CONCEPT 1

The structure of atoms can be represented using simple diagrams.

Activity

What do you know about atoms?

In your notebook, and without referring to your textbook, draw a diagram of a helium atom. What information did you provide about the atom in your diagram?

Mendeleev arranged elements in his periodic table based on the physical and chemical properties of different elements. Metals appear on the left side of the zigzag line, and non-metals appear on the right. Elements in the same families share similar properties. But why is this the case? What characteristic of elements causes their properties to repeat in this predictable way? To find the answer, we need to consider the structure of the atom.

Key Features of Atomic Structure

Recall that the atom is the smallest unit of an element that has the properties of that element. For example, an atom of carbon is represented in **Figure 2.15**. Each atom has a tiny, dense nucleus containing neutrons and protons. (A hydrogen nucleus has a single proton only.) The nucleus is surrounded by electrons, which exist in specific electron energy shells. Most of the mass of an atom is in the nucleus. **Table 2.3** summarizes key characteristics of protons, neutrons, and electrons.

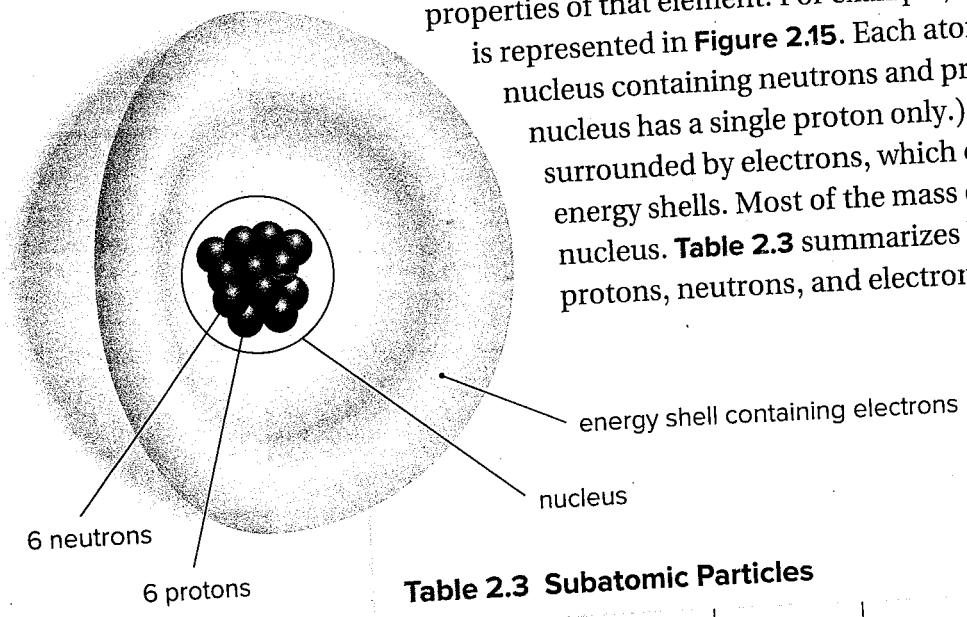


Figure 2.15 Every carbon atom has six positively charged protons in its nucleus and six negatively charged electrons surrounding the nucleus. (Most carbon atoms have six neutrons, but some have seven or eight.)

Table 2.3 Subatomic Particles

Name	Relative Mass	Electric Charge	Symbol	Location in Atom
proton	1836	+	p^+	nucleus
neutron	1837	0	n^0	nucleus
electron	1	−	e^-	electron energy shells surrounding the nucleus

Bohr Diagrams Are a Useful Way to Model Atoms

It is useful to be able to represent atoms in a simplified, two-dimensional way that provides information about their structure. Bohr diagrams represent the electron arrangements of atoms using the "energy shell" concept of Bohr's model of the atom. As shown in **Figure 2.16**, a Bohr diagram shows how many electrons occupy each specific energy level or shell. The number of electrons that can occupy each energy shell changes as you move outward from the nucleus. The first energy shell can have a maximum of two electrons. The second and third energy shells can have a maximum of eight electrons. (This is true for the first 20 elements, after which things become more complex.) The outermost occupied shell of an atom is called a **valence shell**. Electrons in the valence shell are called **valence electrons**.

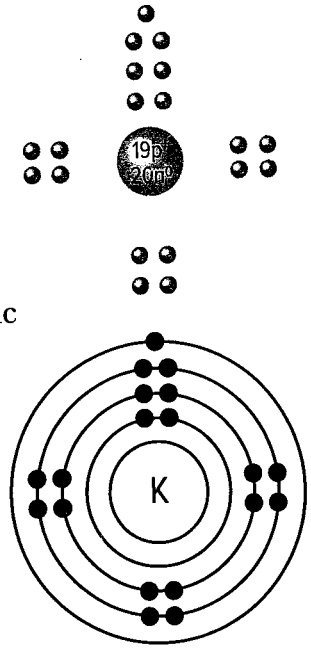


Figure 2.16 Both of these Bohr diagrams represent an atom of potassium. **What is one drawback and one advantage of each diagram?**

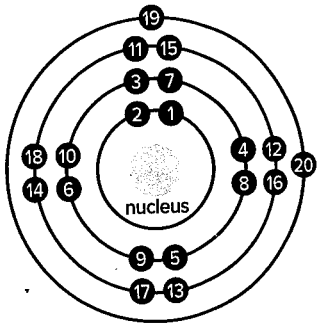
valence shell the outermost occupied energy shell of an atom

valence electrons the electrons in the outermost occupied energy shell of an atom

Activity

Model Bohr Atoms

Your teacher will assign you a number from one to 20. Using a pie plate, a marker, construction paper, pom-poms, and glue, create a Bohr diagram for the element that corresponds to your number. For example, if you are number 6, your element is carbon.



1. Glue a construction paper circle "nucleus" in the centre of your pie plate. Write the symbol for your element on the circle.
2. Examine the diagram on the right to see in what order you will place the pom-pom "electrons" and how many shells will be occupied. (For a neutral atom, number of electrons = atomic number.)
3. Draw circles on the pie plate to represent the occupied energy shells for your atom. Then glue on pom-poms to represent your electrons.
4. Display your model. In your notebook, use the models to help you draw Bohr diagrams for each of the first 20 elements.

Before you leave this page . . .

1. Draw a diagram of an atom, labelling protons, electrons, and neutrons.
2. List how many electrons can be found in the first and second energy shells.