Chapter 9 Study Guide

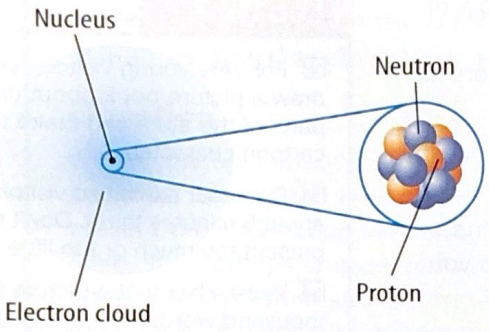
THE BIG IDEA

An atom is the smallest unit of an element and is made mostly of empty space. It contains a tiny nucleus surrounded by an electron cloud.

Key Concepts Summary

Lesson 1: Discovering Parts of the Atom

- If you were to divide an element into smaller and smaller pieces, the smallest piece would be an **atom.**
- Atoms are so small that they can be seen only by powerful scanning microscopes.
- The first model of the atom was a solid sphere. Now, scientists know that an atom contains a dense positive **nucleus** surrounded by an **electron cloud.**

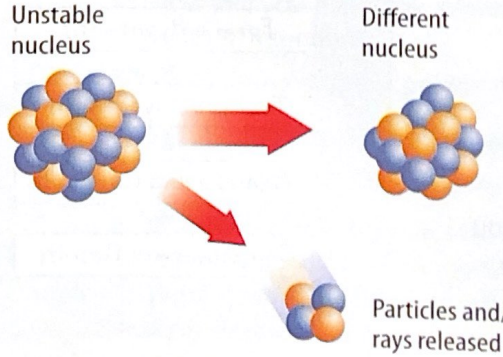


atom p. 315
electron p. 317
nucleus p. 320
proton p. 320
neutron p. 321
electron cloud p. 322

Lesson 2: Protons, Neutrons, and Electrons—How Atoms Differ

- **Nuclear decay** occurs when an unstable atomic nucleus changes into another more stable nucleus by emitting radiation.
- Different elements contain different numbers of protons. Two **isotopes** of the same element contain different numbers of neutrons. When a neutral atom gains or loses an electron, it becomes an **ion.**

Nuclear Decay



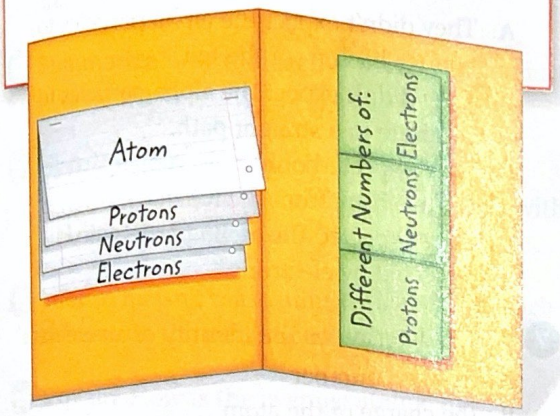
atomic number p. 327
isotope p. 328
mass number p. 328
average atomic mass p. 329
radioactive p. 330
nuclear decay p. 331
ion p. 332

Study Guide

Vocabulary eFlashcards
Vocabulary eGames
Personal Tutor

FOLDABLES® Chapter Project

Assemble your lesson Foldables as shown to make a Chapter Project. Use the project to review what you have learned in this chapter.



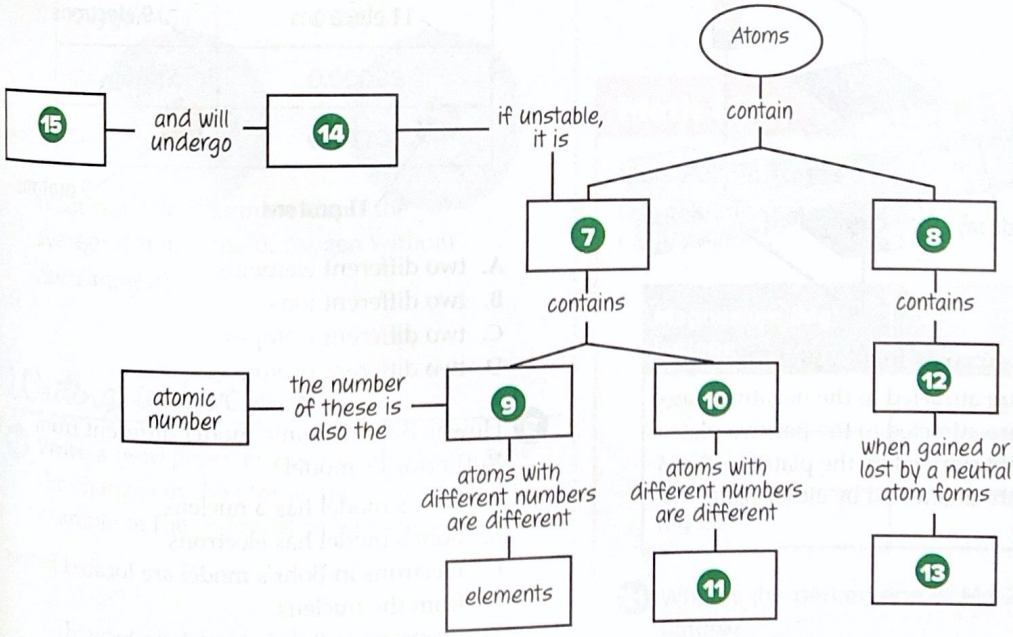
Use Vocabulary

1. A(n) _____ is a very small particle that is the basic unit of matter.
2. Electrons in an atom move throughout the _____ surrounding the nucleus.
3. _____ is the weighted average mass of all of an element's isotopes.
4. All atoms of a given element have the same number of _____.
5. When _____ occurs, one element is changed into another element.
6. Isotopes have the same _____, but different mass numbers.

Link Vocabulary and Key Concepts

Interactive Concept Map

Copy this concept map, and then use vocabulary terms from the previous page to complete the concept map.



Chapter 9 Review

Understand Key Concepts

1 Which part of an atom makes up most of its volume?

A. its electron cloud
B. its neutrons
C. its nucleus
D. its protons

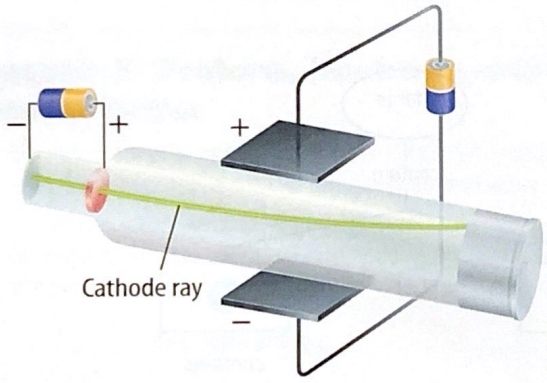
2 What did Democritus believe an atom was?

A. a solid, indivisible object
B. a tiny particle with a nucleus
C. a nucleus surrounded by an electron cloud
D. a tiny nucleus with electrons surrounding it

3 If an ion contains 10 electrons, 12 protons, and 13 neutrons, what is the ion's charge?

A. 2−
B. 1−
C. 2+
D. 3+

4 J.J. Thomson's experimental setup is shown below.



What is happening to the cathode rays?

A. They are attracted to the negative plate.
B. They are attracted to the positive plate.
C. They are stopped by the plates.
D. They are unaffected by either plate.

5 How many neutrons does iron-59 have?

A. 30
B. 33
C. 56
D. 59

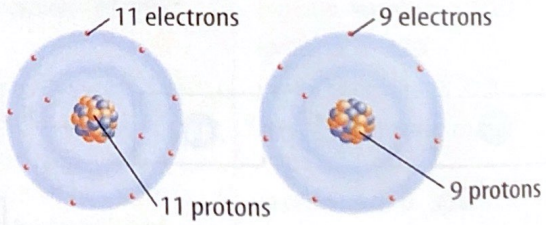
6 Why were Rutherford's students surprised by the results of the gold foil experiment?

A. They didn't expect the alpha particles to bounce back from the foil.
B. They didn't expect the alpha particles to continue in a straight path.
C. They expected only a few alpha particles to bounce back from the foil.
D. They expected the alpha particles to be deflected by electrons.

7 Which determines the identity of an element?

A. its mass number
B. the charge of the atom
C. the number of its neutrons
D. the number of its protons

8 The figure below shows which of the following?



A. two different elements
B. two different ions
C. two different isotopes
D. two different protons

9 How is Bohr's atomic model different from Rutherford's model?

A. Bohr's model has a nucleus.
B. Bohr's model has electrons.
C. Electrons in Bohr's model are located farther from the nucleus.
D. Electrons in Bohr's model are located in circular energy levels.

Online Test Practice

Critical Thinking

10 **Consider** what would have happened in the gold foil experiment if Dalton's theory had been correct.

11 **Contrast** How does Bohr's model of the atom differ from the present-day atomic model?

12 **Describe** the electron cloud using your own analogy.

13 **Summarize** how radioactive decay can produce new elements.

14 **Hypothesize** What might happen if a negatively charged ion comes into contact with a positively charged ion?

15 **Infer** Why isn't mass number listed with each element on the periodic table?

16 **Explain** How is the average atomic mass calculated?

17 **Infer** Oxygen has three stable isotopes.

Isotope	Average Atomic Mass
Oxygen-16	0.99757
Oxygen-17	0.00038
Oxygen-18	0.00205

What can you determine about the average atomic mass of oxygen without calculating it?

Writing in Science

18 **Write** a newspaper article that describes how the changes in the atomic model provide an example of the scientific process in action.

REVIEW THE BIG IDEA

19 **Describe** the current model of the atom. Explain the size of atoms. Also explain the charge, the location, and the size of protons, neutrons, and electrons.

20 **Summarize** The Large Hadron Collider, shown below, is continuing the study of matter and energy. Use a set of four drawings to summarize how the model of the atom changed from Thomson, to Rutherford, to Bohr, to the modern model.

Math Skills

Math Practice

Use Percentages

Use the information in the table to answer questions 21 and 22.

Magnesium (Mg) Isotope	Percent Found in Nature
Mg-24	78.9%
Mg-25	10.0%
Mg-26	

21 What is the percentage of Mg-26 found in nature?

22 What is the average atomic mass of magnesium?

Standardized Test Practice

Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

Multiple Choice

1 Which best describes an atom?

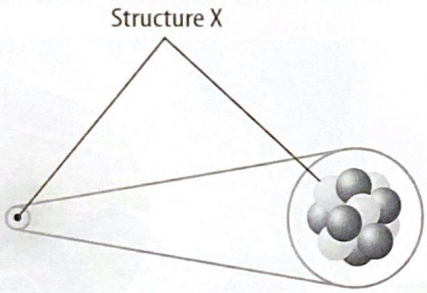
A a particle with a single negative charge

B a particle with a single positive charge

C the smallest particle that still represents a compound

D the smallest particle that still represents an element

Use the figure below to answer questions 2 and 3.



2 What is Structure X?

A an electron

B a neutron

C a nucleus

D a proton

3 Which best describes Structure X?

A most of the atom's mass, neutral charge

B most of the atom's mass, positive charge

C very small part of the atom's mass, negative charge

D very small part of the atom's mass, positive charge

4 Which is true about the size of an atom?

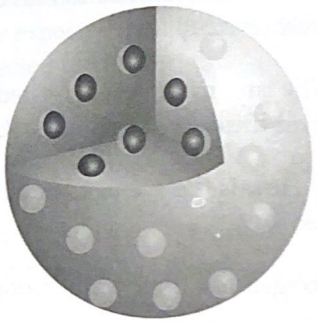
A It can only be seen using a scanning tunneling microscope.

B It is about the size of the period at the end of this sentence.

C It is large enough to be seen using a magnifying lens.

D It is too small to see with any type of microscope.

Use the figure below to answer question 5.



5 Whose model for the atom is shown?

A Bohr's

B Dalton's

C Rutherford's

D Thomson's

6 What structure did Rutherford discover?

A the atom

B the electron

C the neutron

D the nucleus

Online Standardized Test Practice

Use the table below to answer questions 7–9.

Particle	Number of Protons	Number of Neutrons	Number of Electrons
1	4	5	2
2	5	5	5
3	5	6	5
4	6	6	6

7 What is atomic number of particle 3?

A 3

B 5

C 6

D 11

8 Which particles are isotopes of the same element?

A 1 and 2

B 2 and 3

C 2 and 4

D 3 and 4

9 Which particle is an ion?

A 1

B 2

C 3

D 4

10 Which reaction starts with a neutron and results in the formation of a proton and a high-energy electron?

A alpha decay

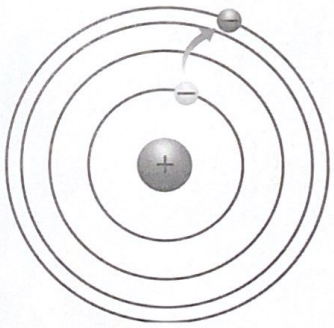
B beta decay

C the formation of positive ion

D the formation of negative ion

Constructed Response

Use the figure below to answer questions 11 and 12.



11 Identify the atomic model shown in the figure, and describe its characteristics.

12 How does this atomic model differ from the modern atomic model?

13 Compare two different neutral isotopes of the same element. Then compare two different ions of the same element. What do all of these particles have in common?

14 How does nuclear decay differ from the formation of ions? What parts of the atom are affected in each type of change?

NEED EXTRA HELP?														
If You Missed Question...	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Go to Lesson...	1	1	1	1	1	1	2	2	2	2	1	1	2	2