Laboratory: Patriotic Colors

**Report Requirement:** Answer all of the questions/do all the computations requested in *italics*. Questions not in italics do NOT need to be answered. You do NOT have to write a formal lab report. You should write your answers into a word processing program and save the file. Go into the Lab – Patriotic Colors Report and cut and paste the answers to each question in the appropriate space. (Lab – Patriotic Colors Report can be found on the Content page or under Assignments → Quizzes.)

Labs not submitted in the appropriate area will *not* be graded.

**Report Scoring:** 20 points total. Questions valued as marked.

**Working with a Partner:** You are permitted to work with a partner. If you do so, the experimental data reported may be the same, but you need to write your own answers to each question. At the beginning of each question you should note that you worked with a partner by writing “Lab Partner (fill in name).”

**Goals:**
1. To demonstrate reversible reactions.
2. To write a chemical reaction.
3. To create an experiment and report results.

**Materials Needed:**
“Patriotic Colors” Lab Kit
straw

**Chemicals Needed:**
Common household chemicals (various). You will need some of the following:
- Distilled water (needed if your tap water is hard)
- Ammonia
- Laundry detergent
- Ashes (from cigarette, wood, or charcoal)
- Lemon juice
- Vinegar
- Soft drinks such as 7-Up or Sprite

**Note:** “Patriotic Colors” is a CHE 106 experiment based on the copyrighted lab sold by Universe of Science, Inc., Moravian Falls, NC. CHE 106 students purchase the kit indirectly through the Parkland College Bookstore. While the directions below were written by instructor Kristine Young and revised by Virginia Lehmann and Laura
Sonnichsen, the idea for the experiment as well as the specific directions are the copyrighted material of University of Science, Inc., and all credit is given to that entity.

Lab Directions:
Perform the lab as directed using the kit instructions. The directions for each experiment are also repeated below (with slight modifications) – make sure that your kit instructions match those given. If they don’t match, do the ones given. Even if they don’t match, you should be able to find the corresponding experiment. Read it over for extra information not repeated in the repeated kit directions.

Hint – when making observations you want to note things such as appearance (clear or cloudy), color, solid formation, gas formation, etc. Please note that “clear” and “cloudy” are NOT an indication of color. You need to indicate BOTH color and whether it is clear or cloudy.

Note: if your tap water is hard, it is recommended that you use distilled water instead of tap water throughout the lab.

1) Read page 1 of the kit packet (gives safety information & kit contents.)

2) Perform Experiment 1 on pages 3 & 4 as described in the kit packet and answer the following questions for credit.

Kit Directions: You will make 4 colorless solutions, then use one solution to turn the other 3 different colors. Keep caps on the bottles when you are not using them.

Take four plastic cups and put about 30 mL of water into each cup (about half full). You can measure with the 50 mL beaker or your graduated cylinder. You will add a different chemical to each cup and make four different colorless solutions. Label the cups as A, B, C, D.

A. Squirt about 10 drips of Phenolphthalein Solution in cup A. Phenolphthalein is pronounced fe-nol-thal-en.
B. Add 5 small scoops of Calcium Chloride to cup B. Stir, with the stick, until the crystals dissolve (go into solution). At this point, no crystals
should be visible – it should look like plain water. Feel the cup – heat is
given off when calcium chloride dissolves.
C. Squirt about 10 drops of the Disappearing Ink (Thymolphthalein Solution)
into cup C. Thymolphthalein is pronounced thy-mol-thal-en. The blue
color should disappear when it is put in the water. If it does not, add one
citric acid crystal and stir. Water from different locations may have
different amounts of acidic substances that react with the Disappearing
ink. If necessary, and another citric acid crystal to make the disappearing
ink in cup C colorless.
D. Add 3 small scoops of the sodium carbonate to cup D. Stir to completely
dissolve the crystals. This will be the Reappearing Solution. You will use
this to make the other solutions in the next experiment.

Take cup D (sodium carbonate reappearing solution) and the plastic dropper.
The dropper is called a pipet (pronounced pie-pet). Put the dropper tip in the
reappearing solution and squeeze slightly. Notice that air bubbles come out.
Keep the dropper in the liquid and release the bulb. Look at the liquid move
up the dropper. Squeezing the air out creates a vacuum, or empty space.
Releasing the bulb allows the liquid to move into the empty space and fill the
dropper. Lift the dropper with the liquid in it and practice squeezing it, so that
one drop comes out at a time back into the solution.

Now, squeeze a few drops of the reappearing solution into each of the other 3
cups (A, B & C). You should get red, white, and blue. If the colors are too
light, try adding a little more reappearing solution. The sodium carbonate
solution reacted with and changed the composition and the structure of the
chemicals that you put in cups A, B & C. These changes are chemical
reactions.

Look closely at cup B – you will see that the white color is actually a white
solid that was formed from the sodium carbonate and calcium chloride. The
name of the white product is calcium carbonate. Save these solutions for the
next experiment.

Question #1: (2 points) Record your observations for Experiment #1. Be detailed!
Include the two reactants initial color, clarity and physical state as well as the
product color, clarity and physical state.
3) Perform Experiments 2 and 3 on page 5 of the packet and answer the following questions for credit:

**Kit Directions:** When experimenting, add a small amount of the material and stir to give it a chance to react. It is always easier to add more than to remove some.

**Experiment 2:** To make the red, white & blue colors disappear, use a clean small scoop and shake just a few citric acid crystals into each of the red, white & blue cups (cups A, B & C). The colors should disappear and the white solid will dissolve. If the colors do not disappear, add a few more citric acid crystals.

The citric acid crystals are reacting with each colored substance to form the colorless substances you started with in experiment 1. Look carefully as the citric acid reacts. You may see bubbles form. The citric acid crystals are reacting with and neutralizing the sodium carbonate solution and carbon dioxide gas is produced. When the fizzing and bubbling is finished, the reaction is complete and neutralized. But, even though the chemicals have been neutralized and are not visible, they are not gone.

**Experiment 3:** In the last reaction, you made the colors disappear. You can make the colors reappear. Use the plastic dropper and add a little more of the sodium carbonate reappearing solution (cup D), one drop at a time, to each of the 3 colorless solutions (cups A, B & C) from experiment 2 until the red, white & blue reappear. Watch the reaction as the drops hit the solutions.

**Question #2:** (3 points) Record your observations for Experiments 2 and 3. Be detailed! Note: These observations will be asked as fill-in-the-blank questions on Cobra, in which case complete sentences are not necessary on this question.

**Question #3:** (2 points) Write the complete chemical equation for the reaction of citric acid ($\text{HC}_6\text{H}_7\text{O}_7$) and calcium carbonate to produce carbon dioxide, water and a third product that you observed in Experiment 2 (when you added the citric acid to the cups).

*HINT:* To use superscripts and subscripts, click the icon on the Cobra answer box and then the down arrow next to the $\text{U}$. Please note that these are toggles, and so therefore must be turned both on AND off.

**Question #4:** (2 points) If you had produced 0.5 g of calcium carbonate in Experiment 1, how many grams of citric acid would you need to add to react completely with the calcium carbonate in Experiment 2? Use the chemical equation you wrote in Q3 to help answer this question. And show your work!

**Question #5:** (2 points) Explain what is meant by a reversible reaction. Use Experiments 1, 2 & 3 to discuss reversible reactions.
4) Perform any **TWO** of the following three Experiments: 5, 6, or 7. For credit, answer the following two questions:

**Kit Directions:**

**Experiment 5:** Most household cleaning solutions are base. Let’s try to find some household chemicals that will work like the sodium carbonate reappearing solution.

Make up more of the colorless phenolphthalein solution (cup A in experiment 1). Pour a little of it into several cups. Add a little ammonia to one cup. Add laundry detergent to another cup (note – it is best if the detergent is not colored!). Did either turn the phenolphthalein red?

**Experiment 6:** Sodium carbonate because it was extracted or taken out of wood ashes by early chemists and pioneers who used it to make soap.

Find a small amount of ashes from a cigarette, wood fireplace, or charcoal grill. Put the ashes in a cup, half filled with water, and stir.

Now, take the funnel, the beaker, and a piece of paper towel (about 3-4 inches wide) and put the paper in the funnel and set the funnel in the beaker. Pour the mixture of water and ashes into the paper and funnel and collect the solution in the beaker. The solution that comes through the filter is called the filtrate.

Add a few drops of phenolphthalein solution to the filtrate. Record your observations.

**Experiment 7:** Try and find household chemicals that will work like the citric acid. Try lemon juice, vinegar, or drinks like 7-Up or Sprite to see if they can turn the red, white & blue solutions colorless.

Prepare the red solution (phenolphthalein or cup A) from the end of experiment 1. Divide the solution into 3 cups. Add a little lemon juice to one cup. Add vinegar to another cup. Add 7-Up or Sprite to the third cup. Record your observations.

**Question #6:** (2 points) For the first experiment you performed (experiment 5, 6, or 7), do all the following:

a) List the experiment number (#5, #6 or #7).

b) Describe all of the steps of your procedure. Include details about the types and quantities of all materials and equipment used. You should have enough detail so that a reader can replicate your exact experiment, using only your experimental description.

c) Report the results of your experiment.

d) Explain the results using chemical terms.
Question #7: (2 points) For the second experiment you performed (experiment 5, 6, or 7), do all the following:
   a) List the experiment number (#5, #6 or #7).
   b) Describe all of the steps of your procedure. Include details about the types and quantities of all materials and equipment used. You should have enough detail so that a reader can replicate your exact experiment, using only your experimental description.
   c) Report the results of your experiment.
   d) Explain the results using chemical terms.

5) Skip ahead to Experiment 13 on page 12. Read it and use it to help you design an experiment to find out whether exercising or increased activity increases the amount of carbon dioxide you exhale. Answer the following question for credit:
   Kit Directions:
   Experiment 13: Analyze means to examine. In this experiment, you can analyze exhaled air for the presence of carbon dioxide.

   Put 5 drops of disappearing ink in a cup of water. Add 1-2 drops of reappearing solution to make it blue. Take a straw and blow into the blue solution until it becomes colorless. Be careful. Do not drink it.

Question #8: (5 points) Use steps of the scientific method to describe your experiment and analyze results. For full credit consideration, you should include a problem statement, a hypothesis, a description of the experiment, an analysis of data, a looping back to an earlier part of the scientific method (if needed), a conclusion, and a theory or law statement (if pertinent). Include your actual data with appropriate units.

These are all of the experiments that you need to do for CHE 106. I encourage you to perform some of the other experiments just for fun...in fact Experiment 12 may make a great party trick!

Looking ahead...
Hold on to the dropper, beaker, funnel, cups & chemicals from this lab kit. You may find them useful in future labs.

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This lab was created by Kris Young and revised by Laura Sonnichsen and Virginia Lehmann. You are welcome to copy and distribute the lab so long as credit is given. Ver.062011