

Copper atoms and copper ions: Johnstone's triangle

Learning objectives

- 1 Describe atoms and ions in terms of gain/loss of electrons.
- 2 Write atomic symbols for atoms and ions.
- 3 Observe that atoms and ions can have different properties.

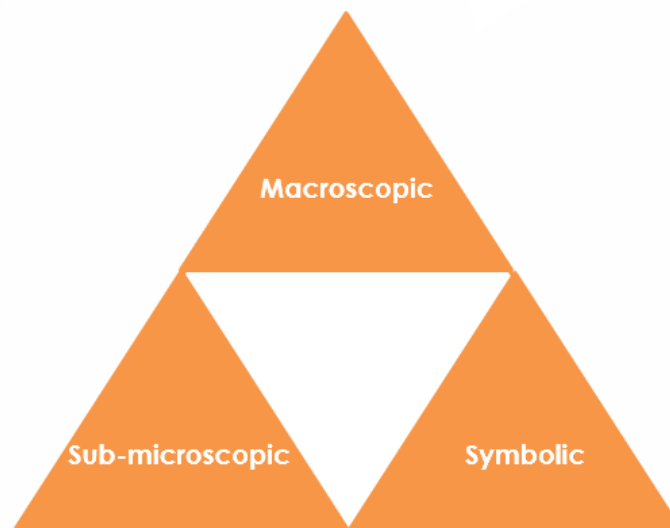
Introduction

A common reaction is used here to show how we can observe macroscopic changes as ions react to become atoms. The reaction is then described using an equation.

Johnstone's triangle

In chemistry we make sense of the things that we can see by representing what we can't see using formulas, equations, diagrams and models.

Johnstone's triangle is a way of thinking about these different concepts as different corners of a triangle:



- Macroscopic – what we can see. Think about the properties we can observe, measure and record.
- Sub-microscopic – smaller than we can see. Think about the particle or atomic level.
- Symbolic – representations. Think about how we represent chemical ideas, including symbols and diagrams.

Being able to connect and move between these three different levels is important for scientific understanding.

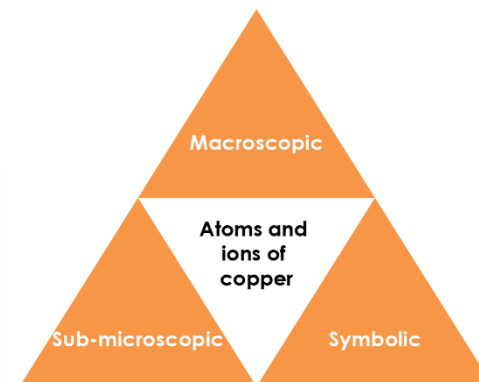
Macroscopic – what we can see

Watch the demonstration – what does the copper solution look like to begin with?

What does the copper metal formed look like? (Use the image to help you.)



Image adapted from © Shutterstock / Craig Walton and Zelenskaya

**Sub-microscopic – smaller than we can see**

Choose the correct word to complete the following:

An electron has a **positive/negative** charge. A proton has a **positive/negative** charge.

When an ion is formed the number of **electrons/protons** does not change. Adding an electron to an atom makes a **positively/negatively** charged ion. Losing an electron from an atom makes a **positively/negatively** charged ion.

In this reaction copper ions are changed back to atoms. A copper atom is formed from a positive copper ion by the **loss/gain** of two electrons.

Symbolic – representations

In the reaction above, copper metal, which is neutral, is formed from copper ions (which have a 2+ charge).

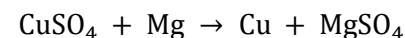
Give the symbol for:

A copper atom:

A copper ion with a 2+ charge:

A negative electron:

The overall equation for the reaction above is:



Label the copper atoms and copper ions in the equation above. Sometimes, it is hard to identify the ions without the charges being marked, so we can use a half equation:

