

4**Atomic Structure****Chapter Test****A. Matching**

Match each description in Column B with the correct term in Column A.

Column A

- ___ 1. proton 4·2
 ___ 2. atom 4·1
 ___ 3. mass number 4·5
 ___ 4. atomic mass unit 4·5
 ___ 5. electron 4·2
 ___ 6. isotopes 4·6
 ___ 7. atomic number 4·4
 ___ 8. atomic mass 4·7
 ___ 9. nucleus 4·3
 ___ 10. neutron 4·2

Column B

- a. the smallest particle of an element that retains the properties of that element
 b. the weighted average of the masses of the isotopes of an element
 c. 1/12th of the mass of a carbon atom with six protons and six neutrons
 d. the number of protons in the nucleus of an element
 e. a negatively charged subatomic particle
 f. atoms with the same number of protons but different numbers of neutrons
 g. the total number of protons and neutrons in the nucleus of an atom
 h. subatomic particle with no charge
 i. the central part of an atom, containing protons and neutrons
 j. a positively charged subatomic particle

B. Multiple Choice

Choose the best answer and write its letter in the blank.

- ___ 11. Which of the following is *not* a part of Dalton's atomic theory? 4·1
 a. All elements are composed of atoms.
 b. Atoms are always in motion.
 c. Atoms of the same element are alike in mass and size.
 d. Atoms that combine do in simple whole-number ratios.
- ___ 12. Dalton theorized that atoms are indivisible and that all atoms of an element are identical. We now know that: 4·2
 a. Dalton's theories are correct.
 b. Atoms of an element can have different numbers of protons.
 c. Atoms are divisible.
 d. All atoms of an element are not identical but they must all have the same mass.
- ___ 13. The nucleus of an atom is: 4·3
 a. positively charged and has a high density. c. negatively charged and has a high density.
 b. positively charged and has a low density. d. negatively charged and has a low density.

- ____ 14. The number of neutrons in the nucleus of an atom can be calculated by: 4.4, 4.5
 a. adding together the number of electrons and protons.
 b. subtracting the number of electrons from the number of protons.
 c. subtracting the number of protons from the mass number.
 d. adding the mass number to the number of electrons.
- ____ 15. Which of these statements is *false*? 4.2, 4.3
 a. Protons have a positive charge.
 b. Electrons are negatively charged and have a mass of 1 amu.
 c. The nucleus of an atom is positively charged.
 d. The neutron is found in the nucleus of an atom.
- ____ 16. All atoms of the same element have the same: 4.4
 a. number of neutrons. c. mass numbers.
 b. number of protons. d. mass.
- ____ 17. The sum of the protons and neutrons in an atom equals the: 4.5
 a. atomic number. c. atomic mass.
 b. nucleus number. d. mass number.
- ____ 18. An atom of an element with atomic number 50 and mass number 120 contains: 4.6
 a. 50 protons, 50 electrons, and 70 neutrons.
 b. 70 electrons, 50 protons, and 50 neutrons.
 c. 120 neutrons, 50 protons, and 70 electrons.
 d. 70 neutrons, 70 protons, and 50 electrons.
- ____ 19. The atomic mass of an element: 4.7
 a. depends upon the number of isotopes of that element.
 b. depends upon the mass of each isotope of that element.
 c. depends upon the relative abundance of each isotope of the element.
 d. all of the above
- ____ 20. The number 84 in the name krypton-84 represents: 4.7
 a. the atomic number. c. the sum of the protons and electrons.
 b. the mass number. d. none of these
- ____ 21. Which of these statements is *not* true? 4.6
 a. Atoms of the same element can have different masses.
 b. Atoms of isotopes of an element have different numbers of protons.
 c. The nucleus of an atom has a positive charge.
 d. Atoms are mostly empty space.
- ____ 22. How do the isotopes hydrogen-1 and hydrogen-2 differ? 4.6
 a. Hydrogen-2 has one more electron than hydrogen-1.
 b. Hydrogen-2 has one neutron.
 c. Hydrogen-2 has two protons.
 d. Hydrogen-1 has no protons.
- ____ 23. Average relative atomic masses are measured in: 4.8
 a. amus. b. grams. c. angstroms. d. nanograms.
- ____ 24. If E is the symbol for an element, which two of the following symbols represent isotopes of the same element? 4.6
 1. $^{20}_{10}\text{E}$ 2. $^{20}_{11}\text{E}$ 3. $^{21}_{9}\text{E}$ 4. $^{21}_{10}\text{E}$
 a. 1 and 2 b. 3 and 4 c. 1 and 4 d. 2 and 3

C. Problems

Solve the following problems in the space provided. Show your work.

25. There are four naturally occurring isotopes of the element chromium. The relative abundance of each is: $^{50}\text{Cr} = 4.31\%$, $^{52}\text{Cr} = 83.76\%$, $^{53}\text{Cr} = 9.55\%$, $^{54}\text{Cr} = 2.38\%$. Calculate the average atomic mass of chromium. 4.7

26. Complete this table. 4.4, 4.5

Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons
8	_____	_____	8	_____
_____	14	_____	7	_____
_____	_____	_____	21	20
11	23	_____	_____	_____
_____	56	26	_____	_____

27. List the number of protons, neutrons, and electrons in each of the following atoms. 4.5

	Protons	Neutrons	Electrons
$^{13}_6\text{C}$	_____	_____	_____
$^{15}_7\text{N}$	_____	_____	_____
$^{20}_{10}\text{Ne}$	_____	_____	_____
$^{11}_5\text{B}$	_____	_____	_____
^9_4Be	_____	_____	_____

D. Essay

28. Explain how the atoms of one element differ from those of another element. 4.3

On your answer sheet, fill in the letter of the answer that best completes each statement.

- The word atom comes from the Greek word *atomos*, meaning
a. matter. b. indivisible. c. mass. d. volume.
- The smallest piece of matter was named "atom" by
a. Socrates. b. Nero. c. Democritus. d. Hipocrates.
- In 1897, J. J. Thomson called the negatively charged particles of an atom "corpuscles." Today they are known as
a. protons. b. electrons. c. neutrons. d. elements.
- Ernest Rutherford tested the Thomson model and found that an atom has a small, positively charged center that he called the
a. proton. b. neutron. c. electron. d. nucleus.
- In 1913, Niels Bohr found that electrons move in definite orbits around the
a. nucleus. b. atom. c. element. d. sun.
- Today's atomic model is based on the principles of
a. planetary orbits. c. plum pudding models.
b. wave mechanics. d. corpuscular theory.
- According to the modern atomic model,
a. an atom has a small, positively charged nucleus.
b. the nucleus is surrounded by a large region in which there are enough electrons to make the atom neutral.
c. both a and b are true.
d. neither a nor b is true.
- The nucleus
a. is the center of the atom.
b. contains neutrons and protons.
c. accounts for 99.9 percent of the mass of an atom.
d. is characterized by all of the above.
- All protons are
a. electrically neutral. c. electrically negative.
b. identical. d. orbiting the nucleus.
- All neutrons
a. are electrically neutral. c. are electrically positive.
b. have a mass of 2 amu. d. are located outside the nucleus.
- The atomic number of an element is determined by the number of
a. electrons in the atom. c. protons in the nucleus of the atom.
b. neutrons in the nucleus of the atom. d. protons plus neutrons in the nucleus of the atom.
- Atoms of the same element that have the same number of protons but different numbers of neutrons are called
a. isotopes. b. isomers. c. subatomic particles. d. allotropes.
- The sum of the protons and neutrons in an atom's nucleus is its
a. isotope number. b. atomic mass. c. mass number. d. atomic number.
- The space in which electrons are likely to be found is called the
a. orbiting field. b. electron cloud. c. atomic mass unit. d. positive field.
- A quark is a(an)
a. subatomic particle. b. laser beam. c. combination of electrons. d. group of protons.

16. The forces that account for the behavior of subatomic particles include
- a. electromagnetic force.
 - b. strong and weak force.
 - c. gravity.
 - d. all of these forces.
17. The discovery of the electron by J. J. Thomson proved that the atom is
- a. indivisible.
 - b. surrounded by positive charges.
 - c. divisible.
 - d. negatively charged.
18. The nucleus accounts for
- a. 99.9 percent of an atom's mass.
 - b. 50 percent of an atom's mass.
 - c. 75 percent of an atom's mass.
 - d. 00.1 percent of an atom's mass.
19. Within the electron cloud, electrons are arranged in
- a. orbits.
 - b. groups of 2.
 - c. energy levels.
 - d. groups of 8.
20. The weakest of the four forces governing the behavior of subatomic particles is
- a. electromagnetic force.
 - b. strong force.
 - c. weak force.
 - d. gravity.
21. All materials are made of
- a. subatomic particles.
 - b. matter.
 - c. groups of protons.
 - d. none of the above.
22. Indirect evidence about an object is evidence gathered
- a. by reading a textbook.
 - b. without actually seeing or touching the object.
 - c. from laboratory experiments.
 - d. that cannot be used in a theory.
23. Democritus concluded that matter
- a. could not be divided into smaller and smaller pieces forever.
 - b. could be divided into indivisible atoms.
 - c. consists of protons, neutrons, and electrons.
 - d. is positively charged.
24. John Dalton's atomic theory includes the idea that
- a. compounds are formed by the joining of atoms of two or more elements.
 - b. atoms are made of smaller particles.
 - c. atoms are neutral.
 - d. electrons move in definite orbits.
25. The probable location of an electron is
- a. easy to determine by studying a periodic table.
 - b. determined by the atomic mass of an element.
 - c. based on how much energy the electron has.
 - d. impossible to determine.

4**Atomic Structure**

Reviewsheet

A. Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this chapter. Each blank can be completed with a term, short phrase, or number.

Atoms of each element are 1 from the atoms of all other elements. Dalton theorized that atoms are indivisible, but the discovery of 2 particles changed this theory. We now know that atoms are made up of electrons, which have a 3 charge; 4, which have a positive charge; and 5, which are neutral. The latter two particles are found in the 6 of the atom.

It was 7 who discovered the nucleus of the atom. The nucleus has a 8 charge and it occupies a very small volume of the atom. In contrast, the negatively charged 9 occupy most of the volume of the atom.

The number of 10 in the nucleus of the atom is the atomic 11 of that element. Because atoms are electrically neutral, the number of protons and 12 in an atom are equal. The sum of the 13 and neutrons is the mass number. Atoms of the same element are identical in most respects, but they can differ in the number of 14 in the nucleus. Atoms that have the same number of protons but different mass numbers are called 15.

The 16 of an element is the weighted average of the masses of the isotopes of that element. Two isotopes of sulfur are $^{32}_{16}\text{S}$ and $^{34}_{16}\text{S}$. An atom of the sulfur-32 isotope contains 17 protons and 18 neutrons. The sulfur-34 isotope has 19 protons and 20 neutrons.

Each of the three known isotopes of hydrogen has 21 proton(s) in the nucleus. The most common hydrogen isotope has 22 neutrons. It has an atomic mass of 23 amu and is called hydrogen-1.

1. _____ 4.1
2. _____ 4.2
3. _____ 4.2
4. _____ 4.2
5. _____ 4.2
6. _____ 4.3
7. _____ 4.3
8. _____ 4.3
9. _____ 4.3
10. _____ 4.4
11. _____ 4.4
12. _____ 4.4
13. _____ 4.5
14. _____ 4.6
15. _____ 4.6
16. _____ 4.7
17. _____ 4.7
18. _____ 4.6
19. _____ 4.6
20. _____ 4.6
21. _____ 4.7
22. _____ 4.7
23. _____ 4.7

B. True-False

Classify each of the following statements as always true, AT; sometimes true, ST; or never true, NT.

- ___ 24. According to Dalton's atomic theory, atoms are composed of protons, electrons, and neutrons. 4-1
- ___ 25. Atoms of elements are electrically neutral. 4-2
- ___ 26. The mass of an electron is equal to the mass of a neutron. 4-2
- ___ 27. The charge on all protons is the same. 4-2
- ___ 28. The atomic number of an element is the sum of the protons and electrons in the atom. 4-4
- ___ 29. The atomic number of an element is the whole number that decreases as you read across each row of the periodic table from left to right. 4-4
- ___ 30. An atom of nitrogen has 7 protons and 7 neutrons. 4-6
- ___ 31. Relative atomic masses are measured in amus. 4-7
- ___ 32. The number of neutrons in the nucleus can be calculated by subtracting the atomic number from the mass number. 4-5

C. Questions and Problems

Answer the following questions or solve the following problems in the space provided. Show your work.

33. Complete the following table. 4-5

Element	Symbol	Atomic number	Mass number	Number of protons	Number of electrons	Number of neutrons
carbon	_____	_____	12	_____	6	_____
_____	K	19	_____	_____	_____	21
_____	_____	12	_____	12	_____	12
helium	_____	2	4	2	_____	_____
_____	_____	5	_____	5	_____	6

34. Fill in the following table. 4-6

Element	Symbol	Atomic number	Mass number	Number of neutrons
nitrogen-15	_____	_____	_____	8
_____	$^{22}_{10}\text{Ne}$	_____	_____	_____
beryllium-9	_____	4	_____	_____

35. Given the relative abundance of the following naturally occurring isotopes of oxygen, calculate the average atomic mass of oxygen: 4-7

oxygen-16:	99.76%
oxygen-17:	0.037%
oxygen-18:	0.204%

8 ATOMIC STRUCTURE

A. DISCOVERING CONCEPTS

Circle the letter in front of the best answer to complete each statement.

- The Greek philosopher _____ proposed the first atomic theory around 400 B.C.
a. Aristotle b. Archimedes c. Democritus d. Plato
- Which of the following statements is NOT part of Dalton's atomic theory?
a. All matter is composed of atoms.
b. Atoms cannot be broken apart.
c. Atoms of different elements are quite different.
d. Isotopes of the same elements have different masses.
- The law of conservation of mass was first stated by _____.
a. Lavoisier b. Dalton c. Proust d. Boyle
- _____ 's hypothesis states that equal volumes of gases under the same conditions of pressure and temperature contain the same number of molecules.
a. Boyle b. Lavoisier c. Gay-Lussac d. Avogadro
- _____ is generally credited with the discovery of the electron.
a. J.J. Thomson b. Millikan c. Chadwick d. Moseley
- The electron's mass is _____ the mass of a proton.
a. less than b. more than c. approximately equal to
- The mass of a proton is _____ the mass of a neutron.
a. less than b. more than c. approximately equal to
- _____ devised an oil drop experiment to determine the charge on an electron.
a. Moseley b. Chadwick c. Millikan d. J.J. Thomson
9. The number of protons an atom has determines its atomic number and is represented by the symbol _____.
a. A b. N c. P d. Z
- The element hydrogen has three _____.
a. electrons b. protons c. neutrons d. isotopes
- The _____ has been assigned a charge of 1+.
a. electron b. proton c. neutron d. neutrino
12. The difference in mass of isotopes of the same element is due to different number of _____ in the nucleus.
a. protons b. neutrons c. electrons d. positrons
- Scientists use the isotope _____ as the standard for the atomic mass scale.
a. hydrogen-1 b. helium-4 c. carbon-12 d. oxygen-16
- Most atoms have a diameter between _____ nanometers.
a. 0.1 and 0.5 b. 1 and 10 c. 10 and 100 d. 10 000 and 1 000 000
15. In a mass spectrometer, the lighter particles are bent _____ the heavier particles as they pass through the fields.
a. less than b. more than c. the same as

4. Use Table 8-3 on page 140 of your text to complete the following table.

Name	Protons	Neutrons	Electrons	Mass Number
Boron-11			5	
	24			52
Sulfur-32				
		70	50	

5. The average atomic mass of an element is the relative mass of an atom compared to a selected standard, the carbon-12 atom.

carbon-12 atom

atomic mass = 12 amu

hydrogen atom

1/12 of atomic mass of carbon-12

atomic mass = 1 amu

magnesium atom

about twice the mass of carbon-12

atomic mass = 24 amu

a. The atomic mass of krypton is about 7 times that of carbon. Estimate the atomic mass of Kr.

b. Find the mass of neodymium, Nd, using Table 8-3 of your text. How many times the mass of carbon-12 is it?

c. A particular atom of cobalt, Co, contains 27 protons, 27 electrons, and 32 neutrons. What is the atomic number and the mass number for this element?

d. How many protons, electrons, and neutrons are in the isotope of chromium with mass number 53?
