Name Date

Topic 2.3 Highlights

How can atomic theory explain patterns in the periodic table?

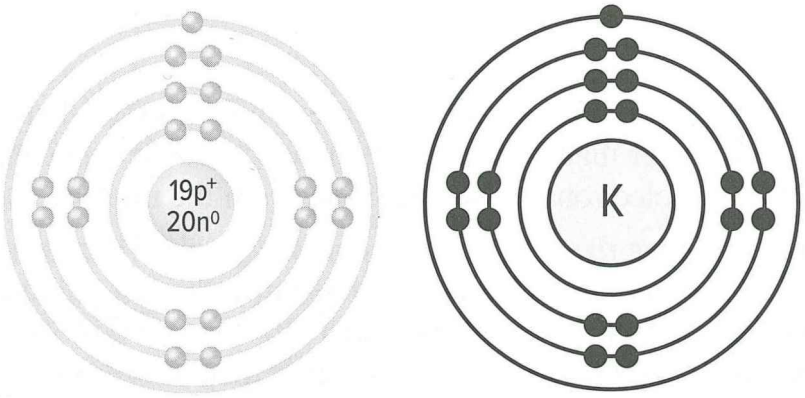
Use with textbook pages 122–133.

Parts of the Atom

The **atom** is the smallest particle of an element. It consists of three **subatomic particles**: protons, electrons, and neutrons. **Protons** (p^+) are positively charged particles, while **neutrons** (n^0) are particles with no charge. Both protons and neutrons are found in the dense, positively charged centre of the atom called the **nucleus**. The nucleus accounts for most of the atom's mass. **Electrons** (e^-) are negatively charged particles that exist in specific **energy** shells around the nucleus. Refer to Figure 2.15 and Table 2.3 on page 124 in the textbook to see a summary of the parts of an atom.

Bohr Diagrams

A **Bohr diagram** shows the electron arrangements of atoms and ions. The first energy shell can hold a maximum of two electrons, while the second and third energy shells can hold a maximum of eight electrons. The outermost energy shell of an atom is called the **valence shell**, and the electrons occupying this shell are called **valence electrons**. The diagram below shows the two different ways to draw a Bohr diagram.

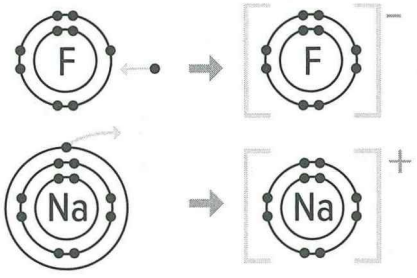


Elements in the Same Groups and Periods

Elements that belong to the *same group* (vertical column) have the same number of valence electrons. For example, beryllium and magnesium belong to Group 2 and so they both have two valence electrons. Elements that belong to the *same period* (horizontal row) have the same number of energy shells. For example, sodium and sulfur both belong to Period 3 and therefore have three occupied energy shells. Analyze Figure 2.17 on page 126 of the textbook. How is the electron configuration similar for elements from the same group and period?

Full Valence Shells

Noble gases are the only elements on the periodic table that have full valence shells. This is what makes them stable. Atoms can obtain full valence shells like the noble gases, by forming ions. Ions are charged particles that have gained or lost electrons. Metals tend to lose electrons and non-metals tend to gain electrons to become stable ions with full valence shells. The figure below shows how an atom can give up an electron or gain an electron to become an ion.



Periodic Trend

Periodic trend refers to the regular pattern in the properties of elements on the periodic table. These trends help us predict the properties of an element. There are two clear trends.

1. Atomic size

The atomic size increases moving down a group. For example, in the alkali metals, potassium (in Period 4) is larger than lithium (in Period 2) because it has more occupied energy shells and its valence electrons are farther away from the nucleus.

The atomic size decreases going from left to right across a period. For example, in Period 2, lithium (in the first column) is larger than neon (in the last column). Neon has 10 protons, while lithium has 3 protons. So, the positively charged protons exert a greater pull on the negatively charged electrons, bringing them closer to the nucleus.

2. Reactivity

The reactivity of metals increases moving down a group. For example, rubidium (in Period 5) is much more reactive in water than lithium (in Period 2) is for the alkali metals. As you move down a group, the atoms get bigger. So, valence electrons are farther from the nucleus, and there is less pull on them.

Parts of the Atom

Use with textbook page 124.

1. Check Your Understanding

As you read the paragraph on Key Features of Atomic Structure on page 124 of the textbook, stop and reread any parts that you do not understand. Write down any sentences that help you understand the concepts better.

2. Summarizing

Summarizing means to restate the main ideas in your own words. A summary can be in point form or in sentence form. Read the paragraph on Key Features of Atomic Structure on page 124 of the textbook. Complete the following table by using point form to summarize the main ideas in the textbook paragraph. Write a summary sentence. Compare your table and points with a partner.

Section of the Textbook	Main Topic	What the Text Says About the Main Topic	Supporting Details
Page 124, "Key Features of Atomic Structure"	What an atom is made of	It talks about neutrons and protons in the nucleus of an atom as well as how it is surrounded by electrons	"The nucleus is surrounded by electrons" "Dense nucleus containing neutrons and protons"

Summary Sentence:

An atom has a nucleus which contains neutrons and protons, circling the nucleus are electrons.

3. Interpreting Tables

A table organizes information in rows and columns so that it can visually display concepts in an organized way for the reader. Refer to Table 2.3 on page 124 in the textbook. In Table 2.3, the word *nucleus* appears in the second row of the last column. The information can be interpreted as "Protons are located in the nucleus of an atom."

a) Analyze Table 2.3. Cover the table and read the boldfaced titles of each column. Based on the title, explain what you would expect to the see in the cells below it.

b) Choose a cell in Table 2.3. Interpret the contents of the cell by writing a complete sentence.

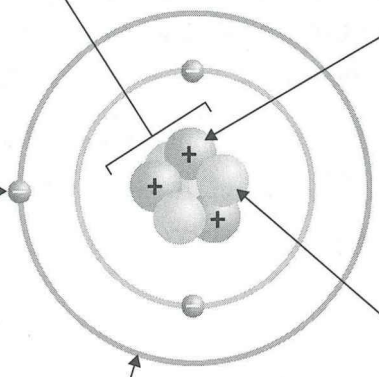
The name tells you what the name of the particle is

Name: proton, neutron, electron. Mass: the number that relates to the mass.
Electric charge: +-0 Symbol: if it's positive,, negative or neutral. Location in Atom: where it is in the atom

4. Interpreting Diagrams

A diagram is a visual representation of some text that uses words and symbols to represent an object. Determine how each part of the diagram shows the main ideas in the paragraph and Table 2.3 from the textbook.

In the numbered boxes, identify the parts of an atom using the following terms: **electron**, **energy shell**, **neutron**, **nucleus**, **proton**. Describe the characteristics of the different parts of the atom by completing the boxes.



2. Nucleus

a) charge positive

b) description where the protons/neutrons are

1. electron

a) symbol —

b) charge negative

c) relative mass 1

d) location in the atom on the valence shell

3. proton

a) symbol +

b) charge positive

c) relative mass _____

d) location in the atom in the nucleus

4. neutron

a) symbol 0

b) charge neutral

c) relative mass _____

d) location in the atom nucleus

5. Valence shell

a) description where the electrons

Bohr Diagrams

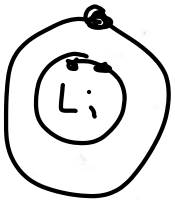
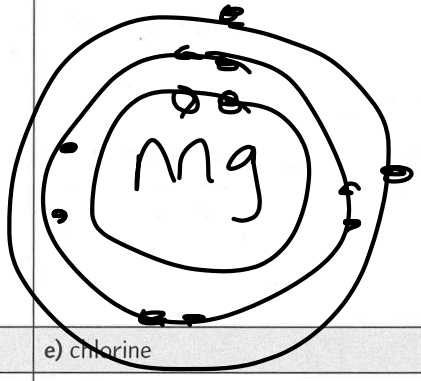
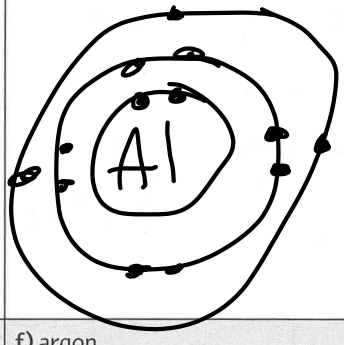
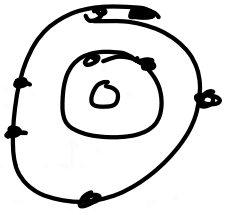
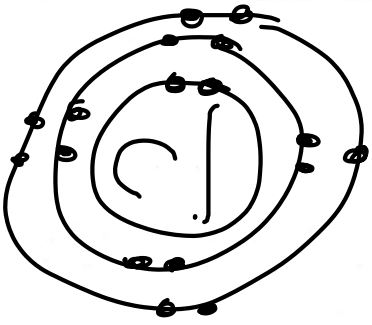
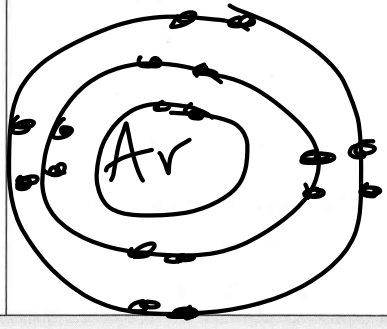
Use with textbook page 125.

1. Define the following terms.
   a) Bohr diagram 2-D Way to look at atoms
   b) valence shell atoms want to have a full valence shell
   c) valence electron the electrons on the outside

2. List two things that a Bohr diagram shows.
   a) structure of atom
   b) number of electrons

3. What is the maximum number of electrons that can be found in
   a) the first energy shell? 2
   b) the second energy shell? 8
   c) the third energy shell? 8

4. Draw the Bohr diagram for each of the following atoms.

a) lithium	b) magnesium	c) aluminum
		
d) oxygen	e) chlorine	f) argon
		

Full Valence Shells

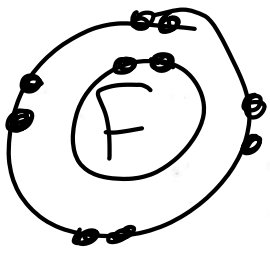
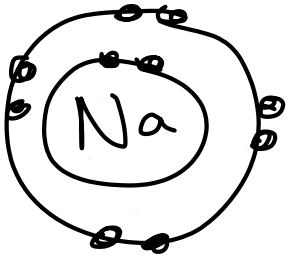
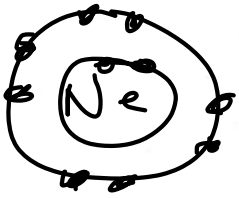
Use with textbook page 127.

1. What information does the charge of an ion give?

an atom w/ a pos. or neg. charge

2. Why do atoms become ions? when a neutral atom gains/loses an electron

3. a) Draw the Bohr diagram for a fluoride ion and a sodium ion in the first two columns of the table.

Fluorine Ion	Sodium Ion	Noble Gas = Neon
		

b) What noble gas would have the same electron arrangement as a fluorine ion and a sodium ion? Draw the Bohr diagram for that noble gas in the third column of the table above.

c) What do these two ions have in common with the noble gas?

they both have full valence rings

4. a) Draw the Bohr diagram for a helium atom in the first column of the table.

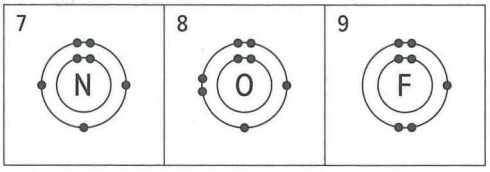
Helium Atom	Ion #1 = _____	Ion #2 = _____

b) What two ions would have the same electron arrangement as a helium atom? Draw the Bohr diagrams for these two ions in the second and third columns in the table above.

Electron Arrangements Show Patterns

Use with textbook page 126.

1. Consider the electron arrangements of nitrogen, oxygen, and fluorine.



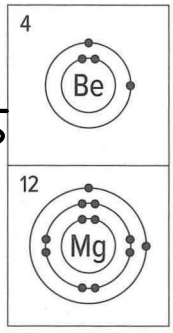
a) What do all three of these elements have in common with respect to their position on the periodic table?

they are all right next to each other

b) How is the number of occupied energy shells related to the period?

their group

2. Consider the electron arrangements of beryllium and magnesium.



a) What do elements in Group 2 have in common?

they have 2 valence electrons

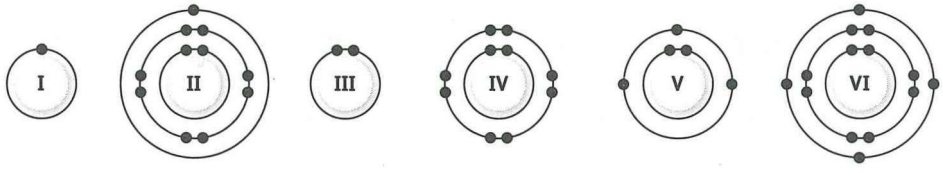
b) How does this relate to their group number?

2

3. a) Which family on the periodic table has full valence shells?

b) How is the electron arrangement in helium different from the other noble gases?

4. Consider the six elements shown.



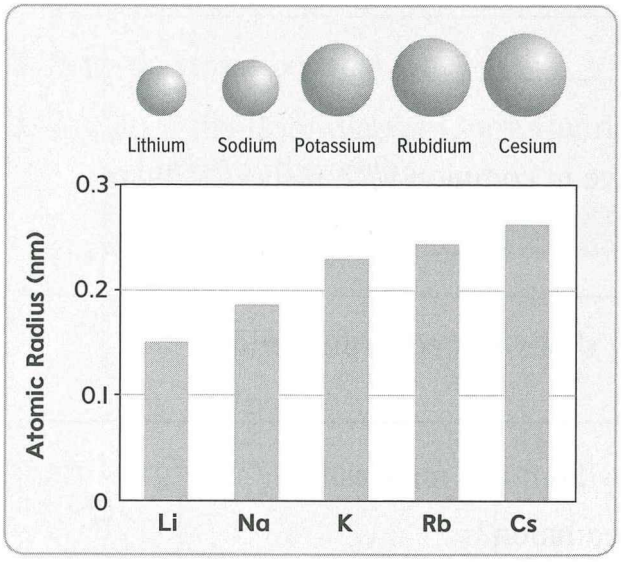
a) Which of these elements belong to the same group?

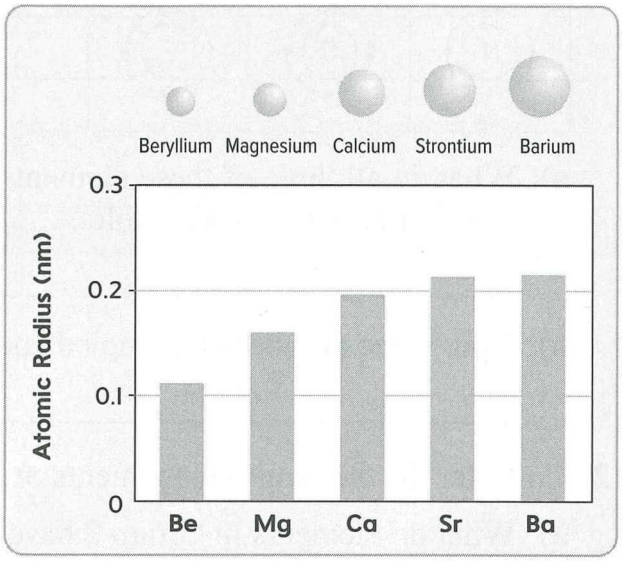
b) Which of these elements belong to the same period?

Periodic Trends

Use with textbook pages 130–131.

Use the following graphs showing the atomic radii for elements in Group 1 and Group 2 to answer questions 1 to 4.





1. What happens to the atomic size as you move down the two groups of elements shown above?

They become smaller

2. Predict the trend in the atomic size as you move down the halogen group.

the atomic size will go down

3. Comparing adjacent elements on the same period (e.g., cesium and barium), which metal group has the bigger atomic size?

group 1

4. Why do you think calcium is almost twice as big as beryllium?

Because it has more protons/neutrons/electrons

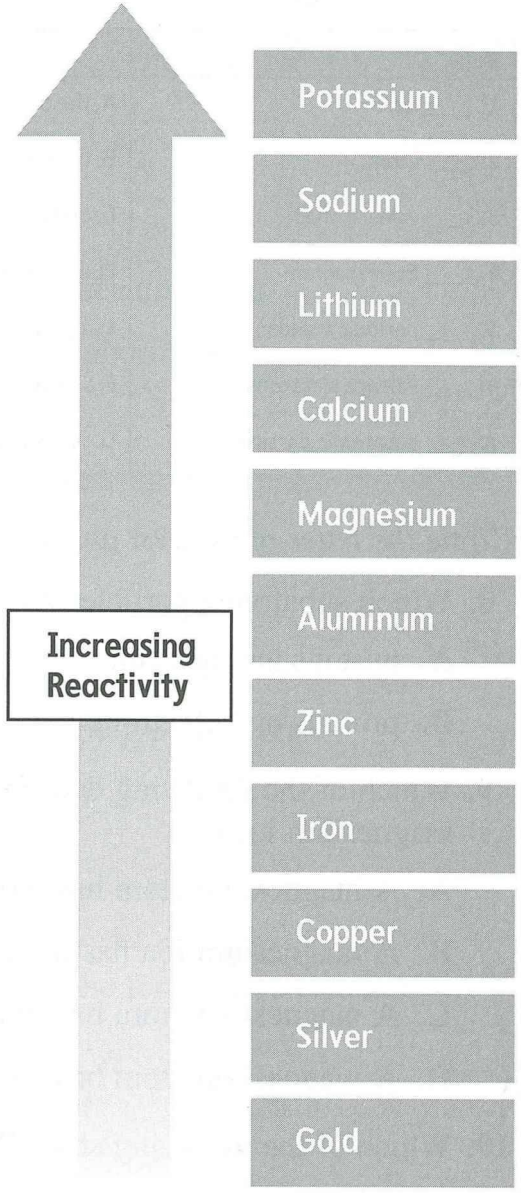
Use the diagram on reactivity to answer questions 5 to 8.

5. **a)** Between lithium, sodium, and potassium, which of these three alkali metals is the most reactive? Explain your answer.

potassium because you can clearly see the answer on the right →

b) What does this suggest about the reactivity of alkali metals as you move down the group on the periodic table?

the lower it is one the table = more reacti



6. Noting the periodic trend, predict whether rubidium would react more or less vigorously in water than potassium. Explain your answer.

Currently it is 3am and my brain is not smart enough to answer this

7. Note the relative reactivity of sodium and magnesium. What happens to the reactivity of metals as you move from left to right across the same period?

8. Noting the periodic trend, predict whether lithium or beryllium would be more reactive. Explain your answer.

C'est tres reative parce que il y a un treand among le elements

2.3 Assessment

Match each term on the left with the best description on the right. Each descriptor may be used only once.

Term	Description
1. E ion	A. the outermost energy shell of an atom
2. D atom	B. the electrons in the outermost energy shell of an atom
3. A valence shell	C. protons, electrons, and neutrons that make up an atom
4. F Bohr diagram	D. a particle that has equal numbers of protons and electrons
5. G periodic trends	E. a particle that has a charge because it has lost or gained electrons
6. B valence electrons	F. a drawing that shows the electron arrangements in individual energy shells
7. C subatomic particles	G. regular patterns seen in the properties of elements due to their atomic structure

Circle the letter of the best answer for questions 8 to 21.

8. Which subatomic particles are found in the nucleus of an atom?

A. protons and neutrons

B. protons and electrons

C. electrons and neutrons

D. electrons, protons, and neutrons

9. Which of the following describes the difference between a magnesium atom and a magnesium ion?

A. A magnesium atom has more protons than a magnesium ion.

B. A magnesium ion has more neutrons than a magnesium atom.

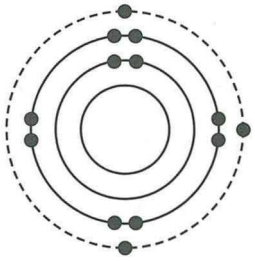
C. A magnesium atom has more electrons than a magnesium ion.

D. A magnesium atom has a positive charge and a magnesium ion has no charge.

10. Which of the following shows how a chlorine atom compares to a chloride ion?

	Chlorine Atom	Chloride Ion
A.	17 protons, 17 electrons	17 protons, 17 electrons
B.	17 protons, 17 electrons	17 protons, 18 electrons
C.	17 protons, 18 electrons	17 protons, 17 electrons
D.	17 protons, 18 electrons	17 protons, 18 electrons

Use the following Bohr diagram to answer questions 11 to 15.



11. Which element is represented by the Bohr diagram?

A. a silicon atom

B. an aluminum atom

C. a magnesium atom

D. a phosphorus atom

12. To what period does this atom belong?

A. Period 1

B. Period 2

C. Period 3

D. Period 4

13. How does this atom acquire a full valence shell?

A. by losing 3 protons

B. by gaining 3 protons

C. by losing 3 electrons

D. by gaining 3 electrons

14. When this atom becomes an ion, what is its ion charge?

A. 2–

B. 2+

C. 3–

D. 3+

15. What noble gas has the same electron arrangement as the ion for this element?

A. helium

B. neon

C. argon

D. krypton

16. How many valence electrons does a phosphorus atom have?

A. 2

B. 3

C. 4

D. 5

17. How many energy shells do a magnesium atom, a silicon atom, and a chlorine atom each have?

A. 1

B. 2

C. 3

D. 4

18. Which of the following particles have the same electron arrangements?

A. a lithium ion, a sodium ion, and a helium atom

B. a fluoride atom, a sodium ion, and a neon atom

C. a magnesium ion, a fluoride ion, and a neon atom

D. a chloride ion, a potassium atom, and an argon atom

19. Amongst the halogens, which correctly compares the relative size of the atoms?

A. iodine is larger than astatine

B. chlorine is larger than iodine

C. astatine is larger than fluorine

D. fluorine is larger than chlorine

20. Rank the following elements from largest to smallest: calcium, bromine, potassium.

	Largest ⟶ Smallest		
A.	bromine	calcium	potassium
B.	calcium	potassium	bromine
C.	potassium	bromine	calcium
D.	potassium	calcium	bromine

21. Which of the following elements is more reactive than chlorine?

A. sulfur

B. argon

C. fluorine

D. bromine

22. Complete a KWL chart for periodic trend.

K What I Know	W What I Want to Know	L What I Learned
How to spell my name	How to spell my middle name	How to spell my last name