SCIENCE LAB PREP WORK

LAB DATE: January 8, 2007

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LAB TITLE: Atoms, Elements & Compounds

INTRODUCTION:

Scientists recently reported that they had created a new element, element 118. But what exactly is an element? What is it made of? What makes something an element? In this lab we will study some of the basic building blocks of chemistry – atoms, elements, and compounds. We will study a substance that you already know a lot about – water. Using a process called electrolysis we will cause a reaction in which water breaks down into its component pieces: hydrogen and oxygen.

PURPOSE:

To answer the following questions –

1. What is an atom?
2. What is an element?
3. What is a compound?
4. What is the law of conservation of matter?

HYPOTHESIS:

1. What is an atom?

I hypothesize that an atom is a combination of protons neutrons and in the outer shells electrons. Most of an atom is empty space. The electron travels rapidly through shells of the atoms electron cloud. There are many shells of an atom the first shell contains two electrons the second shell contains eight electrons and the third shell eighteen fourth shell thirty two and the fifth and sixth are the same. Protons and neutrons are contained in the nucleus of the atom. Protons are positively charged and the neutrons are neutral. Electrons are negatively charged. The atomic mass is the total amount of protons and

neutrons.

2. What is an element?

I hypothesize that elements have all different amounts of atomic masses. And that they are different because they have different amounts of protons, neutrons and electrons.

3. What is a compound?

I hypothesize that a compound is a combination of two or more elements.

4. What is the law of the conservation of matter?

I hypothesize that the law of conservation of matter is where matter is transferred from on atom to another.

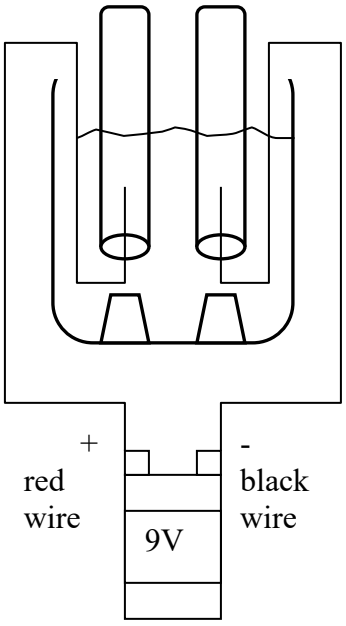
MATERIALS & EQUIPMENT:

- ❒ Water
- ❒ Salt
- ❒ 250 ml beaker
- ❒ 2 Test tubes
- ❒ 2 Test tube stoppers
- ❒ Test tube rack
- ❒ Red coated copper wire
- ❒ Black coated copper wire
- ❒ Steel wool
- ❒ Wire cutter
- ❒ 9 V battery
- ❒ 2 Wood splints
- ❒ Gas lighter
- ❒ Stands, tape, clamps, etc. to secure the test tubes

PROCEDURE

SAFETY PRECAUTIONS: This lab requires that you wear your safety goggles at all times.

1. Fill the 250ml beaker with 200 ml of water.
2. Add 20 g of salt (NaCl) to your water and stir until dissolved.
3. Fill two test tubes to the very top with salt solution and set aside.
4. Place the two test tube stoppers at the bottom of the salt water filled beaker.
5. Cut a length of red copper wire and a length of black copper wire and remove roughly 2cm of rubber coating from each end.
6. Scuff the ends of the wires using steel wool .
7. Construct the following experimental set-up:



IMPORTANT NOTES:

- Do not attach the wires to the battery yet.
- Keep the wires separated
- Invert and submerge the test tubes without allowing any air to get inside them (use your finger to cover the ends as you invert them)
- Be sure that the stoppers are directly below the open ends of the test tubes.

8. Attach the black wire to the negative terminal on the battery
9. CAREFULLY hook the red wire onto the positive terminal on the battery making sure not to touch the stripped wire.
10. Watch what happens. Record your observations.
11. Once one of the test tubes is half full of gas disconnect the battery.
12. Cap the test tubes by lowering them onto the stoppers.
13. Remove the test tubes from the beaker and record what you see.
14. Place the sealed tubes in the test tube rack.

YOUR TEACHER MUST SUPERVISE THE NEXT SEVERAL STEPS. DO NOT CONTINUE WITHOUT ASKING FOR HELP FROM YOUR TEACHER.

14. Light a wooden splint, blow out the flame but leave an ember glowing.
15. Hold the test tube with the least amount of gas below the ember and remove the stopper. Record what happens.
16. Light the other wooden splint and hold it above the tube with the most gas and CAREFULLY remove the stopper. Record what happens.

DATA TABLES AND OBSERVATIONS:

When I hooked the red wire onto the positive terminal on the battery the bare end of the black wire immediately started to bubble. The bubbles rose up to the surface of the salt water in the test tube and the large ones popped creating empty space in the test tube. The smaller ones began to sink around half way down to the bottom of the test tube and then combined with other bubbles floating up and then rose up to the surface when they were big enough. As this goes on for a few minutes the top of the test tube (which was completely filled with salt water) begins to become more and more empty.

While the salt water level is dropping it is revealing a white crust on the inside of the test tube. As all this is happening the test tube with the red wire is not doing anything that I could see. At this point the beaker smelled almost just like the pool. Approximately ten minutes later a white foggy substance seems to collect on the bottom of the 200 ml beaker. It begins to grow deeper over time. Around five minutes later a orange solid begins to form over the white foggy substance but only under the black wire. Another five minutes later the orange solid begins to grow larger. When we removed the test tube

the orange had been concentrated in one particular area and when it was stirred it filled the entire 200 ml beaker with a bright yellow liquid.

When the test tube with the black wire reached half empty we pick it up and while keeping the top of the test tube partly submerged we plug it with the test tube stopper. When we released the test tube stopper the gas immediately caught flame and made a loud plopping noise as if someone was pulling a suction cup off a glass window. The flame was a little blue at the top but mostly red at the bottom. It came and went very fast. The area also smelled of smoke for a short period of time.

DATA ANALYSIS:

Doing this lab helped me better understand what happens when you run electricity through salt water. I learned that the bubbles floating up from the negative electrode was not air, but it was hydrogen gas. I also learned that the loud popping noise was in fact the hydrogen exploding. I also learned about what different kinds of bonds went on in the experiment. I did this experiment to increase my knowledge of elements and compounds. I was surprised to discover that by just adding salt you can come out with very different results than by not adding salt. I was also very surprised with the fact that even one small amount of hydrogen and a very small amount of oxygen combined with one small little ember can make a large explosion. I was also surprised to discover that salt water is a better conductor of electricity that water without salt. My observational data indicates that oxygen gas did not form on the positive electrode. That is because part of the salt in the water combined with the oxygen in the water not allowing it to become oxygen gas. It

would be interesting to conduct further research to see what happens if we did not add salt to the water. And it would be interesting to find out when the oxygen did not combined with salt in the water how much space the hydrogen took up compared to the oxygen. I hypothesize that if I was to perform that experiment that the oxygen would take up more space than the hydrogen because the oxygen is so much larger than hydrogen even though for every one oxygen molecule there is two hydrogen molecules. It is worth noting that there may have been a small amount of air in the negative electrodes test tube. If there was a small amount of air I don't think it would have changed our results in any dramatic way.

QUESTIONS TO CONSIDER:

1. Which gas formed at the negative electrode? Why?

Hydrogen gas formed on the negative electrode and rose to the top. The reason why the hydrogen formed on the negative electrode is that the hydrogen was separated from the water molecule because it was attracted to the negative electrode.

2. Why didn't any gas collect at the positive electrode?

No gas formed on the positive electrode because the electrode was positive and the hydrogen wasn't attracted to the positive electrode and the oxygen was not attracted to the positive electrode because it combined with the salt.

3. Why did we add salt to the water?

We added the salt because it is a better conductor of electricity.

4. Is water a compound, and element, or an atom?

Water is a compound because it is composed of hydrogen and oxygen which are both elements.

5. Are the gases in your test tubes compounds, elements, or atoms?

The gases in our test tubes are elements.

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6. Draw a water molecule, an oxygen molecule, and a hydrogen molecule. How are the hydrogen and oxygen molecules different from hydrogen and oxygen atom?

The hydrogen molecules consist of two hydrogen atoms these atoms consist of protons, electrons and a varying amount of neutrons depending on the isotope. The oxygen molecule is much like the hydrogen molecule. It also consists of two oxygen atoms and within these atoms are protons, neutrons and electrons.

CONCLUSION:

I learned the answer of the four purpose questions. After doing this lab I realized that my hypothesis was partly correct. These are my answers to the purpose questions after doing the lab.

What is an atom?

An atom is the smallest part of an element having the chemical properties of the element.

What is an element?

An element is any of the more than 100 known substances that alone or combined make up all matter.

What is a compound?

A substance formed by combining two or more elements.

What is the law of conservation of matter?

Matter is neither created or destroyed, but is combined and rearranged in different ways.

This lab did trigger one additional question:

What would happen if we did not add salt to the water?

In my opinion I would say that the effectiveness of this lab was very high. I liked it a lot.

EXTRA CREDIT:

You may have heard about new "hybrid" cars that use hydrogen fuel cells. How might this lab relate to the way that a hydrogen fuel cell works?

In a hydrogen fuel cell they do something very similar to what we did in our lab. They separate hydrogen from water by running electricity through the water. However they do

it on a much larger scale.

WEB LINKS:

http://en.wikipedia.org/wiki/Electrolysis

http://hogan.chem.lsu.edu/matter/chap26/animate1/an26_005.mov