Welcome to AP Chemistry

Foxborough High School **Mrs. Borges aka "Mrs. B"**

Dear AP Chemistry student,

It is almost the end of May and the clock starts now. Sometime during the first two full weeks of May 2022, you will be taking your AP Chemistry exam. Of course, this year has been crazy, but it has given you a base for which to start building your chemistry knowledge. There might be some gaps, but we will fill them in together. Between now and your exam, we will be working together to perfect your prior knowledge and to expand upon it through a series of labs, activities, notes, homeworks, tests, and quizzes. (60% test, 35% lab, 5% homework)

Do NOT throw any of your notes that you have from Chemistry away. You will most likely find them to be very helpful at the beginning of the course and over the summer. It is expected that you will remember the material that you have learned in your Chemistry course this year.

You need a calculator… EVERY DAY. You don't need a graphing calculator, but if you have one, you will have everything you need. A simple scientific calculator works perfectly. Make sure that you have batteries handy. I will not be supplying calculators during tests and quizzes throughout the year. It is your responsibility at the AP exam and it is your responsibility during the class.

Communication is going to be vital throughout the year. Don't just wing it! I can be reached in a variety of ways through email: borgesk@foxborough.k12.ma.us or through TEAMS.

Just one other reminder, this is not a high school course, this is a college course. You should be prepared to put in a lot of work, but in the end it will be very rewarding.

To begin your course, you have four assignments for the summer. Be aware that you are expected to turn in these assignments on time. Late work WILL NOT BE GRADED! We currently have the ability to get WiFi in almost every major chain restaurant and through our own cars, there is no reason why you can't have your assignments turned in on time. Plan ahead if you are going away. Remember that this is what you signed up for, so make sure you get the most out of it. I look forward to the year ahead.

Cheers,

Mrs. Borges

SUMMER ASSIGNMENTS!

ASSIGNMENT ∝ **Due Date: First day of Class**

Within this packet is a list of names, formulae, and charges of common ions. Using flash cards, mind tricks, hypnotism, or whatever memorization technique that works for you in order to commit all of these ions to memory. Many of them will be familiar to you as we used them in Chemistry this year. I would try and work with the patterns and grouping that have similar qualities, such as:

- Fluorate vs chlorate vs bromate
- Per—ate vs –ate vs –ite vs hypo—ite
- Phosphate vs hydrogen phosphate vs dihydrogen phosphate
- Sulfate vs thiosulfate

On the first day of class or within the first week, you will have a quiz testing your memorization skills. It is not possible to quiz you on all of them, but you will be expected to know them all throughout the year. Do not expect them to be provided during any test or quiz throughout the year.

*** The other three assignments are to make sure that you review many of the basic concepts from your first year of chemistry. You will complete these over the summer. The first two will be due during the summer and the third will be due the first day of class.

The first two homework assignments are online through a website called WebAssign. You have 10 chances for each problem.

Go to: http://www.webassign.net/

Enter the Class Key in the upper right hand side: **foxboroughhs 0803 5231**

USE YOUR SCHOOL EMAIL, for your user information.

The last assignment is a virtual lab which needs to be completed by the first day of school. You can send it via email.

The textbook we are using is Chemistry, 10th Edition by Steven and Susan Zumdahl. This is a very popular AP Chemistry and freshman college chemistry textbook used nationwide. I will let you know as soon as I can about how to get ahold of the book, but for now the online platform has reference material that you can work from.

ASSIGNMENT β **Due Date: Monday July 12th**

Chapter One

TOPICS:

- Scientific method
- SI units
- Significant digits
- Dimensional analysis
- Temperature
- Density
- Classification of matter

ASSIGNMENT γ **Due Date: Monday August 9th**

Chapter Two

TOPICS:

- Fundamental laws of chemistry
- Atomic structure
- Periodic table
- Nomenclature
- formulas

ASSIGNMENT λ **Due Date: Aug 31st (first day of School)**

Chapter Three – Stoichiometry and Limiting Factors

Read through and then watch the video on Determining Limiting Factor and complete the lab questions. This does not need to be a full lab report, just answer the analysis questions and fill in the data table according to the lab video.

NAMES, FORMULAE, AND CHARGES OF COMMON POLYATOMIC IONS

ammonium	NH_4^{+1}
hydronium	H_3O^{+1}
acetate	$C_2H_3O_2^{-1}$
arsenate	AsO_4^{-3}
azide	N_3^{-1}
perbromate bromate bromite hypobromite	BrO_4^{-1} BrO_3^{-1} BrO_2^{-1} BrO^{-1}
carbonate hydrogen carbonate (bicarbonate)	CO_3^{-2} HCO_3^{-1}
perchlorate chlorate chlorite hypochlorite	ClO_4^{-1} ClO_3^{-1} ClO_2^{-1} ClO^{-1}
chromate dichromate	CrO_4^{-2} $Cr_2O_7^{-2}$

cyanide cyanate thiocyanate	CN^{-1} OCN^{-1} SCN^{-1}
perfluorate fluorate fluorite hypofluorite	FO_4^{-1} FO_3^{-1} FO_2^{-1} FO^{-1}
hydroxide	OH^{-1}
periodate iodate iodite hypoiodite	IO_4^{-1} IO_3^{-1} IO_2^{-1} IO^{-1}
manganate permanganate (same formula, Different charge)	MnO_4^{-2} MnO_4^{-1}
pernitrate nitrate nitrite hyponitrite	NO_4^{-1} NO_3^{-1} NO_2^{-1} NO^{-1}
oxalate	$C_2O_4^{-2}$
peroxide	O_2^{-2}

phosphate phosphite hydrogen phosphate dihydrogen phosphate	PO_4^{-3} PO_3^{-3} HPO_4^{-2} $H_2PO_4^{-1}$
persulfate sulfate sulfite hyposulfite hydrogen sulfate (bisulfate) hydrogen sulfite (bisulfite) thiosulfate	SO_5^{-2} SO_4^{-2} SO_3^{-2} SO_2^{-2} HSO_4^{-1} HSO_3^{-1} $S_2O_3^{-2}$

NAMES, SYMBOLS, AND CHARGES OF SOME TYPE II (MULTIVALENT) CATIONS

ION	IUPAC NAME
Cu^{+1} Cu^{+2}	copper (I) copper (II)
Cr^{+2} Cr^{+3} Cr^{+6}	chromium (II) chromium (III) chromium (VI)
Fe^{+2} Fe^{+3}	iron (II) iron (III)
Co^{+2} Co^{+3}	cobalt (II) cobalt (III)
Mn^{+2} Mn^{+3}	manganese (II) manganese (III)

ION	IUPAC NAME
Sn^{+2} Sn^{+4}	tin (II) tin (IV)
Pb^{+2} Pb^{+4}	lead (II) lead (IV)
Hg_2^{+2} Hg^{+2}	mercury (I) mercury (II)
Au^{+1} Au^{+3}	gold (I) gold(III)
Ag^{+1}	silver *(charge is +1, not +2 as expected)*

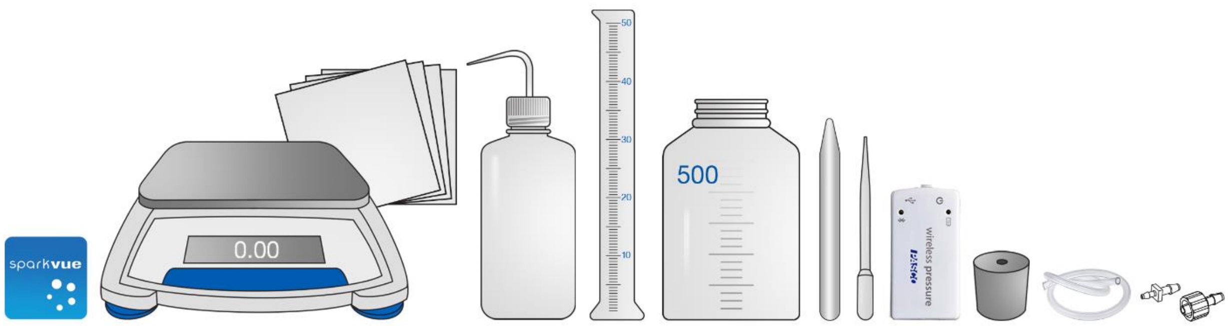
8D – DETERMINING LIMITING REACTANTS

INQUIRY

How can you produce the greatest amount of products without wasting any material?

MATERIALS

- Device with SPARKvue software
- Pressure sensor with tubing and connectors
- Digital balance (readability: 0.01 g)
- Weighing paper
- Sampling bottle, plastic, 500-mL, OR 500-mL Erlenmeyer flask
- Rubber stopper, one-hole, to fit the sampling bottle/flask
- Graduated cylinder, 50-mL
- Scoopula
- Pipet
- 0.12 M $NaHCO_3$, sodium bicarbonate solution, 300 mL
- Citric acid ($C_6H_8O_7$) solid, 2.0 g
- Wash bottle with distilled water



BACKGROUND

In order to avoid wasting materials, chemists are often tasked with determining precisely how much of each reactant is necessary for a reaction. Using mole ratios from the balanced chemical equations and a known amount of one reactant, a chemist can calculate the exact amount of a different reactant is required for both reactants to be completely consumed. But what happens to a chemical reaction when the limiting reactant is consumed? This activity explores how you can determine experimentally which of the two reactants, sodium bicarbonate (baking soda) or citric acid, is limiting through several runs of the reaction.

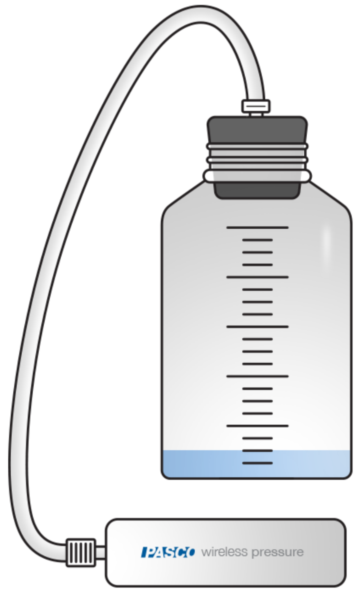
SAFETY

Follow these important safety precautions in addition to your regular classroom procedures.

- Wear safety goggles at all times.
- The gas being generated causes an increase in pressure which may expel the stopper from the bottle. Hold the stopper in place during the experiment but avoid squeezing the body of the sampling bottle/flask.
- Do not point the sampling bottle toward yourself or anyone else.

PROCEDURE

1. Open SPARKvue.
2. Open the 08D Determining Limiting Reactants lab file in SPARKvue.
3. Use the Bluetooth icon to connect the Pressure sensor.
4. Attach the pressure sensor to the threaded sensor tubing connector as shown. Use a double-barbed connector to attach the open end of the tubing to the rubber stopper.
5. Pour just under 40 mL of the sodium bicarbonate solution into the graduated cylinder. Use a pipet to measure exactly 40.0 mL. Have the same person read the graduated cylinder each time for precision.
6. Pour the sodium bicarbonate solution you just measured into the bottle.
7. Measure about 0.10 g of citric acid. Record the exact mass in Table 1 and in Table 2 on your answer sheet.
8. Start collecting data.



9. It is very important to complete this step as quickly as possible. As soon as one lab partner pours the solid citric acid into the bottle, the other lab partner immediately seals the bottle/flask with the stopper. Avoid squeezing the sides of the bottle/flask.
10. Hold the stopper firmly in place and gently swirl the bottle to help the reactants mix. Continue holding the stopper and swirling at the same speed for the duration of the reaction.
11. Stop collecting data when the reaction is complete. Upon reaction completion, no gas bubbles form and the pressure levels off on the graph.
12. Slowly remove the stopper to release the pressure from the bottle.
13. Pour the contents of the bottle/flask into the designated waste container. Thoroughly rinse the bottle/flask with distilled water.
14. Use the graph to find initial pressure, final pressure, and pressure change. Record the values in Table 1.
15. Repeat steps 4-14 for 0.20 g, 0.30 g, 0.40 g, and 0.50 g of citric acid. Make sure all runs are visible in SPARKvue as you collect data.

Watch the following video in order to get the data needed:

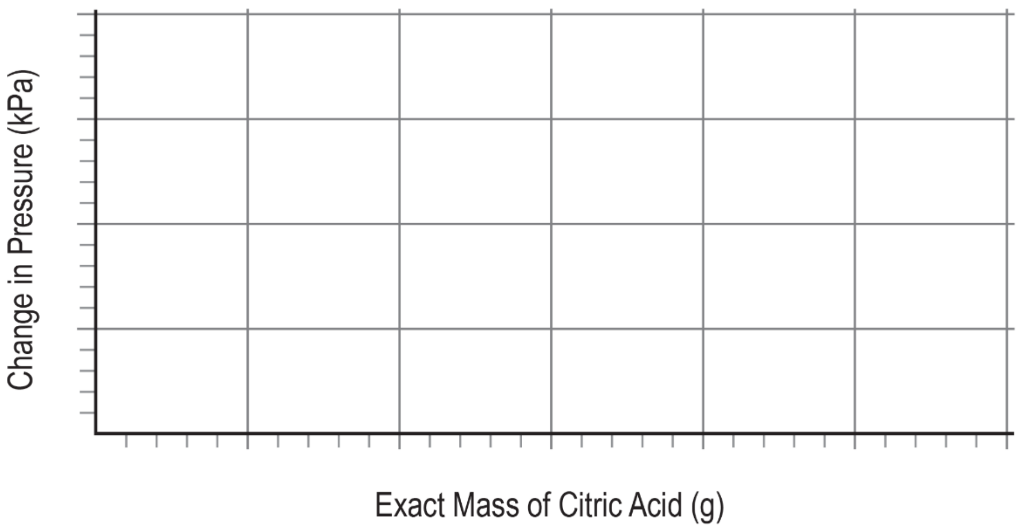
https://www.pasco.com/pav/30/xKNT0cyyvlA

Data and Analysis

Table 1 – Pressure change

Trial #	Approximate Mass of $C_6H_8O_7$ (g)	Exact Mass of $C_6H_8O_7$ (g)	Initial Pressure (kPa)	Final Pressure (kPa)	Change in Pressure (kPa)
1	0.10				
2	0.20				
3	0.30				
4	0.40				
5	0.50				

1. Enter the change in pressure for each run to create a graph of Change in Pressure (kPa) on the y-axis and Exact mass of citric acid (g) on the x-axis. Scale the graph and then reproduce the graph on your paper. Add a title to your graph.



2. Each 40-mL sample of sodium bicarbonate you measured contained 0.41 g of dissolved sodium bicarbonate. Calculate the number of moles of sodium bicarbonate for each trial. Show one sample calculation and record your answers in Table 2.

❓ 3. Calculate the number of moles of citric acid in each trial. Show one sample calculation below and record your answers in Table 2.

Table 2 – Analysis of pressure change

Trial #	Mass of $NaHCO_3$ (g)	Moles of $NaHCO_3$ (mol)	Exact mass of $C_6H_8O_7$ (g)	Moles of $C_6H_8O_7$ (mol)
1				
2				
3				
4				
5				

Questions

❓ 1. Each trial used the same amount of $NaHCO_3$. What happened to the pressure as you added increasing amounts of citric acid? Why did this happen?

❓ 2. Based on the graph, what is the ideal amount (in grams) of citric acid required to react with 0.41 g of $NaHCO_3$? Explain how you determined this answer.

❓ 3. Based on the graph, which trial is closest to the ideal amounts of reactants? Explain how you chose this trial and eliminated the others.

❓ 4. In Table 2, find the moles of each reactant for the ideal trial you identified above. According to the table, what is the ideal $NaHCO_3$: $C_6H_8O_7$ mole-to-mole ratio, in simplified whole number coefficients?

❓ 5. When citric acid and sodium bicarbonate react, the products are sodium citrate ($Na_3C_6H_5O_7$), water, and carbon dioxide. Write the balanced chemical equation including state-of-matter symbols in your balanced chemical equation. How does the $NaHCO_3$: $C_6H_8O_7$ mole ratio in the balanced equation compare to the ratio that you determined in question #4?

❓ 6. Which reactant, if any, was a limiting reactant in each trial? Enter your responses in the table. Support your answers with evidence from the lab.

Evidence for the Limiting Reactant

Trial #	Limiting Reactant	Supporting evidence
1		
2		
3		
4		

5		