

The Periodic Table and Atomic Theory

Textbook pages 64–71

Before You Read

Why do elements in the same family have similar properties? Give your ideas on the lines below.

Mark the Text

Check for Understanding

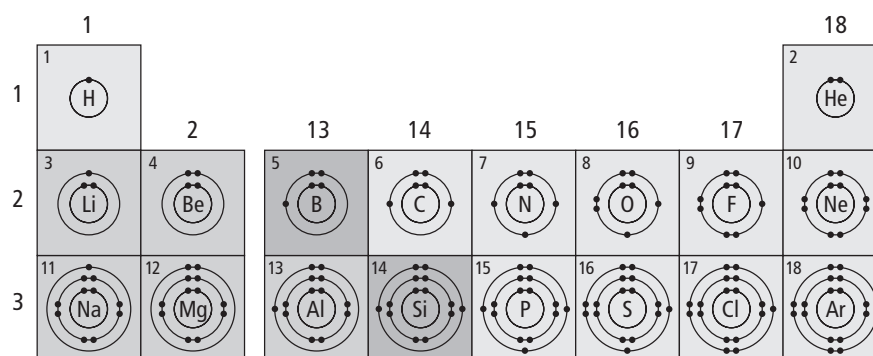
As you read this section, stop and read again any parts you do not understand. Highlight all the sentences that help you get a better understanding.

Reading Check

1. What does a Bohr model show?

Reading Check

2. What are valence electrons?



What is a Bohr model?

A **Bohr model** is a diagram that shows the number of electrons in each of the energy levels around an atom. These regions also may be called **electron shells**. ✓

Each electron shell can hold only a certain number of electrons. The first electron shell can hold a maximum of two electrons. The second electron shell can hold a maximum of eight electrons. The third electron shell can hold a maximum of eight electrons.

The electron shell that holds the outermost electrons—the electrons that are farthest away from the nucleus—is called the **valence shell**. Electrons in the valence shell are called **valence electrons**. ✓

Why are noble gas elements stable?

Atoms of noble gas elements (Group 18) have filled valence shells. They hold the maximum number of electrons that they can. These elements usually do not gain electrons, and they usually do not lose electrons. This arrangement makes these atoms very stable.

What are some patterns that involve valence electrons?

Some patterns of valence electrons	Example
Elements in the same family have the same number of valence electrons.	All the alkali metals (Group 1) have one valence electron. All the halogens (Group 17) have seven valence electrons. All the noble gases except helium have eight valence electrons.
Elements that are in the same period have their valence electrons in the same shell.	Elements in Period 2 have their valence electrons in the second shell. Elements in Period 3 have their valence electrons in the third shell.
The period number of an element = the number of occupied energy shells of its atoms.	Elements in Period 2 have two occupied energy shells. Elements in Period 3 have three occupied shells.

How do atoms form ions?

An ion is an atom with an electric charge because it has gained or lost electrons. An ion has a negative charge when it has more electrons than protons. An ion has a positive charge when it has more protons than electrons.

Atoms tend to gain or lose electrons from their valence shells. Use the Bohr models of the elements to help you understand the next three points.

- ◆ Metals tend to lose electrons and form positive ions.
- ◆ Non-metals (except for noble gases) tend to gain electrons and form negative ions.
- ◆ Ions have an arrangement of electrons that is like the arrangement of electrons in the nearest noble gas.

You show the charge on an ion with a superscript ⁺ or ⁻ sign to the right of the element symbol. For example, a lithium ion is Li⁺. A chlorine ion is Cl⁻.

The charge on an ion is equal to the sum of the charges on its protons and electrons. For instance, the lithium ion has three protons and two electrons. It has a charge of “plus one” because (3+) protons + (2-) electrons = 1+.

Name _____

Date _____

Use with textbook pages 64–67.

The number game with atoms and ions

- Complete the following sentences using the terms in parentheses.
 - The atomic _____ (number/mass) of an element is the same as the number of protons in the nucleus of an atom.
 - An _____ (atom/ion) of an element has the same number of protons as electrons.
 - A positively charged ion has _____ (lost/gained) electrons.
 - A negatively charged ion has _____ (lost/gained) electrons.
- Complete the following table. Some answers are provided to help guide you. You can refer to the Bohr model chart on page 32 and the periodic table on page 202.

Element name	Atomic number	Ion charge	Atom or ion?	Number of protons	Number of electrons
beryllium	4	2+	ion	4	2
	11	0	atom		
		0		18	18
chlorine		0			
	7	3-			10
calcium		0			
		2-		16	
	3	+			
		3+		13	

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Drawing Bohr model diagrams

1. Refer to the Bohr model chart on page 32 to help you complete the following table. Some answers are provided for you. (Hint: Remember that the maximum number of electrons in the first three shells is 2, 8, and 8.)

Atom/ion	Atomic number	Number of protons	Number of electrons	Number of electron shells
neon atom	10	10	10	2
fluorine atom	9			
fluorine ion	9	9	10	2
sodium atom				
sodium ion			10	
argon atom				
chlorine atom				
chlorine ion			18	
potassium atom				
potassium ion			18	

2. Use the table above to draw the Bohr model diagram for the following atoms and ions.

Argon atom	Chlorine atom	Chlorine ion	Potassium atom	Potassium ion

3. What do you notice about the arrangement of electrons in the Bohr model of a neon atom, fluorine ion, and a magnesium ion?
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4. What would you expect to see with the arrangement of electrons in the Bohr model of an argon atom, chlorine ion, and a potassium ion?
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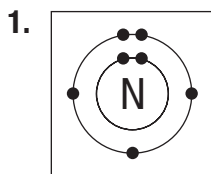
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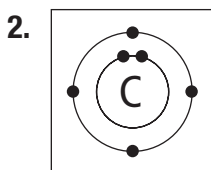
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Analyzing Bohr model diagrams

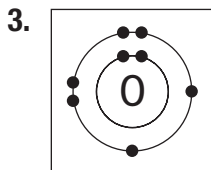
Fill in the blanks beside each Bohr model diagram. The first one has been partially completed to help guide you.



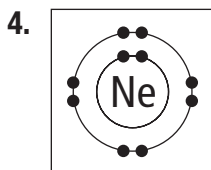
- (a) number of protons 7
 (b) number of shells _____
 (c) number of electrons _____
 (d) number of valence electrons _____
 (e) Bohr model of a nitrogen atom



- (a) number of protons _____
 (b) number of shells _____
 (c) number of electrons _____
 (d) number of valence electrons _____
 (e) Bohr model of a _____



- (a) number of protons _____
 (b) number of shells _____
 (c) number of electrons _____
 (d) number of valence electrons _____
 (e) Bohr model of an _____



- (a) number of protons _____
 (b) number of shells _____
 (c) number of electrons _____
 (d) number of valence electrons _____
 (e) Bohr model of a _____

5. The four elements above are in the same period. What do you notice about the number of shells for elements belonging to the same period?

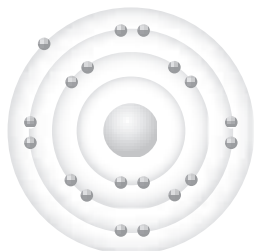
Name _____

Date _____

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The periodic table and atomic theory

Use the following Bohr model to answer questions 1 to 6.



Match the Term on the left with the corresponding Number on the right. Each Number may be used more than once. Refer to the diagram above.

Term	Number
1. _____ number of shells	A. 0
2. _____ number of protons	B. 1
3. _____ total number of electrons	C. 2
4. _____ number of valence electrons	D. 3
5. _____ number of electron(s) it has to lose to become stable	E. 4
6. _____ number of shells holding the maximum number of electrons	F. 19
	G. 20

Circle the letter of the best answer.

7. What is the maximum number of electrons that the first electron shell can hold?
- A. 1
B. 2
C. 4
D. 8

Use the periodic table on page 202 to answer questions 8 to 12.

8. How many electrons are in the outermost shell of a sulphur (S) atom?
- A. 1
B. 2
C. 6
D. 7
9. How many electrons are in the outermost shell of a fluorine (F) ion?
- A. 1
B. 2
C. 7
D. 8
10. How many shells are there in the Bohr model of an aluminum (Al) atom?
- A. 1
B. 2
C. 3
D. 4
11. Which of the following represents the Bohr model electron arrangement of a chlorine (Cl) atom?
- A. 2, 15
B. 2, 2, 13
C. 2, 8, 7
D. 2, 8, 8
12. What do a beryllium (Be) ion and a neon (Ne) atom have in common?
- A. They have full outer shells.
B. They have the same number of electrons.
C. They have the same number of electron shells.
D. None of the above