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FREE LEARNING NOTES FOR ZAMBIA

FORM 1

Chemistry

The atom and the atomic models

Lesson notes for learners · Competence-Based Curriculum

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Everything we see, touch and use, from the air we breathe to the materials in our homes, is made of atoms. Cooking, electricity and even breathing depend on how atoms interact. Scientists have used different models to explain what an atom looks like inside. In this note you learn what an atom is and how the ideas of Dalton, Thomson, Rutherford and Bohr improved our picture of it.

AFTER THESE NOTES YOU SHOULD BE ABLE TO

- Say what an atom is
- Explain what atomic structure and an atomic model mean
- Describe the main atomic models in the order they were proposed
- Describe Bohr's shell model of an atom
- Build and label a simple Bohr model of an element

KEY WORDS

atom	the smallest particle of an element that takes part in a chemical reaction
atomic structure	the composition and layout of the sub-atomic particles in an atom
atomic model	a theoretical picture that describes the structure and behaviour of atoms
nucleus	the small central part of an atom that holds the protons and neutrons
shell	a region around the nucleus where electrons are found
electron	a tiny negatively charged particle found in the shells around the nucleus

1 What is an atom

An atom is the smallest particle of an element that takes part in a chemical reaction. Atoms are the building blocks of all matter. The arrangement of the sub-atomic particles inside an atom decides which chemical reactions the substance can undergo and how it behaves.

The composition and layout of the sub-atomic particles in an atom is called its atomic structure. Understanding it helps us explain the chemical behaviour of substances and has led to advances in energy, medicine and technology.

2 Atomic models

An atomic model is a theoretical representation that describes the structure and behaviour of atoms. Over time, scientists have proposed several models as new evidence appeared. The main ones are the models of Dalton, Thomson, Rutherford and Bohr, and later the quantum mechanical model.

Dalton pictured the atom as a small solid particle that cannot be divided. Thomson showed that atoms contain smaller particles, the electrons. Rutherford proposed that most of the atom is empty space with a small, dense nucleus at the centre. Bohr then suggested that electrons move around the nucleus in fixed shells with set energies. The quantum mechanical model, which came from Schrodinger's work, is the most modern of these ideas.

The progression runs from Dalton's classical model to the quantum model of Schrodinger. Each model was built on the experimental evidence of its time, and each one has strengths and weaknesses.

3 Bohr's shell model

In Bohr's model the protons and neutrons are in the nucleus at the centre, and the electrons move around it in shells. The shells are like layers around the nucleus. The diagram shows a carbon atom, which has 6 protons and 6 neutrons in the nucleus, 2 electrons in the first shell and 4 electrons in the second shell.

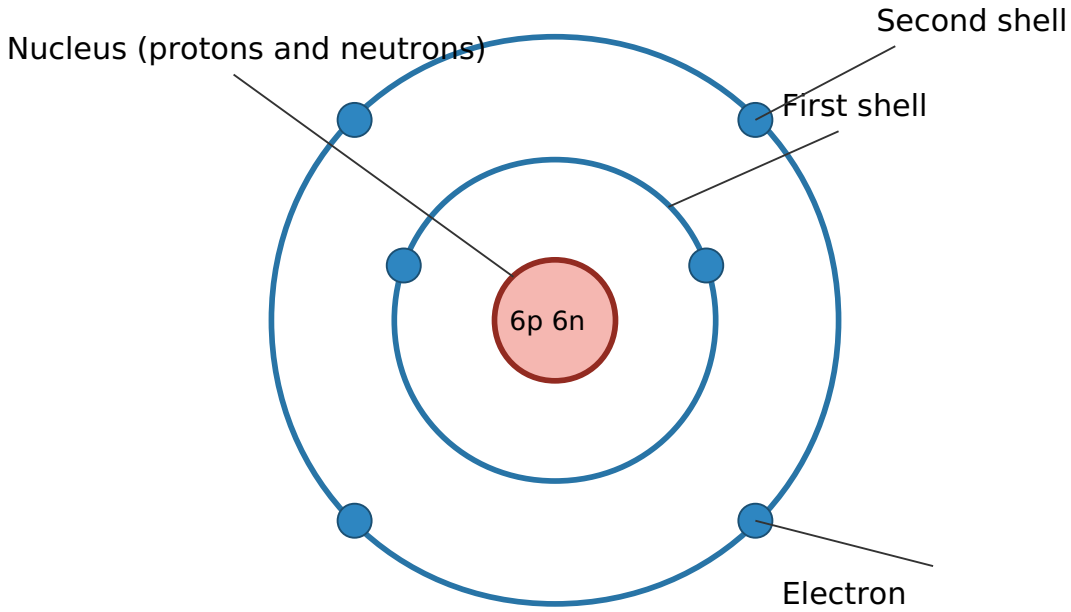

Figure 1. Bohr model of a carbon atom

WORKED EXAMPLE

How would you show an atom of hydrogen on a Bohr diagram?

Hydrogen has 1 proton in the nucleus

Draw a nucleus labelled with 1 proton

Draw one shell around the nucleus

Place the 1 electron on that shell

4 Building and comparing models

In the laboratory you can build the models with materials such as seeds, beads, candies or styrofoam balls. Use different colours for protons, neutrons and electrons, and compare Dalton's model with Bohr's shell model. When you compare them, discuss what each model explains well and what it leaves out, and what experiments the idea was based on.

TRY THIS

In groups, build Bohr models of hydrogen, carbon or oxygen using seeds, beads or coloured paper. Use one colour for protons, a second for neutrons and a third for electrons. Place the nucleus in the centre and the electrons in shells. Present your model to the class and say how it differs from Dalton's model.

REMEMBER

- An atom is the smallest particle of an element that takes part in a chemical reaction
- Atomic structure is the layout of the sub-atomic particles in an atom
- Atomic models are theoretical pictures of the atom: Dalton, Thomson, Rutherford, Bohr and the quantum model
- In Bohr's model protons and neutrons are in the nucleus and electrons are in shells
- Models change as new evidence is found

? Check yourself

1. What is an atom?
2. What is an atomic model?
3. Name three scientists whose atomic models you have studied.
4. In Bohr's model, where are the electrons found?

5. Which two particles are found in the nucleus of Bohr's model?
6. You are a learner at a school in Luangwa. Your group builds a model of a carbon atom using green seeds for protons, red seeds for neutrons and blue seeds for electrons. Carbon has 6 protons, 6 neutrons and 6 electrons. (a) How many seeds of each colour do you need? (b) Where do you place the green a
7. Two learners argue about the atom. One says an atom is a solid ball that cannot be split, as Dalton thought. The other says it has a small nucleus with electrons moving around it in shells. (a) Which learner is describing Bohr's model? (b) Explain why scientists changed from Dalton's model to later

ANSWERS

1. The smallest particle of an element that takes part in a chemical reaction.
2. A theoretical representation that describes the structure and behaviour of atoms.
3. Any three of Dalton, Thomson, Rutherford and Bohr (Schrodinger for the quantum model).
4. In shells around the nucleus.
5. Protons and neutrons.
6. (a) 6 green, 6 red and 6 blue. (b) Together in the centre as the nucleus. (c) 2 blue seeds in the first shell and 4 in the second shell.
7. (a) The second learner. (b) New experimental evidence showed that atoms have smaller parts, so the earlier ideas could not explain everything. (c) Build physical models of both, present them and discuss the strengths, weaknesses and experimental basis of each.

Written by 25Schools to follow the Form 1 Chemistry syllabus of the Zambian competence-based curriculum. Free for learners to read, download and share. More notes and quizzes at 25schools.com.