(aq) ➔ Silver Sulfate(s) + Potassium Nitrate(aq)

Hydrogen Chlorate(aq) + Sodium Hydroxide(aq) ➔ Sodium Chlorate(aq) + Hydrogen Hydroxide(l)

Convert to Balanced Formula Equations

Lead(II) Nitrate(aq) + Calcium Bromide(aq) ➔ Calcium Nitrate(aq) + Lead(II) Bromide(s)

$Pb(NO_3)_2(aq) + CaBr_2(aq) \rightarrow Ca(NO_3)_2(aq) + PbBr_2(s)$

Potassium Sulfate(aq) + Silver Nitrate(aq) ➔ Silver Sulfate(s) + Potassium Nitrate(aq)

$K_2SO_4(aq) + 2AgNO_3(aq) \rightarrow Ag_2SO_4(s) + 2KNO_3(aq)$

Hydrogen Chlorate(aq) + Sodium Hydroxide(aq) ➔ Sodium Chlorate(aq) + Hydrogen Hydroxide(l)

$HClO_3(aq) + NaOH(aq) \rightarrow NaClO_3(aq) + HOH(l)$

Aqueous Solutions

- Aqueous ionic solutions exist as *all free ions* in solution.
- Free ions in solution can conduct electricity
- Solutions that conduct electricity are called *electrolytes.*

Total Ionic Equations

- Once you write the molecular equation (synthesis, decomposition, etc.), you should check for reactants and products that are soluble or insoluble
- We usually assume the reaction is in water
- We can use a solubility table to tell us what compounds dissolve in water.
- If the compound is soluble (does dissolve in water), then splits the compound into its component ions
- If the compound is insoluble (does NOT dissolve in water), then it remains as a compound

Total Ionic Equations

Molecular Equation:

$K_2CrO_4 + Pb(NO_3)_2 \rightarrow PbCrO_4 + 2\ KNO_3$

Soluble Soluble Insoluble Soluble

Total Ionic Equation:

$2\ K^+ + CrO_4^{-2} + Pb^{+2} + 2\ NO_3^- \rightarrow$

$PbCrO_4\ (s) + 2\ K^+ + 2\ NO_3^-$

Total Ionic Equations

- Any aqueous ionic compounds are written as ions while pure substances, solids, liquids, and gases, are not.
  - Ions must show the proper charge and number of ions.

$Pb(NO_3)_2(aq) + CaBr_2(aq) \rightarrow Ca(NO_3)_2(aq) + PbBr_2(s)$

$Pb^{2+}(aq) + 2NO_3^{1-}(aq) + Ca^{2+}(aq) + 2Br^{1-}(aq) \rightarrow$

$Ca^{2+}(aq) + 2NO_3^{1-}(aq) + PbBr_2(s)$

Net Ionic Equations

- These are the same as total ionic equations, but you should cancel out ions that appear on BOTH sides of the equation

Total Ionic Equation:

$2\ K^{+} + CrO_4^{-2} + Pb^{+2} + 2\ NO_3^{-} \rightarrow$

$PbCrO_4\ (s) + 2\ K^{+} + 2\ NO_3^{-}$

Net Ionic Equation:

$CrO_4^{-2} + Pb^{+2} \rightarrow PbCrO_4\ (s)$

Spect Ions K^{+} , NO_3^{-1}

Net Ionic Equations

- Try this one! Write the molecular, total ionic, and net ionic equations for this reaction: Silver nitrate reacts with Lead (II) Chloride in hot water.

  Molecular:

  Net Ionic:

Formation of Precipitate

Check Solubility Chart for products!

- Calcium Nitrate $_{(aq)}$ + Lithium Phosphate $_{(aq)}$ →

  Calcium Phosphate (s)+ Lithium Nitrate (aq)

Bal Eq:

$3\ Ca(NO_3)_{2(aq)} + 2\ Li_3PO_{4(aq)} \rightarrow Ca_3(PO_4)_{2(S)} + 6\ LiNO_{3(aq)}$

Net Ionic Equation:

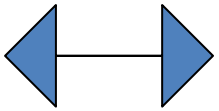
$3\ Ca^{+2}_{(aq)} + 2\ PO_4^{-3}{}_{(aq)} \rightarrow Ca_3(PO_4)_{2(S)}$

Spectators:

Li^{+}_{AQ} / NO_3- (aq)

Neutralization!

Formation of Hydrogen Hydroxide Dash on your table

- Hydrogen Chloride (aq) + Sodium Hydroxide$_{(AQ)}$ →
- Hydrogen Hydroxide (l) + Sodium Chloride (aq)
- Bal Eq: HCl (aq) + NaOH (aq) → H_2O (l) + NaCl (aq)
- Net ionic : H_3O^+ (aq) + OH- (aq)  2 H_2O (l)
- Spectators: Na^+ (aq) , Cl – (aq)

Formation of a gas !

When one of the products forms hydrogen carbonate

- *Hydrogen Carbonate decomposes quickly to water and carbon dioxide! (It is a dash on your table!)*

- Lithium Carbonate $_{(aq)}$ + Hydrogen Chloride$_{(aq)}$ →

Lithium Chloride $_{(aq)+}$ water $_{(l)}$ + Carbon Dioxide $_{(g)}$

Bal Eq:

$$3\ Li_2CO_{3(aq)} + 2\ H_3PO_{4(aq)} \rightarrow 2\ Li_3PO_{4aq)} + 3\ H_2O_{(l)} + 3\ CO_{2(g)}$$

Decomp: $H_2CO_3\ (aq) \rightarrow H_2O_{(l)} + CO_{2(g)}$

Spectators: Li^+_{AQ} & $PO_4^{-3}{}_{(aq)}$

Both Remain Soluble!

- Lithium Nitrate + Sodium Chloride→

Lithium Chloride (aq) + SodiumNitrate (aq)

NO RXN ALL REMAIN AS IONS!

Bal Eq:

$LiNO_3\,(aq) + NaCl\,(aq) \Leftrightarrow LiCl\,(aq) + NaNO_3\,(aq)$

NO NET IONIC!

Spectators : LIST ALL!

$Li^{+}\,(aq)$, $Na^{+}_{(aq)}$, $NO_3^{-1}{}_{(aq)}$ $Cl^{-1}{}_{(AQ)}$

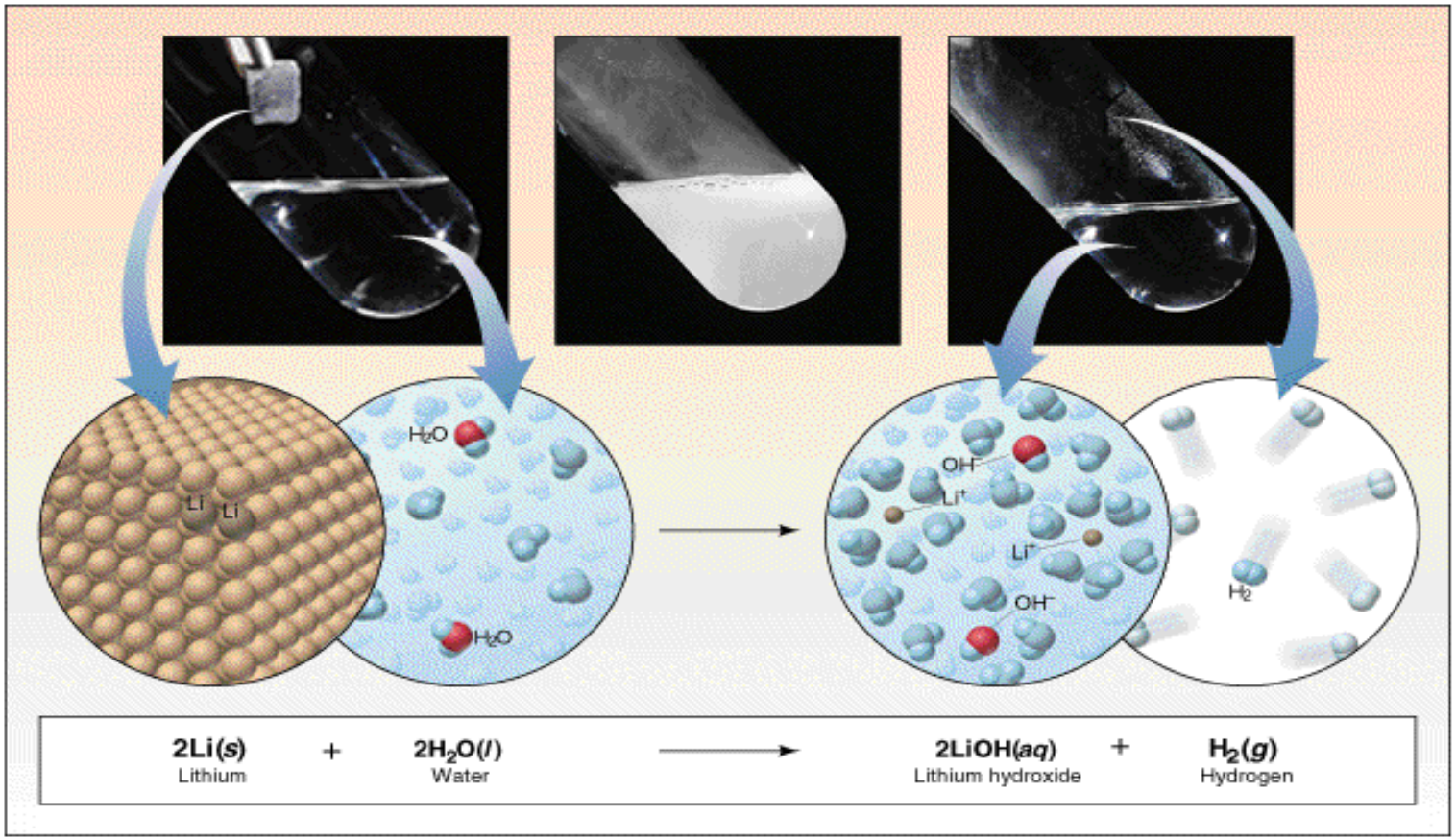
Practice

- Predict the products. Balance the equation

1. $HCl_{(aq)} + AgNO_{3(aq)} \rightarrow$
2. $CaCl_{2(aq)} + Na_3PO_{4(aq)} \rightarrow$
3. $Pb(NO_3)_{2(aq)} + BaCl_{2(aq)} \rightarrow$
4. $FeCl_{3(aq)} + NaOH_{(aq)} \rightarrow$
5. $H_2SO_{4(aq)} + NaOH_{(aq)} \rightarrow$
6. $KOH_{(aq)} + CuSO_{4(aq)} \rightarrow$

Single Replacement Reactions

$A + BX \rightarrow AX + B$



2. Single Replacement Reactions

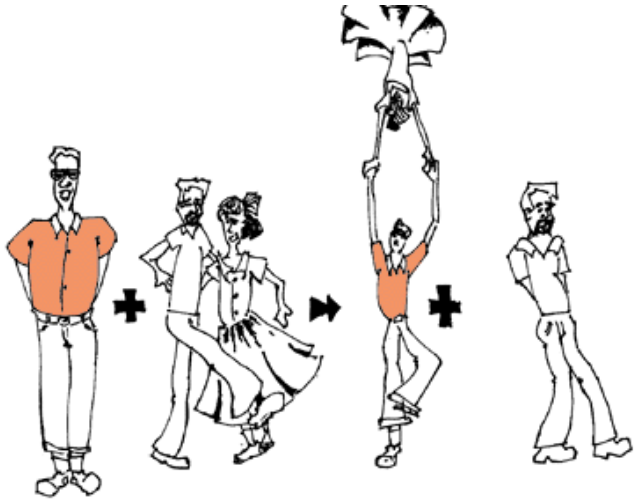
- One element replaces another in a compound.
- A metal can replace a metal (+) **OR**
  a nonmetal can replace a nonmetal (-).
- **element + compound → product + product**

  $A + Bx \rightarrow Ax + B$ (if A is a metal) **OR**

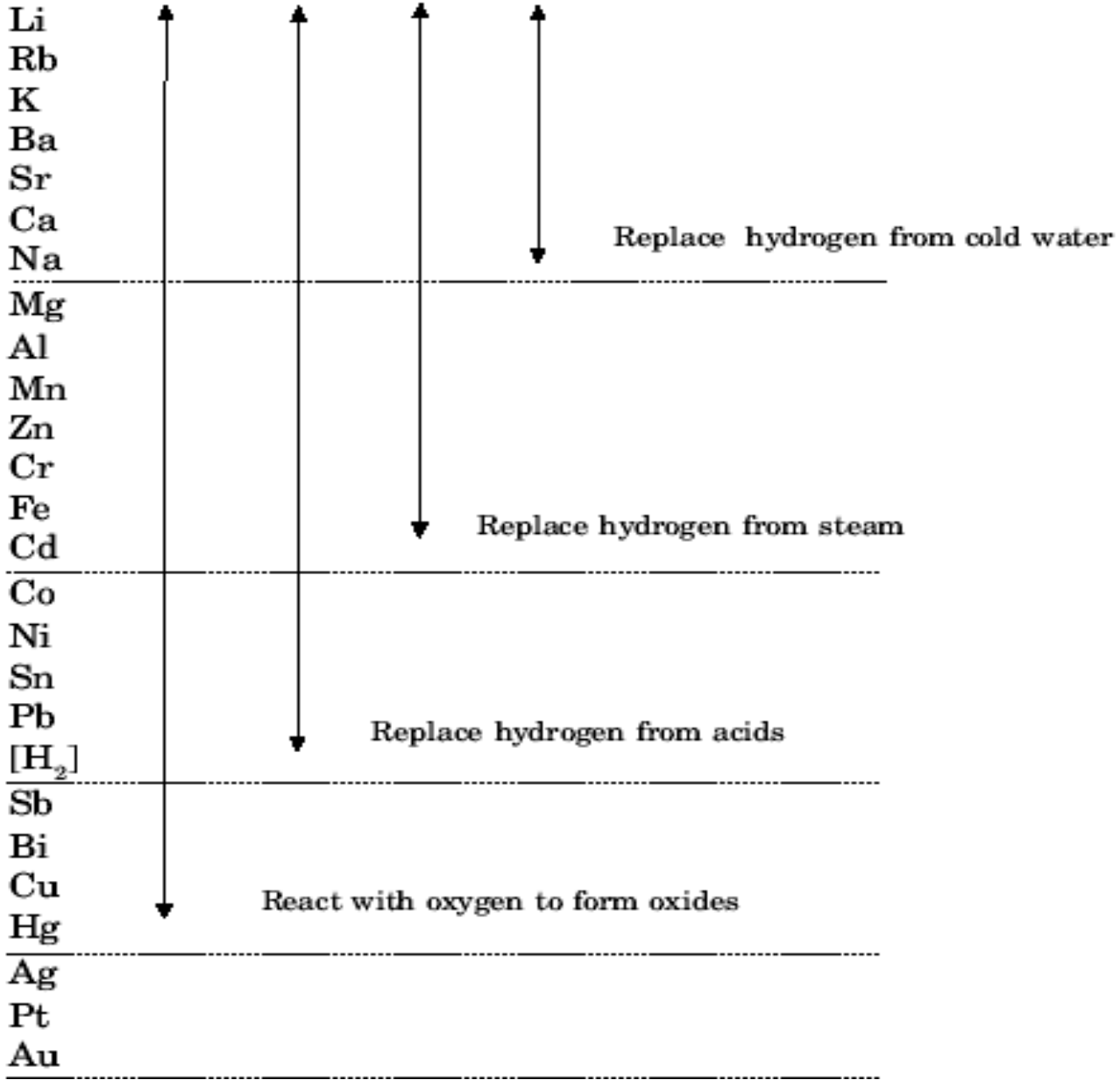
  $y + Bx \rightarrow By + x$ (if y is a nonmetal)

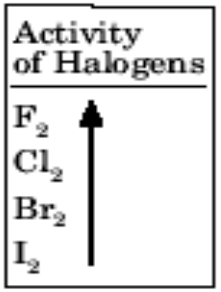
  (remember the cation always goes first!)

When H_2O splits into ions, it splits into H^+ and OH^- (not H+ and O^{-2} !!)



ACTIVITY SERIES of METALS:





Metal Replacing a Metal

- *The elemental metal must be higher in the activity series in order to replace the metal in the compound:*
- Barium + Copper II Nitrate → Barium Nitrate + Copper
- Bal EQ:

$Ba(s) + Cu(NO_3)_2\ (aq) \rightarrow Ba(NO_3)_2\ (aq) + Cu\ (s)$

If NOT no rxn

- Barium + Lithium Nitrate → NO RXN!

Metal + Water

- *MUST READ PARAGRAPH on Activity Series AND DETERMINE STATE OF WATER!!!! Will go with higher form!*

- Lithium + Steam → Lithium Hydroxide $_{(aq)}$ + Hydrogen $_{(g)}$

- Bal Eq:
- 2 Li (s) + 2HOH (g) → 2 LiOH (aq) + $H_{2\ (g)}$

Metal and Acid

read the paragraph and check!

- Acids begin with hydrogen but don't end in hydroxide!
- Zinc metal reacts with aqueous Hydrogen Chloride (hydrochloric acid)

$$Zn_{(s)} + 2HCl_{(aq)} \rightarrow ZnCl_2 + H_{2(g)}$$

Note: Zinc replaces the hydrogen ion in the reaction

Nonmetal- Nonmetal Replacement
check activity series of nonmetal!

- Sodium chloride solid reacts with fluorine gas

$$2\ NaCl_{(s)} + F_{2(g)} \rightarrow 2\ \ NaF_{(s)} + \ Cl_{2(g)}$$

Note that fluorine replaces chlorine in the compound

Practice

- *Predict the products. Then, write and balance the following decomposition reaction equations:*

- Solid Lead (IV) oxide decomposes

$$PbO_{2(s)} \rightarrow \quad Pb + O_2$$

- Aluminum nitride decomposes

$$2\ AlN_{(s)} \rightarrow 2\ Al + N_2$$

Practice

Identify the type of reaction for each of the following synthesis or decomposition reactions, and write the balanced equation:

$N_{2(g)} + O_{2(g)} \rightarrow$

$BaCO_{3(s)} \rightarrow$

Nitrogen monoxide

$Co_{(s)} + S_{(s)} \rightarrow$

(make Co be +3)

$NH_{3(g)} + H_2CO_{3(aq)} \rightarrow$

$NI_{3(s)} \rightarrow$

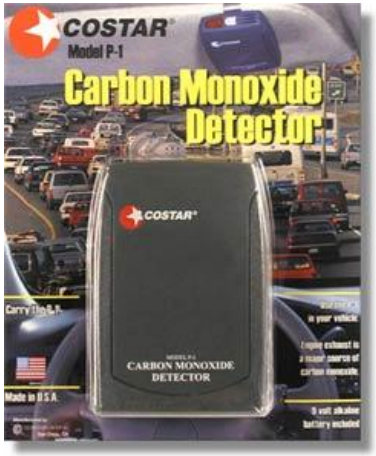
YOU MUST MAKE SURE THE REACTION WILL GO!

- Check the reactivity series of the metals or nonmetal
- Check to see environment (acidic, water, etc)

- Activity Series Sheet

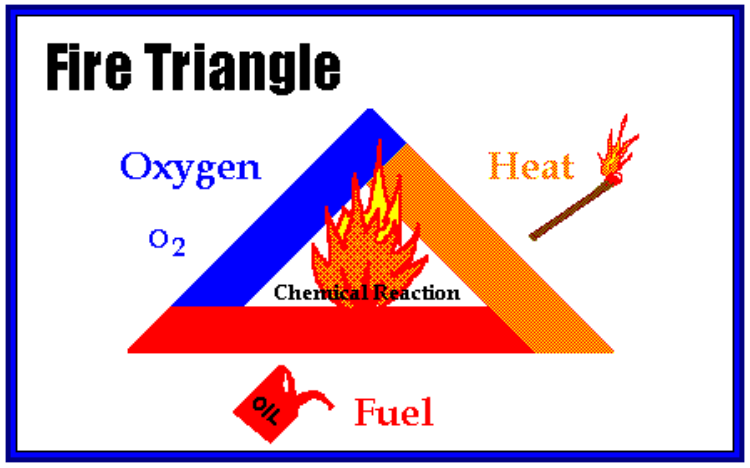
Combustion Reactions

- In general:
  $C_xH_y + O_2 \rightarrow CO_2 + H_2O$
- Products in combustion are ALWAYS carbon dioxide and water. (although incomplete burning does cause some by-products like carbon monoxide)
- Combustion is used to heat homes and run automobiles (octane, as in gasoline, is C_8H_{18})



5. Combustion Reactions

- **Combustion reactions** occur when a hydrocarbon reacts with oxygen gas.
- This is also called burning!!! In order to burn something you need the 3 things in the “fire triangle”:
  1) A Fuel (hydrocarbon)
  2) Oxygen to burn it with
  3) Something to ignite the reaction (spark)



The Tell-Tale Face* of Carbon Monoxide Poisoning

FLU-LIKE SYMPTOMS

1. Headache
2. Fatigue or Weakness
3. Muscle Aches or Pains
4. Nausea or Vomiting
5. Diarrhea or Bloating
6. Confusion or Memory Loss
7. Dizziness or Incoordination
8. Difficult or Shallow Breathing
9. Rapid Heart Beat or Chest Pain
10. Changes in Sensory Sensitivity to Lights, Sounds, Odors, Tastes or Touch

*Edgar Allan Poe's drooping eye and mouth are signs of CO poisoning.

Poe's "Painter Portrait" courtesy of Maryland Historical Society (reversed-image daguerreotype)

AT RISK FROM CARBON MONOXIDE

- CO is most harmful to pregnant women, children, the elderly and anyone with a chronic disorder affecting the blood, brain, heart, lungs or muscles, such as Anemia, Alzheimer's, Angina, Asthma or ALS.
- CO also worsens and may cause Autism, Chronic Fatigue Syndrome, Depression, Fibromyalgia, Impotence, Multiple Chemical Sensitivity, Parkinsonism and Psychiatric Disorders.

FOR MORE INFORMATION:
MCS REFERRAL & RESOURCES
www.mcsrr.org
1-800-466-9320
CARBON MONOXIDE SURVIVORS
www.carbonmonoxide.org

SOURCES OF CARBON MONOXIDE

- External from combustion sources such as vehicles (especially in winter and in buildings with attached garages), furnaces, water heaters, space heaters, ovens, tobacco smoke, explosives and gasoline-powered appliances of all kinds, especially generators and compressors.
- Internal from breakdown of heme and inhaled or ingested dichloromethane, also known as methylene chloride, a common ingredient in solvents and spray cans.

EFFECTS OF CARBON MONOXIDE

- CO binds more tightly than oxygen to heme proteins, especially hemoglobin, myoglobin and cytochromes, impairing function of brain, muscle, liver and other organs.
- CO increases blood sugar, acidosis and polycythemia while decreasing metabolism, blood pressure and body temperature; at high levels, CO may cause coma or death within minutes.
- CO acts as a neurotransmitter modulating heart rate, respiration, blood vessel tone, learning, memory, sexual function and sensory sensitization (or habituation) to odors, light and sounds.
- CO poisoning in pregnancy may result in birth defects, mental retardation and low birth weight.
- Reoxygenation may cause brain lipid peroxidation with chronic neurological effects appearing later

TREATMENT OF CARBON MONOXIDE POISONING

- 100% oxygen daily – hyperbaric if severe or normobaric, humidified and via a partial non-rebreather mask. Continue daily treatments of 1 to 2 hours until symptoms resolve and levels of carboxyhemoglobin, CO in exhaled breath and the arterio-venous gap in the partial pressure of oxygen all return to normal.
- In non-smokers, normal COHb is under 1.6%, normal breath CO is under 4ppm, and the normal arterio-venous P02 gap is over 60 mmHg (venous sample drawn from antecubital fossa without a tourniquet).

Combustion Reactions

Edgar Allen Poe's drooping eyes and mouth are potential signs of CO poisoning.

Combustion

- Example
  - $C_5H_{12} + 8O_2 \rightarrow 5\ CO_2 + \ H_2O6$
- Write the products and balance the following combustion reaction:
  - $C_{10}H_{22} + \ O_2 \rightarrow$

Mixed Practice

- State the type, predict the products, and balance the following reactions:

1. $BaCl_2 + H_2SO_4 \rightarrow$
2. $C_6H_{12} + O_2 \rightarrow$
3. $Zn + CuSO_4 \rightarrow$
4. $Cs + Br_2 \rightarrow$
5. $FeCO_3 \rightarrow$