LAB 3. CHEMICAL REACTIONS:
CHEMICAL PROPERTIES AND EQUATIONS

PURPOSE: To perform and recognize different types of chemical reactions.
To complete and balance chemical equations.
To test the Law of Conservation of Mass.

SAFETY CONCERNS:
Always wear safety goggles. Tie back long hair when using flames.
The heavy metals, Silver, Chromium, and Lead, must be disposed in designated waste containers.

PHYSICAL AND CHEMICAL PROPERTIES:
Each element or compound has unique properties that make it distinguishable from other elements or compounds. Physical properties, such as color, luster, softness, electrical conductivity, the temperature at which it melts or boils, crystal structure etc. are characteristics that are visible or measurable qualities used to identify a substance. Physical changes, such as melting, boiling, or stretching do not affect the identity of the substance, just its form.

Aluminum, Al, for example, is shiny and malleable (it can be physically stretched into wire, rolled into pellets, or pounded into sheets and foil). It conducts heat and electricity but is not magnetic. It has a high melting point (it takes a lot of energy to make it turn from a solid to a liquid) and it is not soluble (doesn’t dissolve) in water. These characteristics are physical properties used to describe aluminum.

Chemical properties are not so obvious. They are determined by how a substance changes or reacts with other substances to form different compounds. When substances react together to create new and different substances we call the change a chemical change or chemical reaction.

Aluminum, Al, for example, chemically undergoes a change (chemical reaction) when put in the presence of hydrochloric acid, HCl. Once reacted, it is no longer aluminum, Al, but has become a new substance, aluminum chloride, AlCl₃. The fact that it reacts with hydrochloric acid is a characteristic chemical property of aluminum. Aluminum chloride is a completely different compound with completely different physical properties than those of the aluminum and hydrochloric acid from which it was made.
**CHEMICAL REACTIONS:**
Not every chemical will react with every other chemical. However, when a chemical reaction does occur there are observable clues that indicate to us that a change has indeed taken place. The following events are measurable or visible indicators that a chemical reaction has occurred:

A. **Gas production** (bubbles appear)
B. **Solid formation** (an insoluble solid, called a precipitate, forms)
C. **Color change**
D. **Temperature change** (a reaction that produces heat is exothermic, a reaction that gets cold is endothermic)

**CHEMICAL EQUATIONS:**
Chemical changes are represented by expressions called chemical equations. (Review the introduction to chemical equations presented in the discussion section of the Lab 1, Burners and Flames.) The chemical equation to describe the reaction of aluminum with hydrochloric acid is as follows:

\[ 2\text{Al}(s) + 6\text{HCl}(aq) \rightarrow 2\text{AlCl}_3(aq) + 3\text{H}_2(g) \]

This chemical equation can be translated into words. The expression reads:

| 2Al\(_{(s)}\) = 2 units (atoms or moles) of solid Aluminum | + = plus (and, combined with) |
| 6HCl\(_{(aq)}\) = 6 units (molecules or moles) of aqueous (dissolved in water) hydrochloric acid | \(\rightarrow\) = yields (gives, results in, produces) |
| 2AlCl\(_{3(aq)}\) = 2 units (molecules or moles) of aqueous Aluminum chloride | + = and (plus) |
| 3H\(_2(g)\) = 3 units (molecules or moles) of hydrogen gas. |

Al and HCl on the left side of the arrow are reactants. \(\rightarrow\) AlCl\(_3\) and H\(_2\) on the right side of the arrow are products.

Not all substances, when placed together, will undergo a chemical change. If nothing new happens (no gas formed, no precipitate formed, no color change, or no temperature change) then we simply write no reaction in place of the products.

**GASES:**
When a gas is formed from a chemical reaction we may be able to identify it by observing its color, odor, and flammability. **Never smell a gas directly** as it may be toxic. If the smell is not obvious then gently waft the fumes toward your nose being very careful not to inhale too much.
The following is a list of the identifying properties of some common gases. Use it to prove the identity of gases that may be produced in your reactions:

<table>
<thead>
<tr>
<th>COMMON GAS</th>
<th>PROPERTIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon dioxide, CO$_2$</td>
<td>Colorless, odorless, and not flammable at all. Large amounts will actually put out a flame so it is used as the gas in standard fire extinguishers.</td>
</tr>
<tr>
<td>Dihydrogen sulfide, H$_2$S</td>
<td>Very toxic. Colorless. Has the odor of rotten eggs.</td>
</tr>
<tr>
<td>Hydrogen, H$_2$</td>
<td>Colorless, odorless, but highly flammable. When a burning splint comes in contact with a test tube of hydrogen it gives a “pop” sound when the gas ignites.</td>
</tr>
<tr>
<td>Nitrogen dioxide, NO$_2$</td>
<td>Red-brown gas with a heavy, burning odor. It is the toxic gas emitted from some factories and causes edema of lung tissue.</td>
</tr>
<tr>
<td>Oxygen, O$_2$</td>
<td>Colorless and odorless. Is necessary for any combustion reaction to occur. If present it will increase the flammability of other substances. A glowing splint will burst into flame in the presence of oxygen.</td>
</tr>
<tr>
<td>Sulfur dioxide, SO$_2$</td>
<td>Toxic gas. Gives off the odor of sulfur when burned.</td>
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**CONSERVATION OF MASS:**

When elements or compounds chemically react to form products, no material (matter) is lost or gained. All of the atoms used as reactants are converted into products. Every atom of every element must be accounted for since they are not destroyed or created, just rearranged and recombined into new things.

The numbers (coefficients) before each formula in a chemical equation indicate how many units of each reactant are being used or how many units of product are formed. When expressing a reaction as a chemical equation we use coefficients to balance the equation as an accounting tool to accurately show that no atoms have been created from nothing or have vanished into nothing.

Because no matter is lost or gained in a chemical change, the total mass of all of the products will be the same as the total mass of all the reactants used. In any chemical reaction mass is maintained or conserved from the beginning to the end. This phenomenon is called the Law of Conservation of Mass.

The mass of an object is a measurement of the quantity of matter it contains. The weight of an object is the measurement of how the force of gravity affects it. A quantity of matter will always have the same mass but may have a different weight at sea level on earth than it does on a mountain, or in space where the gravitational pull is different. Measuring the mass of an object in grams assumes that we are at the constant gravitational pull of our planet.
PROCEDURES:

ACTIONS:

I. CHEMICAL REACTIONS:

1. Metals + Hydrochloric Acid →

A. Obtain 3 large test tubes (labeled Zn, Al, and Cu) equipped with rubber stoppers.¹

B. Pour 3 mLs² of 6M HCl (6 molar hydrochloric acid)³ into each of the 3 tubes.

C. On separate weighing papers measure out about 0.10 grams each of
   - Mossy zinc or zinc shavings (Zn)⁴
   - Aluminum foil or shavings (Al)
   - Copper wire or shavings (Cu)

D. As close to the same time as possible add each of the metal samples into the appropriately marked tubes of HCl and quickly (but loosely⁶) stopper them. Record your observations on the report sheet (Box I #1A, 1B, & 1C).⁷

E. Light a wooden splint by placing it in the flame of a laboratory burner and carefully bring the burning splint right next to the mouth of the Zn/HCl reaction test tube. Remove the stopper and quickly ignite the gas.⁸

F. Repeat the wooden splint ignition test with the tubes of Al/HCl and of Cu/HCl. Record your results.

G. Determine the identity of any gases produced in the reactions.⁹

H. Determine the order of reactivity of these metals with Hydrochloric acid (HCl).

I. Observe the tubes again after about 15 minutes and record your observations.

NOTES:

¹Some glassware has a white patch on which you can mark with pencil to label it’s contents. If there is no white patch you can use a grease pencil to mark directly on the glass.

²You do not need to measure the 3 mLs of HCl exactly in this reaction. You can measure with a graduated cylinder for the first tube and then if the 3 tubes are the same size you can “eye-ball” the level by adding enough to the other tubes so that the level of liquid is the same as in the previously measured 3 mL sample. We are interested in the quality of the reaction not the quantities here.

³Hydrochloric Acid is the acid in your stomach that aids digestion. It is also used in some brands of toilet bowl cleaner. Molarity, M, is a measure of concentration that indicates the number of moles of hydrochloric acid in 1 liter of aqueous solution.

⁴The measurement does not have to be exactly 0.10 grams. Anywhere from 0.08 to 0.12 g (0.1 ± 0.02) is fine. Just record exactly what you have. We want a general knowledge of the amounts so we can compare like quantities of the metals we are using.

⁵Zinc (symbolized Zn) is the metal used in the coating of galvanized materials like nails and buckets. Aluminum (Al) is a light metal used for Copper (Cu) is used for plumbing pipes

⁶The stopper must be loose so that it won’t pop off from any increased pressure in the tube should a gas be produced in the reaction.

⁷Remember that there are several important observations that will indicate that a chemical reaction has taken place:
   - gas production: bubbles will be visible
   - solid formation: cloudiness is evidence of suspended solids
   - color change: observable change not just a lightening of shade by dilution
   - temperature change: observable by touching the outside of the tube with your hands or by placing a thermometer inside.

Indicate which of these, if any, are present. If no reaction is occurring indicate “no reaction”.

⁸If you are not quick enough to ignite the gas then the gas present will escape into the atmosphere and be gone. If this happens just add a little more zinc or aluminum to your HCl and try again.

⁹Refer to the discussion section on Gases at the beginning of this lab chapter to compare the properties of the gas produced with those of the common gases listed.
2. Sodium Bicarbonate + Acetic Acid
   A. To a large test tube add a “large pea” sized scoop of Sodium Bicarbonate (Baking soda = $\text{NaHCO}_3$) and **dissolve it completely** in about $3\text{ mL}$ of water.
   B. Into the tube of dissolved sodium bicarbonate insert a thermometer and make a note of the initial temperature.
   C. Into the tube pour about $2\text{ mL}$s (or $40$ drops) of $5\%$ Acetic Acid (vinegar = $\text{HC}_2\text{H}_3\text{O}_2$) and stopper it loosely. Record your observations on the report sheet (Box I #2).
   D. Test the flammability of the gas using a burning wood splint like you did in #1 and determine the identity of the gas.
   E. Measure the temperature of the final solution and report any changes.

3. Sodium Hydroxide + Acetic Acid
   A. To a large test tube add about $2\text{ mL}$ (or $40$ drops) of $5\%$ Acetic Acid (vinegar = $\text{HC}_2\text{H}_3\text{O}_2$).
   B. Insert a thermometer and note the temperature.
   C. Add an unpopped popcorn kernel sized scoop of solid Sodium Hydroxide (lye or Drano = $\text{NaOH}$). Stir, shake, or swirl to mix.
   D. Record your observations and any temperature changes on the report sheet (Box I #3).

4. Sodium Chloride + Silver Nitrate
   A. To a test tube, enter a pea sized scoop of solid Sodium Chloride (table salt = $\text{NaCl}$) and **dissolve** it in water ($1\text{ mL}$ = about $20$ drops).
   B. Insert a thermometer and observe the temperature.
   C. Drop in about $0.5\text{ mL}$ (10 drops) of $0.1\text{ M}$ Silver Nitrate (“wart remover” or cold sore treatment = $\text{AgNO}_3$).
   D. Record your observations and any temperature changes on the report sheet (Box I #4).
   E. Dispose of waste from this reaction in a designated Silver Waste container.

5. Copper + Silver Nitrate
   A. Place a shiny clean Copper penny or piece of clean copper metal (pennies, plumbing pipes, or heat conduction coating on cooking pans = $\text{Cu}$) into a large test tube or your smallest beaker.
   B. Add about $1\text{ mL}$ (or $20$ drops) of $0.1\text{ M}$ Silver Nitrate (“wart remover” or cold sore treatment = $\text{AgNO}_3$).
   C. Watch and wait and record your observations on the report sheet (Box I #5).
   D. Dispose of waste from this reaction in a designated Silver Waste container.

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10You do not need to measure the $3\text{ mL}$s of water exactly in this reaction. You can estimate $3\text{ mL}$s by comparing the level of liquid in a previously measured $3\text{ mL}$ sample. If the test tubes are the same size then just “eye-ball” the level and that’s close enough here. We are interested in the quality of the reaction not the quantities. As long as the sodium bicarbonate is **completely dissolved** the reaction will show what we need.

11Avoid touching Sodium Hydroxide. If you get some on your hands wash immediately with soap and water. Sodium Hydroxide is a very strong base that is caustic to your skin because it reacts with skin proteins to destroy them. Strong bases like this cause more damage and scarring than do strong acids.

12Silver, Ag, is a heavy metal that can be toxic if ingested in large amounts. We do not want to put silver products down the laboratory drains. It must be disposed of in specially designated waste bottles. Besides being a potentially toxic heavy metal, silver is very expensive and can sometimes be mined from the waste and recycled.

13Tarnished copper can be cleaned by washing in a dilute acid solution such as vinegar (5% acetic acid).

14This is an example of a method to “plate” silver onto copper.
6. **Zinc + Copper (II) Sulfate**
   A. Place a shiny clean Zinc strip or a new galvanized nail into a small test tube.
   B. Add about 1 mL (or 20 drops) of 1.0 M Copper (II) Sulfate (cupric sulfate = an antifungal agent = CuSO$_4$).
   C. Pour off the solution and remove the strip as soon as you see evidence of a reaction on the surface of the Zinc.$^{15}$
   D. Record your observations on the report sheet (Box I #6).$^{7}$

7. **Ammonium Dichromate + Heat**
   A. Into your largest dry test tube scoop enough solid Ammonium Dichromate (used in pyrotechnics, lithography, and photo engraving = (NH$_4$)$_2$Cr$_2$O$_7$) to barely cover the bottom of the tube.
   B. Holding the tube with a test tube clamp pointed away from any people, heat the orange solid in the flame of a laboratory burner just until the reaction starts to get vigorous, then remove it from the heat.
   C. Record your observations on the report sheet (Box I #7).$^{7}$
   D. Dispose of waste from this reaction in a designated Chromium Waste container.$^{18}$

8. **Magnesium + Oxygen**
   A. Do not look directly at this reaction.$^{19}$ Clear the workbench area of any paper or flammable materials near a laboratory burner. Place a beaker of water near the burner.$^{20}$
   B. With a pair of crucible tongs, hold a small strip of Magnesium ribbon (light metal used in “Mag” wheels = Mg) in the hottest part of a burner flame just until the reaction begins. When the reaction starts, remove it from the flame and hold it a foot above the beaker of water.
   C. Record your observations on the report sheet (Box I #8).$^{7}$

9. **Lead (II) Nitrate + Potassium Iodide**
   Proceed to the next page and perform this reaction. You will use this reaction to test the Law of Conservation of Mass as a Scientific Method inquiry following the format given.

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$^{15}$Stop the reaction when you see a brown copper coating on the surface of the zinc. This is an example of a method to “plate” copper onto zinc. If the reaction proceeds too far the metal impurities will continue reacting and turn black.

$^{16}$Be sure the tube is very dry. A wet tube may crack when entered into a flame.

$^{17}$The test tube clamp is different from the crucible tongs. Be sure to use the test tube clamp here as that is less likely to result in a dropped and broken tube.

$^{18}$Chromium, Cr, is a heavy metal that can be toxic if ingested in large amounts. We do not want to put chromium products down the laboratory drains. It must be disposed of in specially designated waste bottles.

$^{19}$The bright light produced from this reaction can damage your eyes similar to looking directly at the sun. Avoid looking directly at the light but turn your head and try to glance out of the corner of your eyes.

$^{20}$Burning magnesium gets extremely hot and fragments can drop from the burning ribbon. The beaker of water is to catch any dropping product that could damage the tabletop.
II. LAW OF CONSERVATION OF MASS:
As you follow the instructions given you will be practicing the scientific method of testing a hypothesis.

You have heard it said that
“**No mass can be lost or gained in a chemical reaction**”

Let’s test this statement by asking the following question:

**QUESTION:**
For the reaction of Lead (II) Nitrate with Potassium Iodide:
Does the total mass of the products equal the total mass of the reactants?

\[
\text{Pb(NO}_3\text{)}_2 + 2\text{KI} \rightarrow \text{PbI}_2 + 2\text{KNO}_3
\]

Or in other words:
Does the reaction of Lead (II) Nitrate with Potassium Iodide obey the Law of Conservation of Mass?

**PROCEDURES:**
1. On the report sheet (IIA) make an educated guess, or **hypothesis**, to answer the above question. Give reasons based on what you have learned so far.

2. Perform the following **experimental procedures** to test your hypothesis.\(^{21}\)

   **Lead (II) Nitrate + Potassium Iodide**
   A. Into a small test tube measure 5 drops (0.25 mL) of 0.1M Lead (II) Nitrate (Pb(NO\(_3\))\(_2\)). Set the tube in a beaker.
   B. Into another small test tube measure 20 drops (1.0 mL) of 0.2M Potassium Iodide (KI). Set the tube in the same beaker as the tube of Lead (II) Nitrate.
   C. Place the beaker containing the 2 tubes of reagents on a **tared** balance and record (IIC) the mass as accurately as the balance will allow.\(^{22}\)
   D. Add the contents of 1 test tube to the other test tube and record your observations. Place both test tubes, (one now empty and the other containing the reaction product) back into the beaker and mass it again on the same electronic balance.\(^{24}\) Record the mass as accurately as the balance will allow.
   E. Compare the total mass of reagents before the reaction with the total mass of products after the reaction has occurred.
   F. Dispose of the waste from this reaction in a designated **lead waste container**.\(^{25}\)

3. Record the **results** on the report sheet (IIC). In the space provided, round the resulting masses to 1 place behind the decimal to compare.\(^{26}\)

4. Write a **conclusion** statement (IID) that sums up the answer to the original question giving factual evidence from your experiment to support your answer.

5. Analyze any potential for **errors**, and record (IIE) any hints to achieving reliable results.

6. From this experience generate questions that could lead to future experiments. (IIF)

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\(^{21}\)For the sake of time and efficiency the experimental procedures have been given to you rather than having you create your own experiment. This won’t always be the case.

\(^{22}\)Remember that to **tare** the balance means to set the reading to zero before the item to be massed is added.

\(^{23}\)The laboratory balance is only as accurate as the last digit displayed. You may have to estimate the last place of the mass if the balance number bounces on its last digit. There is error in the last fluctuating digit. Our laboratory balances can be read to 3 places behind the decimal.

\(^{24}\)Use the same electronic balance for all mass measurements in the same experiment. Using the same balance avoids compounding the errors inherent in the balances.

\(^{25}\)Lead, Pb, is a heavy metal that can be toxic if ingested in large amounts. We do not want to put lead products down the laboratory drains. It must be disposed of in specially designated waste bottles.

\(^{26}\)Because there is error in the last digit of the balance; measurements are often rounded to the next most accurate place. If the error is in the hundredths place, (second place behind the decimal), then round to the nearest tenths, (first place behind the decimal) to compare.
LAB 3. CHEMICAL REACTIONS:

PRE LAB EXERCISES:

1. Classify each of the following conditions as a Physical property (P) or a Chemical property (C).
   - ___ Silver conducts an electric current.
   - ___ Aluminum metal disappears when added to hydrochloric acid.
   - ___ Sugar cubes disappear when added to warm water.
   - ___ Mercury has a density of 13.6 g/mL.
   - ___ Gasoline burns in an automobile engine.
   - ___ Water freezes at 0°C.

2. ___ A gas emitted from a reaction is brown and has a noxious odor. The gas could be:
   - A. Carbon monoxide
   - B. Hydrogen
   - C. Nitrogen dioxide
   - D. Hydrogen Sulfide

3. ___ List all of the following compounds that should never be disposed of in the laboratory sinks.
   - A. Sodium Chloride
   - B. Silver compounds
   - C. Chromium compounds
   - D. Hydrochloric Acid

4. List the clues that indicate evidence that a chemical reaction has occurred.


6. Complete the missing parts of the following table:
   (All answers are hidden in the discussion, procedures, or side notes of this laboratory exercise.)

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Chemical Formula</th>
<th>Common Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Acetic Acid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Ammonium Dichromate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Copper</td>
<td></td>
<td></td>
</tr>
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<td></td>
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</tr>
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<td>J. Zinc</td>
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</tbody>
</table>
LAB 3. CHEMICAL REACTIONS:
REPORT:

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<tr>
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<th>NAME____________________</th>
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<tr>
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Give evidence for the identity of any gas produced.

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</tbody>
</table>

Give evidence for the identity of the gas produced.

<table>
<thead>
<tr>
<th></th>
<th>Describe observations characteristic to this reaction.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Identity of gas produced =___________________</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th></th>
<th>List all of the following that are true about this reaction:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A. Gas production,</td>
</tr>
<tr>
<td></td>
<td>B. Solid formation,</td>
</tr>
<tr>
<td></td>
<td>C. Color change,</td>
</tr>
<tr>
<td></td>
<td>D. Temperature rises or energy released; exothermic</td>
</tr>
<tr>
<td></td>
<td>E. Temperature lowers or energy absorbed; endothermic</td>
</tr>
<tr>
<td></td>
<td>N. No reaction occurred.</td>
</tr>
</tbody>
</table>

Give evidence for the identity of the gas produced.
### 4. Sodium Chloride + Silver Nitrate

\[ \text{NaCl} + \text{AgNO}_3 \rightarrow \text{NaNO}_3 + \text{AgCl} \]

List all of the following that are true about this reaction:

A. Gas production,  
B. Solid formation,  
C. Color change,  
D. Temperature rises or energy released; exothermic  
E. Temperature lowers or energy absorbed; endothermic  
N. No reaction.

Describe observations characteristic to this reaction.

### 5. Copper + Silver Nitrate

\[ \text{Cu} + 2\text{AgNO}_3 \rightarrow \text{Cu(NO}_3\text{)}_2 + 2\text{Ag} \]

List all of the following that are true about this reaction:

A. Gas production,  
B. Solid formation,  
C. Color change,  
D. Temperature rises or energy released; exothermic  
E. Temperature lowers or energy absorbed; endothermic  
N. No reaction.

The gray solid produced is _______.

### 6. Zinc + Copper (II) Sulfate

\[ \text{Zn} + \text{CuSO}_4 \rightarrow \text{ZnSO}_4 + \text{Cu} \]

List all of the following that are true about this reaction:

A. Gas production,  
B. Solid formation,  
C. Color change,  
D. Temperature rises or energy released; exothermic  
E. Temperature lowers or energy absorbed; endothermic  
N. No reaction.

The brown solid produced is _______.

### 7. Ammonium Dichromate + Heat

\[ (\text{NH}_4)_2\text{Cr}_2\text{O}_7 + \rightarrow \text{Cr}_2\text{O}_3 + \text{N}_2 + 4\text{H}_2\text{O} \]

List all of the following that are true about this reaction:

A. Gas production,  
B. Solid formation,  
C. Color change,  
D. Temperature rises or light energy released; exothermic  
E. Temperature lowers or energy absorbed; endothermic  
N. No reaction.

### 8. Magnesium + Oxygen

\[ 2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO} \]

List all of the following that are true about this reaction:

A. Gas production,  
B. Solid formation,  
C. Color change,  
D. Temperature rises or light energy released; exothermic  
E. Temperature lowers or energy absorbed; endothermic  
N. No reaction.

### 9. Lead (II) Nitrate + Potassium Iodide

\[ \text{Pb(NO}_3\text{)}_2 + 2\text{KI} \rightarrow \text{PbI}_2 + 2\text{KNO}_3 \]

This reaction is to be done as a Scientific Method inquiry following the format on the next page.
II. SCIENTIFIC METHOD: LAW OF CONSERVATION OF MASS

QUESTION:
In the reaction of Lead (II) Nitrate with Potassium Iodide,
Does the total mass of the products equal the total mass of the reactants?
\[ \text{Pb(NO}_3\text{)_2} + 2\text{KI} \rightarrow \text{PbI}_2 + 2\text{KNO}_3 \]

A. HYPOTHESIS: (To be done before any experiment is performed.)
Use complete sentences; give rationale for your hypothesis based on previous information.)
I believe that
I believe this because

B. EXPERIMENTAL PROCEDURE:
Lead (II) Nitrate + Potassium Iodide
A. Into a small test tube measure 5 drops (0.25 mL) of 0.1M Lead (II) Nitrate (Pb(NO\(_3\))\(_2\)). Set the tube in a beaker.
B. Into another small test tube measure 20 drops (1.0 mL) of 0.2M Potassium Iodide (KI). Set the tube in the same beaker as the tube of Lead (II) Nitrate.
C. Place the beaker containing the 2 tubes of reagents on a tared balance and record the mass as accurately as the balance will allow.
D. Add the contents of 1 test tube to the other test tube and record your observations. Place both test tubes, (one now empty and the other containing the reaction product) back into the beaker and mass it again on the same electronic balance. Record the mass as accurately as the balance will allow.
E. Compare the total mass of reagents before the reaction with the total mass of products after the reaction has occurred and determine whether they are the same or different within the margin of error of the balance.
F. Dispose of the waste from this reaction in a designated lead waste container.

C. RESULTS:

<table>
<thead>
<tr>
<th>Reagents</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reported to accuracy of the balance. ________ g's</td>
<td>Reported to accuracy of the balance. ________ g's</td>
</tr>
<tr>
<td>Rounded to 1 place behind the decimal. ________ g’s</td>
<td>Rounded to 1 place behind the decimal. ________ g’s</td>
</tr>
</tbody>
</table>

Observations: Describe observations characteristic to this reaction and to the mass information acquired.

D. CONCLUSION:
___ My hypothesis was
   A. incorrect
   B. correct as written
   C. correct except for __________

Answer the original question based on new knowledge from your experiment. Take into account sig figs and uncertainty in balance.

E. ERROR ANALYSIS: (Give warnings, advice, or modifications for future experimenters. Give potential for errors.)

F. FURTHER QUESTION(S): (What new questions might this experiment inspire?)
1. Rank the following metals in order of increasing reactivity with hydrochloric acid (#1 being the most reactive)

<table>
<thead>
<tr>
<th>Aluminum</th>
<th>Copper</th>
<th>Zinc</th>
</tr>
</thead>
<tbody>
<tr>
<td>____</td>
<td>____</td>
<td>____</td>
</tr>
</tbody>
</table>

2. When carbonated beverages containing acids are packaged in Aluminum cans the cans are lined with a plastic coating so that the beverage does not come in contact with the metal. Explain why and what might happen if the plastic coating were not present.

3. Complete and balance the following equations showing complete combustion of hydrocarbons:
(Refer to the Burners, Flames, and Atomic spectra lab discussion for help.)

A. ____ CH$_4$ + ____ O$_2$ →

B. ____ C$_5$H$_{12}$ + ____ O$_2$ →

4. Balance the following chemical equations:

A. ____ C$_3$H$_8$ + ____ O$_2$ → ____ CO$_2$ + ____ H$_2$O

B. ____ C$_2$H$_6$O + ____ O$_2$ → ____ CO$_2$ + ____ H$_2$O

C. ____ C$_4$H$_{10}$ + ____ O$_2$ → ____ CO$_2$ + ____ H$_2$O

D. ____ NaOH + ____ (NH$_4$)$_3$PO$_4$ → ____ Na$_3$PO$_4$ + ____ H$_2$O + ____ NH$_3$

E. ____ Mg$_3$N$_2$ + ____ H$_2$O → ____ Mg(OH)$_2$ + ____ NH$_3$

F. ____ FeS$_2$ + ____ H$_2$O + ____ O$_2$ → ____ FeSO$_4$ + ____ H$_2$SO$_4$

G. ____ S$_8$ + ____ AsF$_5$ → ____ S$_{16}$(AsF$_6$)$_2$ + ____ AsF$_3$

H. ____ Mg$_3$(PO$_4$)$_2$ + ____ H$_2$SO$_4$ → ____ MgSO$_4$ + ____ H$_3$PO$_4$