1) Write the formulas for the following
   a) Calcium nitride          c) Lithium hydroxide
   b) Iron (III) sulfide       d) Sulfuric acid

2) Solve for protons, neutrons, and electrons for the bromide ion.

3) Write the electron configuration for Aluminum
CHEMICAL REACTIONS
DEF: A graph of pressure versus temperature.

At the triple point all phases exist.

Above the critical point, a substance can no longer be a liquid.

Normal melting point & boiling point: m.p. and b.p. at 1 atm
Phase Diagrams

Phase Diagram for Carbon Dioxide

http://www.youtube.com/watch?v=zSwG59d8OCc
What are some indicators?
- Development of Gas
- Color change
- Formation of a precipitate (ppt)
- Release or absorption of energy. (Heat or Light)
  - Endothermic - absorbs energy
  - Exothermic - releases energy
CHEMICAL REACTIONS

- A change in which one or more substances are converted into new substances

http://www.youtube.com/watch?v=aC-KOYQslvU
There are REACTANTS and PRODUCTS.

2Na + Cl₂ → 2NaCl

Sodium and chlorine are the ________ while sodium chloride (table salt) is the ________.
We write the equation to DESCRIBE the chemical reaction.

\[ \text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O} \]
What do you think the (g) means?

\[
\text{CH}_4(g) + 2\text{O}_2(g) \rightarrow \text{CO}_2(g) + 2\text{H}_2\text{O}(g)
\]
CHEMICAL REACTIONS

Need to know:
- Solid (s)
- Liquid (l)
- Gas (g)
- Aqueous = dissolved in water (aq)
- → = yields or produces or forms
Warm Up: you will need the reference table for ALL of these

Normal Melting Point occurs at _______ atm and ________ kPa (hint: standard pressures!)

Which has a greater frequency? Red or blue?

Determine the isotope that has 47 protons and 62 neutrons.
We use COEFFICIENTS to **balance** chemical equations.

Why do we balance them?

- The law of conservation of mass - mass cannot be created or destroyed, only rearranged
- [http://www.youtube.com/watch?v=J5hM1DxaPLw&list=UUAEtajcuhQ6an9WEzY9LEMQ](http://www.youtube.com/watch?v=J5hM1DxaPLw&list=UUAEtajcuhQ6an9WEzY9LEMQ)
- ***When balancing equations you can NEVER change the subscripts of a compound, you can ONLY change the coefficients.***
coefficients

\[ 2H_2 + O_2 \rightarrow 2H_2O \]

reactants \hspace{2cm} products
Balance the following equation.

\[ \underline{\text{__KClO}_3} \rightarrow \underline{\text{__KCl}} + \underline{\text{__O}_2} \]
BALANCING EXAMPLES

- \( \_ \_ \text{H}_2 + \_ \_ \text{O}_2 \rightarrow \_ \_ \text{H}_2\text{O} \)

- \( \_ \_ \text{Fe} + \_ \_ \text{Cl}_2 \rightarrow \_ \_ \text{FeCl}_3 \)

- \( \_ \_ \text{Cu} + \_ \_ \text{AgNO}_3 \rightarrow \_ \_ \text{Ag} + \_ \_ \text{Cu(NO}_3\text{)}_2 \)
You CANNOT change the subscripts, but you CAN change the coefficient by placing it at the front of the element or compound.
Try these!

- Sodium chloride and lead (II) nitrate are combined to make lead (II) chloride and sodium nitrate.

- Iron and chlorine react to produce iron (III) chloride

- When chlorine gas reacts with methane, carbon tetrachloride and hydrogen chloride are produced.
5 Types of Chemical Reactions

- Synthesis
- Decomposition
- Single replacement
- Double replacement
- Combustion
SYNTHESIS REACTIONS

- A chemical reaction where two or more compounds react to produce **ONE PRODUCT**!
- Two compounds combine to make **ONE** new substance.
CHEMICAL REACTIONS

- $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$

- Hydrogen plus oxygen (gas) yields water.
- This is a SYNTHESIS REACTION.
SYNTHESIS REACTION

Fe + O₂ → FeO₂

http://www.youtube.com/watch?v=A5H6DVe5FAI
Types of Synthesis Reactions

- Binary compounds
- Metal oxide and water
- Non metal oxide and water
DECOMPOSITION REACTION - A REACTION IN WHICH ONE REACTANT BREAKS DOWN INTO TWO OR MORE PRODUCTS

\[ \text{FeO}_2 \rightarrow \text{Fe} + \text{O}_2 \]

http://www.youtube.com/watch?v=zrg8XlHEDJ8
http://www.youtube.com/watch?v=cLz2RUS23XA&list=UUAEtajcuhQ6an9WEzY9LEMQ
TYPES OF DECOMPOSITION REACTIONS

- Binary
- Metallic carbonate
- Metallic hydroxide
- Metallic chlorates
BALANCING REACTIONS

- $\text{Mg} + \text{P}_4 \rightarrow \text{Mg}_3\text{P}_2$

- Is this synthesis or decomposition?
**BALANCING REACTIONS**

- Synthesis or decomposition?
- Balance:

  - \( \text{____Cu} + \text{_____O}_2 \rightarrow \text{_____Cu}_2\text{O} \)
Chemical Reactions

Tell me the type of reaction, the product(s), and balance the equation.

1. Na + S \rightarrow _______
2. Zn + O_2 \rightarrow _______
3. Ca(OH)_2 \rightarrow _______
4. CaCO_3 \rightarrow _______
5. Mg + O_2 \rightarrow _______
A single replacement reaction is a reaction in which one of the pieces of a reactant are replaced with a lone element (or diatomic molecule) to create a new compound and element (or diatomic molecule).

They are “switching” places.
When predicting single replacement reactions you must use the activity series to determine if a reaction will occur or not.

The higher an element is on the activity series the more reactive the element is.

In order for a reaction to occur the LONE (nonbonded) element must be more reactive than the element it would try to replace in a compound.

If the element that is nonbonded is NOT more reactive than the reaction does not occur (DNR)
ACTIVITY SERIES of Halogens:

- F₂
- Cl₂
- Br₂
- I₂

ACTIVITY SERIES of Metals

- Li
- Rb
- K
- Ba
- Sr
- Ca
- Na
- Mg
- Al
- Mn
- Zn
- Cr
- Fe
- Cd
- Co
- Ni
- Sn
- Pb
- [H₂]
- Sb
- Bi
- Cu
- Hg
- Ag
- Pt
- Au

- Replace hydrogen from cold water
- Replace hydrogen from steam
- Replace hydrogen from acids
- React with oxygen to form oxides
Halogens can also be replaced.

Look at the halogens activity series.

\[ \Box \text{LiCl} + \Box F_2 \rightarrow \Box \text{LiF} + \Box \text{Cl}_2 \]

Predict if the following reaction will occur

\[ \text{CaCl}_2 + \text{Br}_2 \rightarrow \]
**Single Replacement**

- Will these work? If so, what are the products?
  - LiCl + Br₂ →
  - Mn+ HI →
  - AgNO₃ + Li →
  - KNO₃ + Zn →
  - Na + Ca₃(PO₄)₂ →
  - Ag + Cu₃(PO₄)₂ →
  - Al(NO₃)₃ + Mg →
TWO ACTIVITY SERIES:

- Halogens
- Metals
In a double replacement reaction, there are two replacements taking place.

Analyze what happened in the reaction above:
When writing double replacement reactions you must use the solubility rules to determine if a compound is soluble or insoluble.
PRACTICE

- NaCl(aq) + Ca(NO₃)₂(aq) →

- Li₃PO₄(aq) + BaF₂(aq) →

- LiOH(aq) + H₂SO₄(aq) →
COMBUSTION REACTIONS

- A hydrocarbon (any amount of hydrogens combined with any amount of carbons) plus oxygen yields carbon dioxide and water.
  - $\text{CH}_4 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
  - $\text{C}_2\text{H}_8 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
  - $\text{C}_3\text{H}_5 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$

- Let’s Balance!
Ionic equations are used with single and double replacement reactions.

**Reaction:**

\[ 2\text{NaCl (aq)} + \text{Pb(NO}_3\text{)}_2\text{(aq)} \rightarrow \text{PbCl}_2\text{(s)} + 2\text{NaNO}_3\text{(aq)} \]

**Complete Ionic Equation:**

\[ 2\text{Na}^+ \text{(aq)} + 2\text{Cl}^- \text{(aq)} + \text{Pb}^{2-} \text{(aq)} + 2\text{NO}_3^- \text{(aq)} \rightarrow \text{PbCl}_2\text{(s)} + 2\text{Na}^+ \text{(aq)} + 2\text{NO}_3^- \text{(aq)} \]

Separate ONLY the aqueous compounds.
In a reaction, when (aq) is behind a compound, it means dissolved in water.

When this happens the compounds break apart into ions.

Draw this in your notes.
Spectator ions will not be a part of the solid on the products side.
They are the ones that do not help in the reaction; they are on the side lines.

Complete Ionic Equation:
\[2\text{Na}^+ + 2\text{Cl}^- + \text{Pb}^{2+} + 2\text{NO}_3^- \rightarrow \text{PbCl}_2(\text{s}) + 2\text{Na}^+ + 2\text{NO}_3^-\]

The spectator ions in this complete ionic equation would be the \( \text{Na}^+ \) and the \( \text{NO}_3^- \).
For net ionic equations, we take out the spectator ions. (They are just sitting around.)

Complete Ionic Equation:

\[
2\text{Na}^+ (aq) + 2\text{Cl}^- (aq) + \text{Pb}^{2-} (aq) + 2\text{NO}_3^- (aq) \rightarrow \text{PbCl}_2 (s) + 2\text{Na}^+ (aq) + 2\text{NO}_3^- (aq)
\]

Cross out the Spectator Ions

\[
2\text{Na}^+ (aq) + 2\text{Cl}^- (aq) + \text{Pb}^{2-} (aq) + 2\text{NO}_3^- (aq) \rightarrow \text{PbCl}_2 (s) + 2\text{Na}^+ (aq) + 2\text{NO}_3^- (aq)
\]

Net Ionic Equation:

\[
2\text{Cl}^- (aq) + \text{Pb}^{2+} (aq) \rightarrow \text{PbCl}_2 (s)
\]
Try One.

- Find the Complete and Net Ionic Equations for:
  \[ \text{FeCl}_3(\text{aq}) + \text{Mg(OH)}_2(\text{aq}) \rightarrow \text{MgCl}_2(\text{aq}) + \text{Fe(OH)}_3(\text{s}) \]

Reminder: ALWAYS BALANCE THE EQUATION FIRST!