The Fundamental Laws of Chemistry

Indicator:
Explaining the Law of Conservation of Mass or Lavoisier’s Law.

Objectives:
1. Students are able to prove the Law of Conservation of Mass by doing experiment.
2. Students are able to understand the Law of Conservation of Mass by a video.
3. Students are able to do the task and evaluation.

Basic Competency:
Proving and communicating the application of the fundamental laws of chemistry by an experiment and also applying the mole concept in stoichiometry.

Standard Competency:
Understanding the fundamental laws of chemistry and its application in stoichiometry.

Indicator:
Explaining the Law of Conservation of Mass or Lavoisier’s Law.
The modern chemistry emerged in the eighteenth century, when chemists began to use the balance or scale, such as shown in Figure 1.1(Balance or scale), systematically as a research tool. Scale measures mass, which is the quantity of matter in a material. Matter is a general term for the physical substance around us. Matter can be defined as whatever occupies space and can be perceived by our sense.

The law of conservation of mass also inspired Dalton when he declared his atomic theory. Dalton declared that atom is the tiniest and smallest ball, cannot be cracked, created, or disappeared. Not only that, the law of conservation of mass can also answer the question of. “Why equation of reaction has to be balanced? Look at this reaction!

\[ 3\text{F}_2 + 2\text{H}_2 \rightarrow \text{F}_2 + 4\text{HF} \]

This reaction shows that the total atom of fluorine and hydrogen is equal in the right and left side, its mean that the reaction is balance.
Reaction of Marble (Calcium Carbonate) and Hydrochloric Acid Solution

Materials and Equipments:
1. Digital Balance
2. Erlenmeyer 250 mL picture (b)
3. HCl Solution 0.1 M 25 mL
4. Balloon is filled with small piece of marble picture (c)

Experiment Procedures:
1. Put into a conical flask carefully 25 ml solution of 0.1 M HCl as shown in the picture. *Describe the hydrogen chloride solution.*

2. Weigh the conical flask containing 25 mL of HCl, and cover with balloon which contain with small pieces of marble together using a scale as shown in the picture. Record your observation.
3. Drop the marble into the solution and wait for 5 minutes until reaction occurs (shown in the picture below). Weigh the conical flask and all content. Compare your observation with one obtained in step 2.

4. Write the reaction equation for this experiment.

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**CHEM - TASK**

1. 24 grams of sulfur powder is reacted with oxygen to produce sulfur dioxide of 48 grams. How many grams of oxygen have been reacted?

2. 4 grams of calcium metal is reacted with 8 grams chlorine to produce calcium chloride. How many grams of calcium chloride have been produced?
Standard Competency:
Understanding the fundamental laws of chemistry and its application in stoichiometry.

Basic Competency:
Proving and communicating the application of the fundamental laws of chemistry by an experiment and also applying the mole concept in stoichiometry.

Indicator:
Explaining the Law of Definite Proportions or Proust’s Law.

Objectives:
1. Students are able to prove the Law of Definite Proportions by doing experiment
2. Students are able to understand the Law of Definite Proportions by a video.
3. Students are able to do the task and evaluation.
After 1800 chemistry was dominated by scientists who, following Lavoisier’s lead, performed careful weighing experiments to study the course of chemical reactions and to determine the composition of various chemical compounds. One of these chemists, a Frenchman, Joseph Proust showed that a given compound always contains exactly the same proportion of elements by mass. Proust found that the substance of copper (II) carbonate, CuCO$_3$, is always 5.3 part copper to 1.0 part carbon to 4.0 part oxygen (by mass).

Proust demonstrated the fundamental law of definite proportions: *In a given chemical compound, the proportions by mass of the elements that compose it are fixed, independent of the origin of the compound or its made of preparation.*

We may also use percentage of mass of atoms in a compound. For CuCO$_3$,

$$\% \text{ mass of Cu} : \% \text{ mass of C} : \% \text{ mass of O}$$

$$= \frac{1 \times \text{atomic mass of Cu}}{1 \times \text{atomic mass of Cu} + 1 \times \text{atomic mass of C} + 3 \times \text{atomic mass of O}} \times 100\%$$

$$= 51.43\% : 9.72\% : 38.85\%$$

Pure copper(II) carbonate always contains 51.43 % copper, 9.72 % carbon, and 38.85 % oxygen by mass. Pure sodium chloride contains 60.66 % chlorine and 39.34 % sodium by mass, whether it is obtained from salt mines by crystallizing it from ocean water, or synthesizing it from its elements, sodium and chlorine.
Play with Magnesium Ribbon

**Aims**
To find the Law of Definite Proportions and communicate it into experiment.

**Apparatus and Materials**
- Porcelain cup
- Balance
- Clamp
- Magnesium ribbon
- Oxygen

**Procedures**
1. Prepare the porcelain cup and its cover. Weigh and note its mass in \( m_1 \) column.
2. Prepare three magnesium ribbons (Mg) in different size.
3. Take 1 Mg ribbon and put down in porcelain cup. Weigh and note its mass in \( m_2 \) column.
4. Heat the porcelain cup in step 3. During warm-up, use the clamp to open cover of is place little by little so that oxygen on the air can enter.
5. After that, weigh it and note its mass in \( m_3 \) column.
6. Repeat step 3 until 5 with another ribbon.

**Note:** Keep white smoke which is formed not lost in step 4.
The Fundamental Laws of Chemistry

Experiment | Porcelain cup and its cover | Before heating mass | After heating mass | Magnesium mass which is reacted | Oxygen mass which is reacted | Magnesium mass which is formed |
---|---|---|---|---|---|---|
1 | m₁ | m₂ | m₃ | (m₂ - m₁) | (m₃ - m₂) | (m₃ - m₁) |
2 |   |   |   |   |   |   |
3 |   |   |   |   |   |   |

**DISCUSSION**

1. Write down the formula from the experiment!
   Answer:
   ........................................................................................................................................................................

2. Based on the experiment result, determine the ratio mass of Magnesium and oxygen which is reacted!
   Answer:
   ........................................................................................................................................................................
   ........................................................................................................................................................................
   ........................................................................................................................................................................

**CONCLUSION**

What is your conclusion from this experiment?
Answer:
........................................................................................................................................................................
........................................................................................................................................................................
........................................................................................................................................................................
........................................................................................................................................................................

Have a Good Job!!!!!
CHEM - TASK

1. The proportion of iron (Fe) mass and sulphur (S) mass in ferrous sulfate (FeS) is 7:4.
   a. How many grams of Iron can be reacted with 20 g of Sulphur?
   b. If 70 g of iron is reacted with 50 g of Sulphur, how many grams of Sulphur that has not reacted?
   c. How many grams of Iron and Sulphur have to be reacted to form 88 g of Ferrous Sulphide compound?

CHEM - QUIZ

“THE WAR OF PAPER BALL” QUESTION

AIM: To check your understanding about PROUST’S LAW.
RULE OF THE QUIZ:
1. Ask all students to stand up and divide into two groups (right and left group).
2. Give every student a piece of paper.
3. Ask every student to write one question about “The Law of Definite Proportions” in the paper without write their name.
4. Ask them to crumple up the question paper.
5. When teacher give command ‘Start’, The war between two groups is begun by throwing paper question each other as much as they can until teacher give command to ‘Stop’ after 10 seconds.
6. Ask student in each group to open the paper questions that they get and try to answer one by one in front of the class.
7. Teacher will give an addition when the group can’t answer the question.
8. The group that can answer the most question is the winner and get ‘a BIG PRIZE’.
Standard Competency:
Understanding the fundamental laws of chemistry and its application in stoichiometry.

Basic Competency:
Proving and communicating the application of the fundamental laws of chemistry by an experiment and also applying the mole concept in stoichiometry.

Indicator:
Explaining the Law of Multiple Proportions or Dalton’s Law.

Objectives:
1. Students be able to share and discuss about the Law of Multiple Proportions.
2. Students be able to understand the Law of Multiple Proportions by a video.
3. Students be able to do the task and evaluation.
In chemistry and physics, **Dalton’s law** (also called Dalton’s law of partial pressures) states that the total pressure exerted by a gaseous mixture is equal to the sum of the partial pressures of each individual component in a gas mixture. This empirical law was observed by John Dalton in 1801 and is now related to the ideal gas laws.

How can the law of conservation of mass and the law of definite proportions be explained? The answer of this question was provided by John Dalton (1766-1844), an English school teacher. In 1808 Dalton proposed a new theory of matter. Dalton reasoned as follows:

a. Element is made of tiny particles called atoms.
b. All atoms of a given element are identical in mass and in all other properties, but atoms of different element have different mass and properties.
c. Chemical reactions only rearrange the way the atoms are combined; the atoms themselves are unchanged.
d. Chemical combination of elements to make different compounds occurs when atoms of unlike elements join together in small whole-number ratio.

Dalton fourth postulate is clearly related to the law of conservation of mass, and the fourth one is an attempt to explain the law of definite proportions. Dalton fourth postulate also predicts the possibility of the same elements to combine in different ratio to give different compounds. So the summary of Dalton’s Law is **When two elements form a series of compounds, the different masses of one element that combine with the same mass of other element are in the ratio of small whole-number.**
Compounds A and B are colorless gases obtained by combining sulfur with oxygen. Compound A is obtained by combining 6.00 g of sulfur with 5.99 g of oxygen, whereas compound B is obtained by combining 8.60 g of sulfur with 12.88 g of oxygen. Prove that ratio of oxygen by mass in compound A and compound B is a small whole-number.

CHEM - DISCUSSION

Hydrogen and Oxygen can form water (H₂O). Both of this elements can form one compound. Beside water, both of this elements can form Hydrogen Peroxide (H₂O₂).

Source: http://bandungekspres.com
Source: http://breeze.blogdetik.com

Water (H₂O).
Hydrogen peroxide (H₂O₂)

Based on Dalton’s Law, explain how water and hydrogen peroxide can be formed (Make group to discuss about it, each of group consist from 4-5 peoples!)

CHEM - QUIZ

You must make 2 groups to began this quiz!
After that, make 5 questions about Dalton’s Law for each group and give the point behind the question (point can be discussed with your teacher).
Last, each of group must give question for another group to be answered. If your group can answer the question, you get the point, but if not you will loose your point. The Main purpose is to collect highest point.
Standard Competency:
Understanding the fundamental laws of chemistry and its application in stoichiometry.

Basic Competency:
Proving and communicating the application of the fundamental laws of chemistry by an experiment and also applying the mole concept in stoichiometry.

Indicator:
Explaining the Law of Combining Volume or Gay-Lussac’s Law.

Objectives:
1. Students are able to share about the Law of Combining Volume.
2. Students are able to understand the Law of Combining Volume by a video.
3. Students are able to do the task and evaluation.
Joseph Louis Gay-Lussac
(also Louis Joseph Gay-Lussac, 6 December 1778 – 9 May 1850) was a French chemist and physicist. He is known mostly for two laws related to gases, and for his work on alcohol-water mixtures, which led to the degrees Gay-Lussac used to measure alcoholic beverages in many countries.

Did You Know

A French chemist, Joseph Gay-Lussac, conducted some important experiments on the volume of gases that react one another to form new gases. He found that:

- 2 volumes of hydrogen react with 1 volume of oxygen to give 2 volumes of water vapor.
- 1 volume of nitrogen reacts with 1 volume of oxygen to give 2 volumes of nitrogen oxide.
- 3 volumes of hydrogen react with 1 volume of nitrogen to give 2 volumes of ammonia.

Based on his experiment, Gay-Lussac discovered the law of combining volumes: The volumes of two reacting gases (at the same temperature and pressure) are in the ratio of simple integers. Moreover, the ratio of the volume of each product gas to the volume of either reacting gas is the ratio of simple integers.

The combination of volume law can be used to determine the volume of reactants needed and its product result. The formula is:

\[ V_1 = \frac{a_1}{a_2} V_2 \]

\( V_1 \) = Unknown volume
\( V_2 \) = Known volume gas
\( a_1 \) = Unknown coefficient
\( a_2 \) = Known coefficient

Gay-Lussac did not theorize on his experimental findings, but shortly after he published his findings, an Italian chemist, Amedeo Avogadro, used them to formulate an important hypothesis.
CHEM - TASK

40 mL of N₂ gas reacted with 100 mL of O₂ gas, then it produces 40 mL of NₓOᵧ gas. Determine the chemical formula of NₓOᵧ!

CHEM - QUIZ

“BEACH BALL”

In this quiz all of students must be sit around in the class and the teacher stand in the center. Your teacher will throw the beach ball to 1 student and give him/her the question. The student must answer the question to continue throw the ball to another student. All of students must be ready to get the question and catch the ball. Question examples questions as follow:

1. Gay-Lussac famous by his Combining Volume’s Law, is it true?
2. The formula to support Gay-Lussac’s Law is.........
3. Gay-Lussac said that The volumes of two reacting gases (at the same temperature and pressure) are in the ratio of simple integers. Moreover, the ratio of the volume of each product gas to the volume of either reacting gas is the ratio of simple integers, is it true?
4. Combustion of ethane as follow:
   \[ 2\text{C}_2\text{H}_6(g) + 7\text{O}_2 \rightarrow 4\text{CO}_2(g) + 6\text{H}_2\text{O}(g) \]
   Volume of CO₂ which is formed in combustion of 3L ethane is.........
Standard Competency:
Understanding the fundamental laws of chemistry and its application in stoichiometry.

Basic Competency:
Proving and communicating the application of the fundamental laws of chemistry by an experiment and also applying the mole concept in stoichiometry.

Indicator:
Explaining the Avogadro’s Hypothesis.

Objectives:
1. Students be able to share about the Avogadro’s Hypothesis.
2. Students be able to understand the Avogadro’s Hypothesis by a video.
3. Students be able to do the task and evaluation.
The combination of volume law by Gay Lussac was further developed by Italian scientist, Armedeo Avogadro in 1811. That research had purpose of proving the combintaion volume law which was not accepted by Dalton. Why Dalton did not accept this law? According to Dalton’s law, atom cannot be divided into smaller parts. Let’s observe Dalton’s opinion in explaining the formation of water vapor, hydrochloride acid, and ammonia.

According to the equation above, it is impossible for 2 volumes of hydrogen gas and 1 volume of oxygen gas to form 2 volumes of water vapor, also the forming of hydrochloric acid and ammonia. Avogadro has different opinion. He believed that elements can attend as diatomic molecules.

Then in 1811 Avogadro stated a postulate that has been known as **Avogadro’s Hypothesis:**

“Equal volumes of different gases (at the same temperature and pressure) contain equal number of particles.”

Molecules number 1 : molecules number 2 = $V_1 : V_2 = a_1 : a_2$

We can use that relation to calculate the molecules number of a substance included in chemical reaction by this formula:

\[ \text{Molecules number 1} = \frac{a_1}{a_2} \times \text{molecules number 2} = \frac{V_1}{V_2} \times \text{molecules number 2} \]
Summarize and relate of Avogadro’s Hypothesis with Gay-Lussac’s Law in the Fundamental Law of Chemistry! Discuss it in group which is consist of 4-5 students, after that present in in front of of class!

What is the volume given in dm$^3$ of 1 mol of an ideal gas at 20°C and 100 kPa? (This combination of temperature and pressure is often called room temperature and pressure).

GOOD LUCK!!!!
1. Nitrogen and silicon form two binary compounds with the following compositions:

<table>
<thead>
<tr>
<th>Compound</th>
<th>Mass % N</th>
<th>Mass % Si</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>33.28</td>
<td>66.72</td>
</tr>
<tr>
<td>2</td>
<td>39.94</td>
<td>60.06</td>
</tr>
</tbody>
</table>

a. Calculate in each case the mass of silicon that combines with 1000 g nitrogen.
b. Prove that these compounds satisfy the law of multiple proportions. If the second compound has the formula \( \text{Si}_3\text{N}_4 \), what is the formula of the first compound?

2. The mass proportion of carbon and oxygen in carbon dioxide is 3 : 8

a. How many grams of carbon can be reacted with 48 gram of oxygen?
b. If 12 gram of Carbon is reacted with 24 g of oxygen, is there any element left?
   How many grams of carbon dioxides formed?
c. How many grams of carbon and oxygen that must be reacted to form 33 g of carbon dioxide compound?

3. When hydrogen is reacted with oxygen to form water, the composition of the water formed does not depend on the amount of oxygen used. Explain this in terms of the law of definite proportions?

4. Dalton assumed that all atoms of the same elements were identical in all their properties. Is this assumption valid or not. Explain?

5. Look at this equation of reaction below:
   \[ \text{C}_2\text{H}_4\,(g) + \text{O}_2\,(g) \rightarrow \text{CO}_2\,(g) + \text{H}_2\text{O}\,(g) \]
   If the \( \text{C}_2\text{H}_4 \) reacted is 0.8 liters, then on the similar T and P, how much is:
   a. Volume of \( \text{O}_2 \) reacted.
b. Volume of \( \text{CO}_2 \) and \( \text{H}_2\text{O} \) produced.

6. A 0.02 g sample of magnesium reacts with oxygen to give 0.166 g of magnesium oxide (MgO). A second magnesium sample with a mass of 0.288 g also reacts with oxygen to give the same products. Using the law of definite proportions, calculate the mass of magnesium oxide obtained in the second sample?

7. Gaseous methanol (\( \text{CH}_3\text{OH} \)) reacts with oxygen (\( \text{O}_2 \)) to produce water vapor and carbon dioxide will be produced from 2 L of methanol, if all gases are heated at the same temperature and pressure conditions, how many litres of oxygen need?

8. A reaction of 2 litres of Bromine (Br) gas and 6 litres of fluorine gas (F) yields 4 litres gaseous product. What is the formula of the gaseous product?

9. At certain temperature and pressure, 4 L of hydrogen gas contains \( 5 \times 10^{22} \) of hydrogen gas molecules, at the same conditions, what is the volume of ammonia gas containing \( 10^{23} \) ammonia molecules?

10. If a balloon contained 1 dm\(^3\) of helium at 20 °C and 100 kPa pressures, how many moles of helium would be present?
The Fundamental Laws of Chemistry

Chemistry Concept

The Law of conservation mass
by Lavoisier

The Law of Definite Proportions
by Proust

The Law of Multiple Proportions
by Dalton

The Law of Combining Volumes
by Gay-Lussac

Avogadro’s Hypothesis
by Avogadro

Have relationship with

Can explain

To solve

Mole Concept
Stoichiometry

FOR INTERNATIONAL SENIOR HIGH SCHOOL
REFERENCES


USER MANUAL SPECIAL CD

1. Open CD with your laptop or computer.
2. Open the folder titled “Special CD”.
3. Open the file entitled “PPT VIEW” and then click accept, and then open the file titled “Special CD” or directly open the file titled “Special CD”.
4. Good luck.
Notes:
WORKSHEET KEYS

WORKSHEET 1

The formula of reaction is:

\[ \text{HCl} + \text{CaCO}_3 \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2 \]

First weight : 210.255g
Second weight : 210.255g

1. \[ \text{S} + \text{O}_2 \rightarrow \text{SO}_2 \]
   - \( 24 \text{ g} \) + \( ? \) \( 48 \text{ g} \)
   - Oxygen have been reacted = \( 48 \text{ g} - 24 \text{ g} = 24 \text{ g} \)

2. \[ \text{Ca} + \text{Cl}_2 \rightarrow \text{CaCl}_2 \]
   - \( 4 \text{ g} \) + \( 8 \text{ g} \) + \( ? \)
   - Calcium Chloride have been produced = \( 4 \text{ g} + 8 \text{ g} = 12 \text{ g} \)
WORKSHEET 2

DISCUSSION

1. Write down the formula from the experiment!
   Answer:
   \[2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}\]

CONCLUSION

What’s your conclusion from this experiment?
The ratio mass of Magnesium and Oxygen is fixed, independent of the origin of the compound or its made of preparation.

CHEM - LAB

1. \(\text{Fe} + \text{S} \rightarrow \text{FeS}\)

   \[\frac{7}{4} \times 20\text{g} = 35\text{g}\]
   a. \(\frac{7}{4} \times 20\text{g} = 35\text{g}\)

   \[\frac{4}{7} \times 70\text{g} = 40\text{g}\]
   b. \(\frac{4}{7} \times 70\text{g} = 40\text{g}\)

   So sulphur that has not reacted = 50g – 40g = 10g

   c. Iron have to be reacted = \(\frac{7}{11} \times 88\text{g} = 56\text{g}\)

   Sulphur have to be reacted = \(\frac{4}{11} \times 88\text{g} = 32\text{g}\)

CHEM - TASK
Dalton said that when two elements form a series of compounds, the different masses of one element that combine with the same mass of other element are in the ratio of small whole-number. In this problem, hydrogen and oxygen can form water and hydrogen peroxide because the ratio mass of hydrogen and oxygen is in small whole-number. It can be proved like following:

\[
\text{Ar H}=1, \text{Ar O}=16 \Rightarrow \text{in } \text{H}_2\text{O} = 2:16 = 1:8 \\
\text{Ar H}=1, \text{Ar O}=16 \Rightarrow \text{in } \text{H}_2\text{O}_2= 2:\cancel{32} = 1:16
\]

**CHEM - TASK**

Compound A
Sulphur:Oxygen = 6g:5.99g \(\Rightarrow\) 1:1

Compound B
Sulphur:Oxygen = 8.6g:12.88g \(\Rightarrow\) 2:3

From the answer, we know that the ratio in small whole number.
WORKSHEET 4

**CHEM - TASK**

40\(N_2\) + 100\(O_2\) \(\rightarrow\) 40\(NxOy\)

2\(N_2\) + 5\(O_2\) \(\rightarrow\) 2\(NxOy\)

N\(\rightarrow\) 2\(x = 4\)

X = 2

O\(\rightarrow\) 2\(y = 10\)

Y = 5

So the formula is \(N_2O_5\)

WORKSHEET 5

**CHEM - DISCUSSION**

Avogadro’s idea about the concept of element molecule, then on the reaction between hydrogen gas and oxygen gas to form water at constant temperature and pressure can be written as follows:

2 element molecules of hydrogen + 1 element molecule of oxygen \(\rightarrow\) 2 water molecules.

It can explain Gay-Lussac’s Law.
The Fundamental Laws of Chemistry

**CHEM - QUIZ**

**COMMUNI_WORDS**
1. Lorenzo Romano
   Amedeo Carlo Avogadro
2. “Equal volumes of different gases (at the same temperature and pressure) contain equal number of particles.”
3. Italian scientist
4. Last Fundamental Law of Chemistry
5. Molecule concept.

**CHEM - TASK**

\[ PV = nRT \]

\[
100.000 \text{ Pa} \times V = 1 \times 8.314 \text{ J/mol.K} \times 293 \text{K} \\
V = \frac{2436.002 \text{ J/mol}}{100.000} \\
V = 0.02436 \text{ mol}
\]
Answer the questions below correctly!

1. a. Compound 1 = Mass N : Si = 33.28% : 66.72% = 1 : 2

   The mass of silicon = \( \frac{2}{1} \times 1000g = 2000g \)

   Compound 2 = Mass N : Si = 39.94% : 60.06% = 2 : 3

   The mass of silicon = \( \frac{3}{2} \times 1000g = 1500g \)

   b. \((\text{Si} : \text{N})_2 = 3 : 2 \rightarrow \text{Si}_3\text{N}_4\)

   \((\text{Si} : \text{N})_1 = 2 : 1 \rightarrow \text{Si}_2\text{N}\)

2. \(\text{CO}_2 \rightarrow \text{C} : \text{O} = 3 : 8\)

   a. \(\frac{3}{8} \times 48g = 18g\)

   b. Carbon which is left = 12g – \(\frac{2}{8} \times 24g\) = 3g

   \(\text{CO}_2\) which is formed = \(\frac{11}{8} \times 24g = 33g\)

   c. Carbon = \(\frac{3}{11} \times 33g = 9g\)

   Oxygen = \(\frac{8}{11} \times 33g = 24g\)

3. Because based on Proust’s law, in a given chemical compound, the proportions by mass of the elements that compose it are fixed, independent of the origin of the compound or its mode of preparation.

4. It is valid because elements are made of tiny particles called atoms.

5. \(\text{C}_2\text{H}_4 + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 2\text{H}_2\text{O}\)

   0.8L

   a. Volume \(\text{O}_2\) = 3 x 0.8L = 2.4L

   b. Volume \(\text{CO}_2\) = 2 x 0.8L = 1.6L

   Volume \(\text{H}_2\text{O}\) = 2 x 0.8L = 1.6L

6. \(2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}\)

   0.02g 0.166g

   2Mg + O\(_2\) \rightarrow 2MgO

   0.288g ?

7. \(4\text{CH}_3\text{OH} + 5\text{O}_2 \rightarrow 4\text{CO}_2 + 6\text{H}_2\text{O}\)

   2L

   Oxygen which is needed = \(\frac{5}{4} \times 2L = 2.5L\)
8. \( 2\text{Br}_2 + 6\text{F}_2 \rightarrow 4\text{BrxFy} \)
\[
\text{Br} \rightarrow 4x = 4 \\
X = 1
\]

\[
\text{F} \rightarrow 4y = 12 \\
Y = 3
\]

So the formula is \( \text{BrF}_3 \)

9. \( V_1 = \frac{a_1}{a_2} V_2 \)
\[
4L = \frac{5 \times 10^{22}}{10^{23}} \times V_2 \\
4 \times 10^{23} = 5 \times 10^{22} V_2
\]

\[
V_2 = \frac{4 \times 10^{23}}{5 \times 10^{22}} \\
V_2 = 8L
\]

10. \( V = 1L \)
\[
T = 20^\circ C = 293 \\
P = 100\text{kPa} = 100000\text{Pa} \\
PV = nRT \\
100000\text{Pa} \times 1L = n \times 8.314\text{J/molK} \times 293K \\
100000 = 2436.002 \times n \\
\quad\quad\quad n = 41.05 \text{ mol}
\]