Experiments With Water

Name: _____

Date: _____

Information: Cavendish's Experiments

Henry Cavendish was a scientist who lived in the 1700s during the same time period as Priestley and Lavoisier. Cavendish did experiments with acids. What do you know about acids? You probably know that acids can dissolve things like metals. Spilling acid on your hand could result in a burn or skin irritation.

In his experiments with acids, Cavendish discovered that when he poured an acid onto a metal a gas was formed. He collected a container of this gas and found that a candle would not burn inside of it. Because a candle would not burn, he called the gas, "inflammable air."

Next he mixed the inflammable air with regular air. He got his candle ready and lit it. He was very surprised to find that an explosion was the result! Pure inflammable air would not allow a candle to burn. But if regular air was present the inflammable air explodes! After the explosion, Cavendish noticed that a steam-like gas formed tiny droplets on the side of the container. Cavendish learned that these droplets were actually water!

Critical Thinking Questions

1. Up until the time of Cavendish most people thought water was an element. After he did his experiments, do you think Cavendish believed that water was an **element**? Explain and give evidence from his experiments.

   No. Since water could be made from "inflammable air" (now called hydrogen) it must not be an element.

2. How is "inflammable air" similar to and/or different from "azote"?

   A candle won't burn in pure inflammable air just like it won't burn in azote (now called nitrogen). However, azote never exploded when burned mixed with air.

3. What needs to be mixed with "inflammable air" to make it become flammable?

   Regular air

Information: Lavoisier's Water Experiment

Lavoisier did an experiment with water. He passed steam through a super hot iron rifle barrel, as depicted in Figure 1:

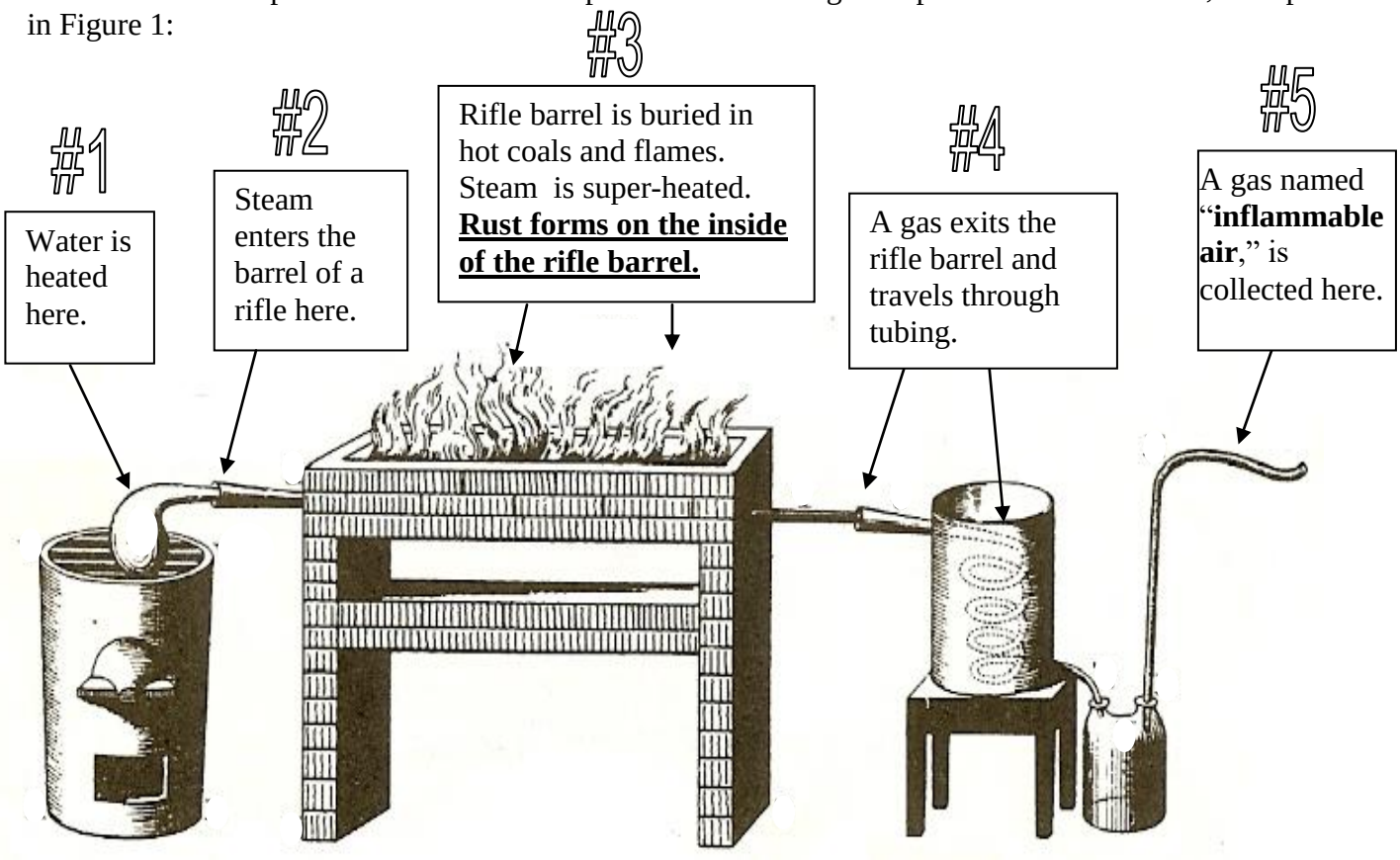

Figure 1: Lavoisier's Water Experiment

Critical Thinking Questions

4. Study the diagram of Lavoisier's experiment. Lavoisier concluded that water is definitely not an element. What evidence from his experiment supports his claim that water is not an element?

   Water was somehow broken down into inflammable air (hydrogen) and a perhaps part of the rust. (We now know that the oxygen atoms from water combined with iron to form rust, which left the hydrogen atoms from oxygen behind.)

5. How do you think Lavoisier tested the gas he collected to determine that it was inflammable air instead of azote?

   He could mix it with air and light a candle to see if it would explode.

6. Is rust an element? Explain.

   No. Rust was formed from a portion of the water and iron.

Information: Lavoisier Makes Water!

In a later experiment, Lavoisier combined inflammable air and oxygen to get water. He discovered that 2 parts of inflammable air with one part of oxygen formed water (along with an explosion) after a spark was introduced.

Let's compare air and water for a moment. Air is approximately 19% or 20% oxygen and 79% nitrogen along with small amounts of carbon dioxide and other gases. Humidity (which is water vapor) is also a component of air and the amount of humidity can vary with the weather. Sometimes air can become polluted with small amounts of other gases. Air is still called "air" no matter if it is 20% oxygen or 18% or some other percent. Water, however, is *always* ONLY 2 parts of inflammable air for every 1 part of oxygen.

Critical Thinking Questions

7. Both air and water are made of more than one component. Air is an example of a **mixture**. Water is an example of a **compound**. What is the difference between a mixture and a compound?

   A compound always has a fixed composition whereas a mixture could be formed with a little or a lot of the particular ingredients.

8. Both elements and compounds fit into a category called "**pure substances**." Mixtures, however, are not pure substances. As best you can, define what it means for something to be a pure substance.

   Basically, pure substances are substances that cannot be made simply by mixing ingredients together. All matter is either mixed (a mixture) or not (a pure substance).

9. Salt water is made by dissolving salt in water. You could dissolve one or two or three teaspoons of salt in a glass of water to make salt water.

   a) Is salt water a pure substance or a mixture? Explain how you know.

   It is a mixture because its composition is not fixed.

   b) Is salt water a compound? Explain.

   No because mixtures are never compounds. Compounds have fixed proportions.

10. Salt is formed from the elements sodium and chlorine.

    a) Is salt an element? Explain.

    No. Elements cannot be made from other elements.

    b) What information do you need before you can determine if salt is a pure substance or a mixture?

    We need to know if the proportions of sodium and chlorine are always constant when forming salt.

11. There are two different kinds of mixtures. The two categories of mixtures are defined based on how well the components mix. Salt water is an example of a "homogeneous" mixture. (The prefix "homo-" means "same.") Oil and water is an example of a "heterogeneous" mixture. (The prefix "hetero-" means "different.")
    a) Define homogeneous:

    Evenly mixed, uniform throughout.

    b) Define heterogeneous:

    A portion of the mixture will differ from another portion of the mixture.

12. Are compounds homogeneous or are they heterogeneous? Explain.

    Homogeneous

13. Are elements homogeneous or are they heterogeneous? Explain.

    Homogeneous

14. Is the air in the room you are in right now homogeneous or is it heterogeneous? Explain.

    Answers may vary. If someone is wearing perfume, then the air in that person's immediate vicinity will be different from the air across the room. Generally, we usually consider air to be very evenly mixed.

15. Milk purchased at the grocery store has the word "homogenized" on the label. It is different from milk straight from the farm because it has been "homogenized." On the farm, the cream in the milk rises to the top and you need to shake it before you drink it. What do you think the process of homogenization tries to accomplish?

    They want to make the milk homogeneous to keep the cream from separating.