SNC2D CHEMISTRY

CHEMICAL REACTIONS

☞ Conservation of Mass (P.176-177)

Activity: Measuring Mass (Part 1)

INSTRUCTIONS (CLOSED SYSTEM)

A. Measure ~ 30 mL of vinegar (acetic acid) into a small Erlenmeyer flask.
B. Using a scoopula, place a small amount of baking soda (sodium hydrogen carbonate powder) into a small balloon.
C. Carefully place the balloon over the mouth of the Erlenmeyer flask, ensuring the vinegar and baking soda do **not** mix.
D. Using a balance, measure and record the total mass of the assembly.
E. Tip the balloon up and empty it's contents into the Erlenmeyer flask. Ensure the balloon does fly off. Record your observations.
F. Once the reaction has stopped, measure and record the mass of the assembly again.
G. Clean up your work area but remain where you are.

Activity: Measuring Mass (Part 1)

QUESTIONS

1. What evidence of a chemical change did you notice?
2. Compare the total mass of the Erlenmeyer flask/balloon assembly before and after the reaction. What do you notice?

1. bubbles of gas are produced, change is difficult to reverse
2. total mass of assembly before and after should be relatively the same

Activity: Measuring Mass (Part 2)

INSTRUCTIONS (OPEN SYSTEM)

H. Fill a small test tube ~ half full with of vinegar (acetic acid).
I. Using a scoopula, place a small amount of baking soda (sodium hydrogen carbonate powder) into a small beaker.
J. Carefully place the test tube into the beaker, ensuring the vinegar and baking soda do **not** mix.
K. Using a balance, measure and record the total mass of the assembly.
L. Empty the contents of the test tube into the beaker. Ensure that the reaction does not spill over. Record your observations.
M. Once the reaction has stopped, place the test tube back into the beaker and then measure and record the mass of the assembly again.
N. Clean up your work area and put your equipment away.

Activity: Measuring Mass (Part 2)

QUESTIONS

3. Compare the total mass of the beaker/test tube assembly before and after the reaction. What do you notice?
4. Compare the results of the two experiments. What do you notice? Explain any difference.

3. total mass before should be greater than the total mass after
4. in the closed system mass was conserved – in the open system mass was lost – the gas lost must have mass

Chemical Reactions

The most important advancement in understanding what happens during chemical reactions was made about two centuries ago by the French chemist Antoine Lavoisier, with the assistance of his wife and research colleague Marie-Anne Paulze. The couple made meticulous measurements of the masses of reactants and products in many kinds of chemical reactions.

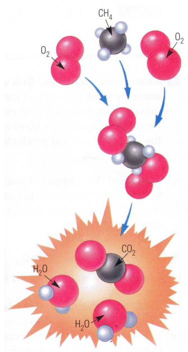
Chemical Reactions

What they discovered was that the total mass of reactants and the total mass of products in a given reaction are always the same. Another way of saying this is that the mass is conserved (i.e. the mass does not change during a chemical reaction). No known exceptions to this have ever been observed. For this reason, this experimental result has come be known as the ***law of conservation of mass****.*

Law of Conservation of Mass

NOTE!

The law of conservation of mass is very important in understanding what happens to the atoms in chemical reactions. It implies that no atoms are destroyed and no new atoms are produced during a chemical reaction. Instead, the atoms in the reactants of a chemical reaction are simply rearranged to form the products. Chemical bonds between atoms are broken and new ones are formed, and the atoms simply reconnect in new ways.

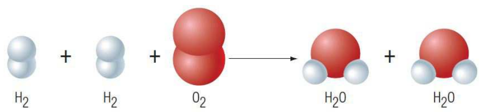


Counting Atoms in Reactants & Products

The rearrangement of atoms that occurs during a chemical reaction can be illustrated using models or diagrams. Consider a vehicle that runs on electricity produced in a fuel cell. The electricity comes from a reaction between hydrogen gas and oxygen gas to form liquid water. The equations for these reaction are:

word equation: *hydrogen + oxygen ➜ water*

chemical equation: $H_{2(g)} + O_{2(g)} \rightarrow H_2O_{(l)}$

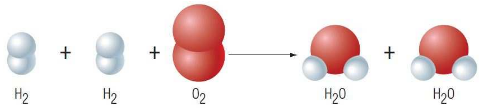


Counting Atoms in Reactants & Products

In the illustration, there are equal numbers of hydrogen atoms (four) and equal numbers of oxygen atoms (two) on both the reactants side and the products side. When the number of each kind of atom is the same on both sides of the chemical equation, the equation is said to be balanced!

word equation: *hydrogen + oxygen ➔ water*

balanced equation: $2H_{2(g)} + 1\,O_{2(g)} \rightarrow 2H_2O_{(l)}$



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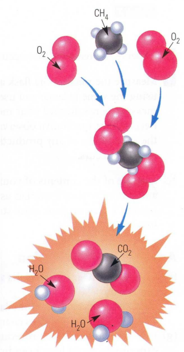
Law of Conservation of Mass

LAW OF CONSERVATION OF MASS

- total mass of reactants
  = total mass of products
- total # of reactant atoms
  = total # of product atoms



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Law of Conservation of Mass

PRACTICE

1. When a forest fire occurs, the ashes that remain have a much lower mass than the trees that burned. Does this break the law of conservation of mass? Why or why not?

   no – the reaction involved the production of gases that escaped

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Law of Conservation of Mass

PRACTICE

2. A solid has a mass of 35 g. When it is mixed with a solution, a chemical reaction occurs. If the total mass of the products is 85 g, what was the mass of the original solution?

   $m_{solution}$ = 50 g

Law of Conservation of Mass

PRACTICE

3. Solution A has a mass of 60 g. Solution B has a mass of 40 g. When they are mixed, a chemical reaction occurs in which a gas is produced. If the mass of the final mixture is 85 g, what mass of gas was produced?

   m_{gas} = 15 g

Law of Conservation of Mass – DYK?

The law of conservation of mass has implications far beyond the laboratory. Think about engines that use fuels as a source of energy. When cars burn gasoline, energy is released during the chemical reaction of combustion. However, since mass is conserved, all of the mass of the fuel is still present in some form after combustion occurs.

Law of Conservation of Mass – DYK?

NOTE!

Every kilogram of fuel mixed with oxygen in an internal combustion engine produces 3 to 4 kg of water vapour and carbon dioxide gas, as well as pollutant gases such as nitrogen oxides and unburned hydrocarbons.

Law of Conservation of Mass

ENVIRONMENTAL CONCERN

- when cars burn gasoline, energy is released
- since mass is conserved, all the fuel is still present as H_2O, CO_2 and other pollutants

✔ Check Your Learning

1. (a) Why does bread rise?
   (b) How do you think the mass of the bread would compare to the original total mass of the ingredients in the recipe?

   (a) the yeast reacts with the sugar – produces carbon dioxide
   (b) should be slightly lighter – gases have escaped

✔ Check Your Learning

TEXTBOOK
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