Does Mass Change in Chemical Reaction?

Name_____

Intro

During this lab we will perform an experiment similar to that of Lavoisier. Instead of burning metal we will be reacting baking soda ($NaHCO_3$) with hydrochloric acid (HCl).

Materials

- triple beam balance
- baking soda
- 1 ginger ale bottle with cap
- test tube
- square of paper

Procedure A (open container):

1) Using your 150 ml beaker obtain about 50 ml of HCl. **Note: Be very careful with HCl. If you get any on your hands, wash them immediately.**
2) Pour the 50 ml of HCl into your ginger ale bottle.
3) Crease the square of paper down the middle and measure its mass.
4) Keeping the paper on the balance, place about three grams of baking soda on it. The exact amount is not crucial just measure out between 2.5 - 3.0 grams. However, you should precisely record the amount used.
5) Get a test tube that will fit completely inside the bottle. Test this by sliding the mouth of the test tube into the mouth of the bottle. If none of the tubes in your drawer fit then exchange one of them for a test tube from the supply bench.
6) Pour the baking soda into a test tube.
7) Now place the bottle and the cap on the balance with the baking soda in a test tube, and record the mass of everything together.
8) Carefully slide the test tube into the bottle so that the two chemicals don't mix. DO NOT PUT THE CAP ON. Tilt the bottle to the side until the acid and baking soda mix. Move the bottle around to make sure everything reacts, but take care not to spill anything.
9) After all fizzing has stopped, place the bottle back on the balance with the cap and record the total mass after the reaction.
10) Empty the bottle into the sink and rinse everything with water.

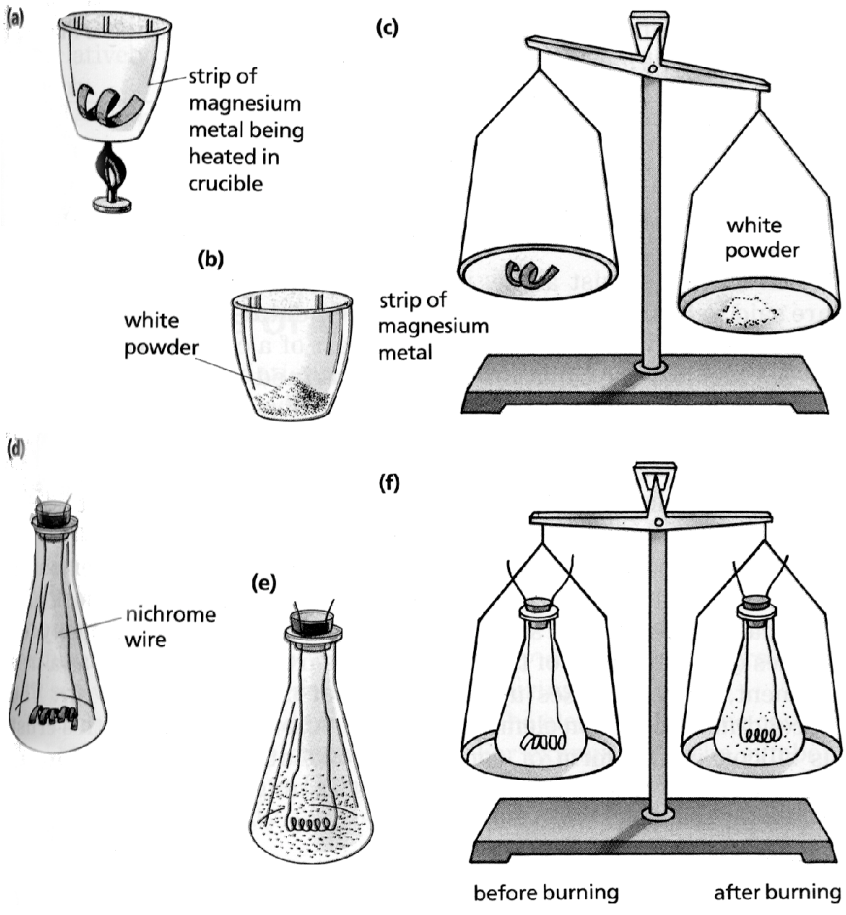
Procedure B (closed container):

Repeat all measurements and observations for procedure A, ***except*** <u>cap the bottle tightly before performing the reaction.</u> Label all measurements and observations below.

From Prentice Hall - Chemistry: The Study of Matter (1989).

At the time that Lavoisier was investigating the process of burning, it was known that when certain metals were heated in air, they formed a new substance called a calx. It also was known that the calx weighted more than the original metal. To the scientists of the time, this seemed to show that a change in weight (or mass) could occur during a chemical change. Lavoisier believed, moreover, that in the increase in weight was the result of the metal combining with a substance from the air. In a famous experiment, Lavoisier heated tin and air in a sealed container. Lavoisier found that the weight of the container and its contents did not change as the metal changed to a calx. However, when the container was opened, air rushed in to replace the gas that had combined with the tin. The container now showed an increase in weight. Experiments of this kind led Lavoisier to conclude that matter cannot be created of destroyed by a chemical change. This principle became known as the law of conservation of mass. See figure below.

For all practical purposes, this law is true for all ordinary chemical changes. No measurable change in mass takes place during ordinary chemical reactions. However, it is possible for a measurable amount of mass to be converted to energy by changes in the nuclei of atom. The energy given off by the sun is the result of such a process. The same is true of energy generated in nuclear power plants.



Caution: Do not try this at home. Heating any sealed container can be very dangerous.

An investigation of the process of burning similar to that done by Lavoisier. (a) A strip of magnesium metal. (b) The white powder that is formed when the magnesium metal is burned. (c) The white powder weighs more than the strip of metal. (d) If magnesium metal is wrapped around the nichrome wire, and the battery is then connected to the ends of the wire, the magnesium metal will burn, forming the white powder shown in (e) (This is a dangerous procedure that should only be done under supervision.) (f) This time, there is no weight change before and after the burning. Flask and contents in (d) weigh the same as flask and contents in (e).

1) **ON A SEPARATE SHEET OF PAPER:** Copy your data neatly so that it is organized and complete. Each measurement should have a label and unit. Ex. mass of paper = 1.05 g. Determine in each experiment if mass was gained or lost. **Show all work**.
2) Describe Lavoisier's experiment. What were the similarities and differences between our experiment and his?

3) State the Law of the Conservation of Mass. Did your experiment verify this law? Why or why not?

4) If the Law of Conservation of Mass is true (and it is), then you should have found no mass change in the second experiment when the cap was ON the bottle. If your mass did change during that expeirment, what might be some explanations for why your mass changed.

5) Calculate the percent error found in your second experiment, and add this to your separate data/calculation sheet.

observed value = mass after reaction
expected value = mass before reaction (because the mass shouldn't have changed)

$$\% \text{ error} = \frac{|\text{ observed value } - \text{ expected value }|}{\text{expected value}}$$