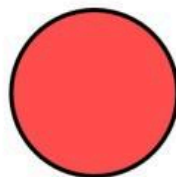


Unit 1: Matter and Measurement
Pure Substances, Atoms, and Molecules Worksheet

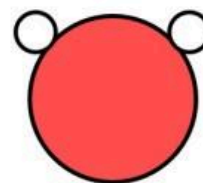
Pure substances are fundamental in chemistry, comprising either individual atoms or molecules. Atoms are the basic building blocks of elements, each with unique properties. Molecules consist of two or more atoms bonded together, forming compounds with distinct characteristics. Ionic compounds, like salts, are composed of formula units – tightly bound pairs of oppositely charged ions. Understanding these components is crucial to deciphering the diverse properties and behaviors of matter.



**hydrogen
atom**



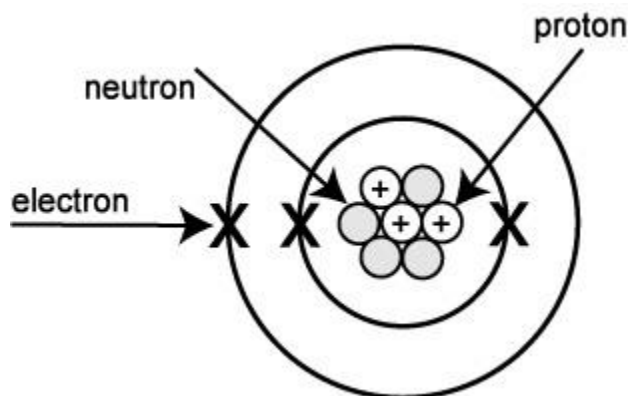
**oxygen
atom**



**water
molecule**

Cite: <https://chemnotcheem.com/what-is-a-molecule/>

1. Pure substances are fundamental in chemistry, existing as either elements or compounds with consistent compositions.
 - a. What defines a pure substance, and how does it differ from a mixture?
 - b. Provide an example of a pure substance in daily life and explain why it fits the definition.
 - c. Why is maintaining the purity of substances important in various fields of science and industry?



Cite: https://wikieducator.org/Atomic_Structure_and_the_Periodic_Table

2. An atom is the smallest unit of matter with the characteristics of an element. Unique atomic structures determine each element's properties, contributing to the diversity and behavior of all substances.
 - a. What is an atom, and what are the three subatomic particles that compose it?
 - b. How do the number of protons in an atom's nucleus relate to its identity as an element?

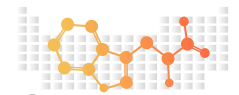
3. Molecules are groups of atoms held together by chemical bonds. They form the basis of compounds, showcasing distinct properties and functionalities that drive the complexity of the material world.
 - a. Define a molecule and give an example of a simple molecular compound.
 - b. Is H_2O an element, molecule and/or a compound?
 - c. How do molecules differ from elements?



Cite: <https://www.quora.com/What-is-a-substance-made-up-of-more-than-one-element>

4. Compounds are substances formed by chemically combining different elements in fixed ratios. Their distinct properties arise from the specific arrangement of atoms within molecules, showcasing the diversity of matter.
 - a. Which of the following two above diagrams is of a molecule, and which is of a compound?
 - b. Compare and contrast a molecule and compound.
 - c. Can something be both a molecule and compound?

5. Create the chemical formula for a compound made up of one magnesium atom and two chlorine atoms.



ChemTalk

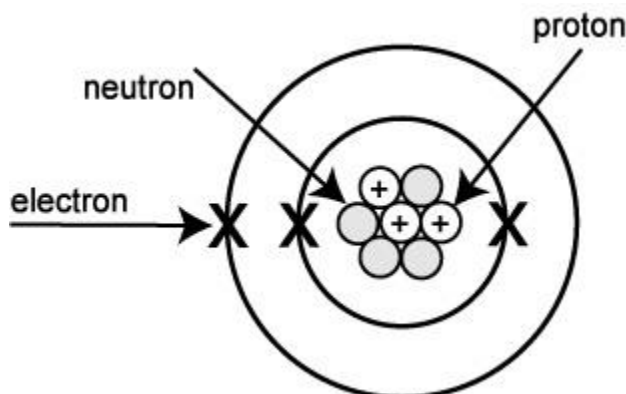
Unit 1: Matter and Measurement

6. A compound is found to be composed of 25% magnesium and 75% chlorine by mass. What is its empirical formula?

ANSWER KEY

1. Pure substances are fundamental in chemistry, existing as either elements or compounds with consistent compositions.
 - a. What defines a pure substance, and how does it differ from a mixture?
 - b. Provide an example of a pure substance in daily life and explain why it fits the definition.
 - c. Why is maintaining the purity of substances important in various fields of science and industry?

- a) A pure substance is a material with a consistent composition and unchanging properties throughout, distinct from mixtures that contain varying components.
- b) Water is an example of a pure substance. Regardless of its source, water has the same composition (H_2O) and properties.
- c) Substance purity is crucial for consistent results and reliable performance in scientific research, manufacturing, and technological applications.



Cite: https://wikieducator.org/Atomic_Structure_and_the_Periodic_Table

2. An atom is the smallest unit of matter with the characteristics of an element. Unique atomic structures determine each element's properties, contributing to the diversity and behavior of all substances.
 - a. What is an atom, and what are the three subatomic particles that compose it?
 - b. How do the number of protons in an atom's nucleus relate to its identity as an element?

- a) An atom is the basic unit of an element. Subatomic particles include protons (positively charged), neutrons (neutral), and electrons (negatively charged).
- b) The number of protons defines the atomic number, which is unique to each element and determines its chemical identity.

3. Molecules are groups of atoms held together by chemical bonds. They form the basis of compounds, showcasing distinct properties and functionalities that drive the complexity of the material world.
- Define a molecule and give an example of a simple molecular compound.
 - Is H_2O an element, molecule and/or a compound?
 - How do molecules differ from elements?

- a) A molecule is a group of atoms bonded together. It's formed when atoms share electrons to achieve a more stable configuration. Oxygen gas (O_2) is an example of a simple molecule, consisting of two oxygen atoms bonded together.
- b) Water (H_2O) is a molecule because it consists of two or more atoms chemically bonded together. It also has two different elements bonded, also making it a compound.
- c) Elements are made up of identical atoms, while molecules are composed of two or more different types of atoms.



Cite: <https://www.quora.com/What-is-a-substance-made-up-of-more-than-one-element>

4. Compounds are substances formed by chemically combining different elements in fixed ratios. Their distinct properties arise from the specific arrangement of atoms within molecules, showcasing the diversity of matter.
- Which of the following two above diagrams is of a molecule, and which is of a compound?
 - Compare and contrast a molecule and compound.
 - Can something be both a molecule and compound?

- a) The diagram on the left (O_2) is a molecule. The diagram on the right (H_2O) is a compound and a molecule.
- b) A molecule refers to bonded atoms, be they of the same or different elements. Conversely, a compound is a particular type of molecule, comprised of distinct elements in fixed proportions, resulting in unique characteristics.
- c) Interestingly, a compound is often made up of molecules. For example, water is both a molecule and a compound: its molecules consist of two hydrogen atoms and one oxygen atom bonded together.

5. Create the chemical formula for a compound made up of one magnesium atom and two chlorine atoms.



6. A compound is found to be composed of 25% magnesium and 75% chlorine by mass. What is its empirical formula?

1. Mass of Mg = 25 g, Mass of Cl = 75 g
2. Moles of Mg = $25 \text{ g} / 24.31 \text{ g/mol} \approx 1.03 \text{ moles}$
3. Moles of Cl = $75 \text{ g} / 35.45 \text{ g/mol} \approx 2.11 \text{ moles}$
4. Ratio of moles: Mg:Cl $\approx 1:2.05 \approx 1:2$
5. Empirical formula: **MgCl_2** (1 magnesium atom, 2 chlorine atoms)