

Relative Mass And Mole Answer Key

Relative Mass and the Mole

How can atoms be counted using a balance?

Why?

Consider the following equation for a chemical reaction: $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$

This can be interpreted as two molecules of hydrogen and one molecule of oxygen combining to form two water molecules. But how often do chemists limit their reactions to one or two molecules? Usually a reaction is done with an unimaginable number of molecules. How then do chemists know they have the right mix? The molecules need to be quickly counted! How do we count molecules? The answer is the unit called the **mole**. This activity will start by considering two egg farmers (a chicken farmer and a quail farmer). They produce such large numbers of eggs that they can't count them all individually, so they count in dozens of eggs in some cases, while in other cases they use mass. Weighing is often easier than counting!

Model 1 – Eggs

Chicken		Quail		Ratio of numbers of eggs	Ratio of masses of eggs
Number of eggs in the sample	Mass of the sample	Number of eggs in the sample	Mass of the sample		
1	37.44 g	1	2.34 g	1 : 1	16 : 1
10	374.40 g	10	23.40g	1 : 1	16 : 1
438	16398.72g	438	1024.92g	1 : 1	16 : 1
1 dozen	449.28g	1 dozen	28.08g	1 : 1	16 : 1
1 million	3744000.00g	1 million	234000.00g	1 : 1	16 : 1

1. Consider the data in Model 1.

a. What is the mass of a standard chicken egg?
37.44g

b. What is the mass of a standard quail egg?
2.34g

c. Show mathematically how the 16:1 ratio of masses was calculated in the last column of Model 1.

$$\begin{aligned}\text{Ratio of masses of eggs} &= \text{mass of 1 chicken egg} / \text{mass of 1 quail egg} \\ &= 37.44\text{g} / 2.34\text{g} \\ &= 16 / 1 \\ &= 16 : 1\end{aligned}$$

2. Use a calculator to complete the table in Model 1. Divide the work among group members. Reduce all ratios to the lowest whole numbers possible.

Relative Mass and Mole: Answer Key and Comprehensive Guide

Are you struggling to grasp the concepts of relative mass and the mole? Do you need a reliable resource to check your answers and solidify your understanding? This comprehensive guide provides not only an answer key to common relative mass and mole problems but also a thorough explanation of the underlying principles. We'll break down these crucial chemistry concepts, offering clear examples and practical applications to help you master them. Get ready to conquer relative mass and mole calculations!

Understanding Relative Atomic Mass (Ar)

Before diving into problem-solving, it's crucial to understand the foundation: relative atomic mass. Relative atomic mass (A_r) is a weighted average of the masses of all the isotopes of an element, relative to the mass of carbon-12 (which is assigned a value of exactly 12). This value takes into account the natural abundance of each isotope. For example, chlorine has two main isotopes, Cl-35 and Cl-37. Their relative abundances influence the overall relative atomic mass of chlorine, which is approximately 35.5.

Calculating Relative Atomic Mass

Calculating A_r involves using the following formula:

$$A_r = [(\% \text{ abundance of isotope 1} \times \text{mass of isotope 1}) + (\% \text{ abundance of isotope 2} \times \text{mass of isotope 2}) + \dots] / 100$$

This formula allows you to calculate the average atomic mass considering the different isotopes and their proportions in nature.

Example Calculation

Let's say an element has two isotopes: Isotope A (60% abundance, mass 69 amu) and Isotope B (40% abundance, mass 71 amu).

$$A_r = [(60 \times 69) + (40 \times 71)] / 100 = 70 \text{ amu}$$

The Mole: A Chemist's Counting Unit

The mole (mol) is a fundamental unit in chemistry representing Avogadro's number (approximately 6.022×10^{23}) of particles. These particles can be atoms, molecules, ions, or even formula units. The mole provides a convenient way to relate the macroscopic world (grams) to the microscopic world (atoms and molecules).

Molar Mass (Mr)

The molar mass (M_r) of a substance is the mass of one mole of that substance, expressed in grams per mole (g/mol). For elements, the molar mass is numerically equal to its relative atomic mass. For compounds, it's the sum of the molar masses of all the atoms in the chemical formula.

Example Calculation: Molar Mass of Water (H₂O)

$$\text{Mr}(\text{H}_2\text{O}) = 2 \times \text{Mr}(\text{H}) + 1 \times \text{Mr}(\text{O}) = 2 \times 1.01 \text{ g/mol} + 1 \times 16.00 \text{ g/mol} = 18.02 \text{ g/mol}$$

Relative Mass and Mole Calculations: Answer Key Examples

Now let's tackle some example problems and provide the answer key.

Problem 1: Calculate the relative atomic mass of an element with two isotopes: Isotope X (75% abundance, mass 24 amu) and Isotope Y (25% abundance, mass 26 amu).

$$\text{Answer: } A_r = [(75 \times 24) + (25 \times 26)] / 100 = 24.5 \text{ amu}$$

Problem 2: How many moles are there in 10 grams of water (H_2O)? ($\text{Mr}(\text{H}_2\text{O}) = 18.02 \text{ g/mol}$)

$$\text{Answer: } \text{Moles} = \text{mass} / \text{molar mass} = 10 \text{ g} / 18.02 \text{ g/mol} = 0.555 \text{ moles}$$

Problem 3: What is the mass of 0.25 moles of carbon dioxide (CO_2)? ($\text{Mr}(\text{CO}_2) = 44.01 \text{ g/mol}$)

$$\text{Answer: } \text{Mass} = \text{moles} \times \text{molar mass} = 0.25 \text{ mol} \times 44.01 \text{ g/mol} = 11.00 \text{ g}$$

Advanced Applications: Empirical and Molecular Formulas

Understanding relative mass and moles allows you to determine empirical and molecular formulas. The empirical formula represents the simplest whole-number ratio of atoms in a compound, while the molecular formula represents the actual number of atoms in a molecule.

Conclusion

Mastering relative mass and mole calculations is fundamental to success in chemistry. By understanding the concepts of relative atomic mass, the mole, and molar mass, you can confidently tackle a wide range of stoichiometric problems. This guide, complete with examples and an answer key, provides a solid foundation for further exploration of chemical calculations. Remember to practice regularly to solidify your understanding.

FAQs

1. What is the difference between relative atomic mass and molar mass? Relative atomic mass (A_r) refers to the average mass of an atom of an element relative to carbon-12. Molar mass (M_r) is the mass of one mole of a substance (element or compound). They are numerically equivalent for elements but differ for compounds.
2. Why is the mole such an important concept in chemistry? The mole provides a bridge between the microscopic world of atoms and molecules and the macroscopic world of grams and liters, enabling accurate measurements and calculations in chemical reactions.
3. Can I use a different standard besides carbon-12 for relative atomic mass? While carbon-12 is the internationally accepted standard, historically other standards were used, but they are no longer current practice.
4. How do I handle isotopes with more than two significant isotopes when calculating relative atomic mass? The same formula applies: you simply add more terms to the equation, including the abundance and mass of each additional isotope.
5. Where can I find more practice problems on relative mass and moles? Numerous chemistry textbooks and online resources (including educational websites and YouTube channels) offer extensive practice problems and worked examples. Look for resources specifically focused on stoichiometry.

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flowing through the pulmonary capillaries. The cardiovascular system then moves the oxygenated blood from the heart to the microcirculation of the various organs by convection, where oxygen is released from hemoglobin in the red blood cells and moves to the parenchymal cells of each tissue by diffusion. Oxygen that has diffused into cells is then utilized in the mitochondria to produce adenosine triphosphate (ATP), the energy currency of all cells. The mitochondria are able to produce ATP until the oxygen tension or PO_2 on the cell surface falls to a critical level of about 4–5 mm Hg. Thus, in order to meet the energetic needs of cells, it is important to maintain a continuous supply of oxygen to the mitochondria at or above the critical PO_2 . In order to accomplish this desired outcome, the cardiorespiratory system, including the blood, must be capable of regulation to ensure survival of all tissues under a wide range of circumstances. The purpose of this presentation is to provide basic information about the operation and regulation of the cardiovascular and respiratory systems, as well as the properties of the blood and parenchymal cells, so that a fundamental understanding of the regulation of tissue oxygenation is achieved.

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