Chemical Reactions Lab

name: _____ 160/1200

This is the largest lab of the year. You will do 20 experiments and write out detailed balanced chemical equations for them all. You must read the procedures for each before doing the experiments. Goggles On!!

List the 5 kinds of chemical reactions.		

We will be looking for evidence that a chemical reaction has taken place.
There are 6 indicators that a chemical reaction has probably happened. (use the acronym — TOPIC-B). What does each stand for?

T –

O –

P –

I –

C –

B –

During several of the experiments you will produce a gas. You may make O_2, CO_2, or H_2.
Since all of these gases are invisible and have no smell, to determine which gas it is, you will have to test them using a burning, or glowing hot piece of wood (a splint).

gas	To test, use a...	result
carbon dioxide	flaming splint	
oxygen	glowing splint	
hydrogen	flaming splint	

Do not write on this lab report until you get home. Only write on white paper that is 8½ x 11 inches in size. Try to make this lab report PERFECT. This is the first BIG DEAL lab report.

DO not turn in frilly edged paper. Think on scrap paper, this report should have no crossing out, or arrows pointing far away. Leave space for me to write comments.

THIS LAB REQUIRES:

1. TITLE PAGE with a serious title, an optional funny title, and a few sentences explaining the point of this lab experience. (3 points)
2. All 20 balanced equations with phase symbols (40 points)
3. Neatly written answers to the 30 lab questions (30 points)
4. Your initials 5X below, which means you're saying I should be strict in grading. (2 points)

There is NO CONCLUSION FOR THIS LAB

<u>This lab is worth 75 points because it is SO LONG, and IMPORTANT.</u>

Check List: First five lab questions, worth one point each for your…..		initials
A	Did you check every single equation for correct PHASE SYMBOLS?	
B	Did you include your observations?	
C	Did you leave any blanks?	
D	Did you check to do all 30 lab questions, in order?	
E	Is your name <u>and</u> class period on the cover?	

For each experiment you need to make OBSERVATIONS.
On white paper, a maximum of 6 experiments per side, tell about the reactants, and products. You might mention colors, mass, temperatures, gas test results, the TOPIC B reaction indicators, etc. Notes about all things you learn in lab might be helpful to have later when you are writing this lab report.
The observations get stapled onto the back of the lab report.

Reaction "A" Decomposition of Water by Electrolysis

The Hoffmann Apparatus is set up for you to observe. Watch the demonstration. This machine decomposes water into it's component elements. The gases fill the tubes in very different volumes, think about WHY that is. What proportion do they fill? The water has some sulfuric acid in it. Sodium chloride would help as well. Think about why the acid, or salt, would be necessary. The acid, or salt, are NOT part of the word equation or reaction. Test both gases in the tubes, as shown. See BASICS.

Reaction "B" Synthesis of Water

Obtain ~25 mL of hydrogen gas from the Hoffmann Apparatus in a large test tube. After you test it, put your pinky finger into the tube, does if feel wet? Does it look like there was condensation in the tube? It will only toot once.

Reaction "C" Combustion of Wood

Wood is not "one thing". It is mostly cellulose, which is formed from a chain of glucose molecules. It's "real" formula is $(C_6H_{10}O_5)n$ where "n" is an integer. Cellulose is a chain molecule of indefinite length. We will use this formula for wood: $C_{24}H_{40}O_{20(S)}$ Set your splint on fire and observe the wood burning. Think about what other reactant from the air is combining with it. If you blow it out with your breath, think why your breath blows it OUT instead of making it burn faster. See BASICS.

Reaction "D" Combination Reaction of a Copper Oxide

Obtain some copper wire. Holding it with tongs, in the hottest part of the Bunsen burner flame. It gets red hot, but when it cools, you'll see the outside of the wire changed color because the copper reacts combines with the oxygen in the air. Compare the product to the two types of copper oxide provided. Determine by color which of these oxides formed. When it's cool to the touch, try to scrape off some of this new solid you just made with your fingernail.

For the next set of reactions, obtain a watch glass. Make is clean and dry.
You will use 3 drops of each of the two solutions to see these reactions.
Make sure that you DO NOT cross contaminate the solutions, by touching the
eye droppers to each other, or to the watch glass. If you do, and you might, get a CLEAN eye droppers.
Soap and water and dry watch glass between each reaction.

Reaction "E" Double Replacement

Put 2 drops of sodium phosphate solution into 2 drops of silver nitrate solution. Observe.

Reaction "F" Double Replacement

Put 2 drops of sodium hydroxide solution into 2 drops of copper (II) sulfate solution. Observe.

Reaction "G" Double Replacement

Put 2 drops of cobalt (II) nitrate solution into 2 drops of sodium hydroxide solution. Observe.

Reaction "H" Double Replacement

Put 2 drops of rubidium bromide solution into 2 drops of ammonium nitrate solution. Observe.

Reaction "I" Single Replacement with Magnesium and Hydrochloric Acid

Put about 1 inch of acid into a large test tube. Have another CLEAN & DRY large test tube in hand. Put the metal into the dry tube, then invert this tube onto the acid tube. Hold the tubes together with 2 fingers. Test gas in the top tube without tipping it sideways or up, with a flaming splint.

Reaction "J" Single Replacement with Iron and aqueous Sodium Chloride

Put about one inch of the salt water into a small test tube. Gently insert an iron nail into the solution, let this sit for 3 minutes. Dump the solution out in your hands, and observe the nail.

Reaction "K" Single Replacement with Iron and aqueous Copper (II) Sulfate

Put about 1 inch of strong copper (II) sulfate solution into a small test tube. Gently insert the nail, pointy side down. Let this sit for 3 minutes. Dump the solution into a sink, and catch the nail in your hand. Observe the pointy side. Think about what that red stuff might be. Ask around.

Reaction "L" Single Replacement with Aluminum and aqueous Potassium Chloride

Put about an inch of the potassium chloride solution into a small test tube. Gently insert an aluminum nail into the solution, let this sit for 3 minutes. Dump the solution out in your hands, and observe the nail.

Reaction "M" Combustion of Methane

Turn on your Bunsen burner (that's a capital B for Mr. Bunsen!) The methane gas burns with the oxygen in the air. The products are invisible gases, but they are really there. Combustion always a hydrocarbon and oxygen which always forms carbon dioxide and water gases.

Reaction "N" Combustion of Candle Wax

Demonstration. We will burn the candle for about 15 minutes, then blow it out. We'll write down the start and end masses in our observations. There are many kinds of waxes, all with different formulas. "Wax" is a general term, not a compound name. Think about how the Law of Conservation of Matter works for this reaction. The formula we will use for wax is: $C_{20}H_{42(S)}$

Reaction "O" Combustion of Ethanol

Demonstration — We will combust the alcohol ethanol ($C_2H_5OH_{(L)}$) by sparking it with a "butane lighter". The alcohol will burn the same color as a Bunsen burner flame (dull) so it will be put into an evaporating dish containing, $CuCl_{2(S)}$ — which WILL NOT be part of the reaction, but will make if more fun. Technically speaking, ethanol is NOT a hydrocarbon, it is an oxygenated-hydrocarbon. It combusts well.

Reaction "P" Combustion of Butane

The "clicker lighter" contains a liquid called butane. It gets sprayed through a tiny hole in the metal tube of the hand held device, where it vaporizes into a gas. Butane gas mixes with the oxygen from the air. The "click" sparks it and it combusts well. The formula for butane gas is $C_4H_{10(L)}$

Reaction "Q" The Ionization of Potassium Nitrate into water

Get about 40 mL of deionized water in a medium sized beaker, and measure the temperature to the nearest 10th degree. Add a scoop of potassium nitrate. Stir carefully with the thermometer. Measure the highest or lowest temperature the solution gets to. Do not get this in your mouth.

Reaction "R" Decomposition of Copper (II) Carbonate by heating

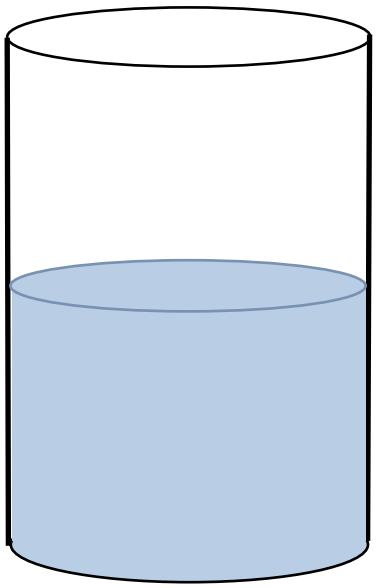
Put about 1/4 inch of copper (II) carbonate into a large test tube, then put it into a test tube clamp as shown. Have a wood splint in your hand to set it aflame as you begin to heat the compound. Heat the test tube. As the powder changes color, put flaming splint partly into the tube to test the gas is produced. Test the gas twice. What color is the solid product left over in the test tube? Have you ever (recently) seen black powder like that before? (yes)

Reaction "S" Synthesis of Magnesium Oxide

This is the most dangerous part of the lab. Curl the metal around a pencil into a small spring shape. Make sure it fits INSIDE the crucible. Put the crucible on the indestructible black table. Carefully pick up the Bunsen burner, pointing the flame onto the edge of the metal. When the metal catches on fire, adjust flame to the bottom of the crucible, where it sits on the table top. Heat it from below. Gently fan some air (oxygen) into the top of the cup. Cool it several minutes before you mass the crucible and magnesium oxide product. Compare the before and after masses.

Reaction "T" The Combustion of Sucrose

Get a small test tube and put a small amount of table sugar, or sucrose, $C_{12}H_{22}O_{11(S)}$ into it. Using a test tube clamp, heat the sugar in the tube. Notice a phase change, then a color change, and finally another color change, and the release of gases. This is mostly a combustion reaction, but closer to the end there is incomplete combustion resulting in the formation of solid carbon. It might smell badly. Test tubes into trash cans when done. What is incomplete combustion? Check the nearest BASICS, or else.



The optimist sees this glass as half full.

The pessimist sees this glass as half empty.

What does a chemist see this glass as?

Reaction	Balanced Chemical Equations with Phase Symbols
A	
B	
C	
D	
E	
F	
G	
H	

Reaction	Balanced Chemical Equations with Phase Symbols
I	
J	
K	
L	
M	
N	
O	
P	

Reaction	Balanced Chemical Equations with Phase Symbols
Q	
R	
S	
T	Write the balanced equation for the complete combustion of sucrose

Lab Questions. Do these on White 8½ x 11 inch paper, leave room between each question for comments, and do not run into the right side or left side margin if you can help it (you can). Use a lot of paper, and answer the questions IN ORDER, OR ELSE. Write WHOLE SENTENCES, not short answers, or fill in the blanks.

Read the longer questions, there is information in them to help guide you to academic nirvana, so to speak.

1. Acid it used in the Hoffmann Apparatus but it is NOT part of the chemical equation. Why is acid used? We could have used sodium chloride (or any aqueous salt). If there was no acid or salt, the machine would not decompose water, why? See BASICS.

2. On the first day of school your teacher blew up a hydrogen balloon and it created a loud fireball. You also reacted hydrogen with oxygen to create water, but there was no fireball; all you got was a cute toot. Why was there such a big difference between these identical reactions?

3. Why does a candle go out when you blow them out with your breath (chemically speaking)?

4. Why does a "glowing" splint of wood catch fire again when you put it into a test tube with oxygen gas?

5. What is another name for a combination reaction?

6. In double replacement reactions we always start with two ____ _____.

7. In double replacement reactions, the products are always an ____ _____ and a ____.

8. Occasionally you mix together two ionic solutions and end up with no precipitate.
   This is NOT a double replacement reaction, instead it is just a _____.

9. Aqueous means dissolved into water. Sodium chloride ionizes when it dissolves (it's ionic).
   What happens to sucrose, table sugar, when it dissolves into water? Table I near the bottom for ideas.
   $C_{12}H_{22}O_{11(S)}$ GOES INTO WATER → _____

10. Water is a common solvent in chemistry, but it's not the ONLY solvent. Soluble means can dissolve into any solvent, and insoluble means something cannot dissolve into any solvent.
    Name two compounds from Table I that are insoluble in water.

The set up for single replacement reactions has atoms going into a single aqueous solution. Three different paths can be taken. Most commonly is a cation replacement, next is an anion replacement. The last is actually a NO REACTION, like when your teacher's gold wedding band went into the acid.

11. Write a balanced chemical equation for cation replacement single replacement reaction NOT from this lab.

12. Write a balanced chemical equation for anion replacement single replacement reaction NOT from this lab.

13. Skip this one.

14. Write a set up for a single replacement reaction that results in a "no reaction" that is not Au + HCl.

15. If you don't have sufficient oxygen for complete combustion, name some other products you end up with instead of CO_2 and H_2O.

16. Write a balanced equation showing two AQ solutions mixing, but forming a "no reaction".
    Write out all formulas, even the products, with phase symbols.

17. The smallest of all hydrocarbons is methane CH_4. Hexane is a medium sized, liquid hydrocarbon with formula of C_6H_{14}. Write out the word equation for the combustion of hexane.

18. Write out the balanced chemical equation for the combustion of hexane, with phase symbols.

19. An oxygenated hydrocarbon has oxygen combined inside of a hydrocarbon, including ethanol. You saw the combustion of ethanol in lab. Another alcohol is pentanol with formula of $C_5H_{11}OH_{(L)}$. Write the balanced chemical equation for the combustion of this oxygenated hydrocarbon with phase symbols.

20. When magnesium oxide is synthesized, the mass of the metal is less than the mass of the magnesium oxide. If the Law of Conservation of Matter is in effect (it always is) how can you explain the gain of mass in the crucible?

21. Table salt will dissociate or ionize into loose mobile ions in water. Write the chemical symbols that show the process of ammonium chloride dissolving into water. Look at Table I for help.

22. Write out the ABSTRACT that shows a combination reaction and the reverse of that a decomposition reaction on the line below it. Use any letters that you like. Use the letters of your initials to do this.

23. Incomplete combustion happens when there is insufficient oxygen present to change all of the carbon into carbon dioxide gas. Often the extra carbon ends up as solid carbon. Write out the balanced equation of the incomplete combustion of methane that produces soot (solid carbon) with phase symbols. Look at BASICS.

24. In two of your experiments you made the same black solid product. What is the name of this product, what is the formula of this product, and what 2 types of reactions that produced it?

25. Write the word equation for the chemical reaction in experiment "G". Include phases with names. Do not use any numbers — unless it is a Roman Numeral.

26. In the last experiment, when you combusted sucrose, there is water gas produced at the bottom of the test tube. Explain why how some condensation formed at the top of the test tube. Is the water product a gas or a liquid?

27. Write the word equation for reaction decomposing $CuCO_{3(S)}$.

28. Write the word equation for the reaction "K" with metal and the solution.

29. Write the word equation for the reaction "I" with the metal and the acid solution.

30. Write an "abstract" for a double replacement reaction.

31. Write an "abstract" for a single replacement reaction.

32. There is no extra credit, but, tell me, how does the chemist see the cartoon on page 4 of this lab handout?