

4**Atomic Structure**
Reteaching Worksheet**Section 4.4 Atomic Number***Re-read Section 4.4 in your text*

All atoms are composed of the same particles: positively charged protons, negatively charged electrons, and uncharged neutrons. The electrons orbit a small, dense nucleus made of neutrons and protons.

What makes a silver atom different from a gold atom? How can you distinguish between a hydrogen atom and a helium atom? All of the atoms of an element have the same number of protons. The number of protons is an identifying characteristic of atoms and is called the atomic number. Silver has 47 protons, so its atomic number is 47. Gold has 79 protons, so its atomic number is 79.

Since atoms are electrically neutral, the number of positively charged protons must equal the number of negatively charged electrons. Therefore, the atomic number of an atom not only equals the number of protons but also equals the number of electrons for a neutral atom.

atomic number = the number of protons = the number of electrons

Look at the periodic table in your text. The atomic number is written as a whole number above the chemical symbol of each element. The atomic numbers increase as you read across each row from left to right in the periodic table.

Apply

1. Use the periodic table to complete this table.

Element	Symbol	Atomic number	Number of protons	Number of electrons
a. Sodium	_____	_____	_____	_____
b. _____	Ta	_____	_____	_____
c. _____	_____	_____	_____	76
d. _____	_____	82	_____	_____
e. _____	_____	_____	80	_____

2. What is the total (combined) number of protons and electrons in the following elements?

- a. calcium _____
- b. cobalt _____
- c. xenon _____
- d. nitrogen _____
- e. uranium _____

Section 4.5 Mass Number

Re-read Section 4.5 in your text

The mass of an atom is concentrated in its nucleus, which consists of protons and neutrons. The mass of a single proton or a single neutron is approximately 1 atomic mass unit (amu) each (amu's are discussed in more detail in Section 4.7 of your text). The sum of the masses of the protons and neutrons in the nucleus gives us the mass of the atom. In turn, the mass of an atom is equal to the total number of protons and neutrons. The mass of an atom is referred to as the mass number.

$$\text{mass number} = \text{mass of the atom} = \text{number of protons and neutrons}$$

The atomic number of an atom is the total number of protons. The atomic mass number of an atom is the total number of neutrons and protons. Consequently, it is possible to determine the number of neutrons in an atom.

$$\begin{aligned}\text{number of neutrons} &= \text{mass number} - \text{atomic number} \\ &= (\text{protons} + \text{neutrons}) - \text{protons}\end{aligned}$$

Once again, look at the periodic table in your text. Look for the letters *Na* in the first column on the left. *Na* is the chemical symbol for sodium which comes from the first two letters of its Latin name, *natrium*. The atomic number is written as a subscript in front of the symbol. The atomic mass is written as a superscript: $^{23}_{11}\text{Na}$.

How many neutrons does sodium have? The mass number minus the atomic number equals the number of neutrons. Therefore, sodium has 12 neutrons.

Apply

1. Use the periodic table to help you find the answers to the following problems.
 - a. An atom has 23 neutrons and 18 protons. What is its mass number? What is its atomic number?
 - b. An element has 80 electrons and 80 protons. What is its atomic number? What is its atomic mass? How many neutrons does it have? Write its chemical symbol.
 - c. Write the complete symbolic notation for the element whose atomic number is 79. This is the element gold. What does the superscript number represent? What does the subscript number represent?

 - d. An atom has a mass number of 19 and has 9 electrons. Which element is it and what is its atomic number?

 - e. Aluminum and silicon have a mass number difference of approximately one. How can this be?

CHAPTER 6 REVIEW ACTIVITY

Text Reference: Section 6-19

Subatomic Particles

The three particles found inside the atom are the proton (charge = +1), the neutron (charge = 0), and the electron (charge = -1). In an uncharged atom, the number of electrons equals the number of protons. However, an atom may become charged by the gain or loss of electrons. The net charge is then the algebraic sum of the charges of its protons and electrons.

The number of protons in an atom is called its *atomic number*. The total number of protons and neutrons is called its *mass number*.

Each of the exercises below represents the neutral or charged atom with the name and net charge given. Given the information, determine the values of (a), (b), and (c) for each.

1. Lithium¹⁺

Number of protons = 3
Number of electrons = (a) _____
Number of neutrons = 4
Atomic number = (b) _____
Mass number = (c) _____

2. Phosphorus³⁻

Number of protons = (a) _____
Number of electrons = 18
Number of neutrons = (b) _____
Atomic number = (c) _____
Mass number = 31

1. a. _____

b. _____

c. _____

2. a. _____

b. _____

c. _____

3. Vanadium⁰

Number of protons = (a) _____
Number of electrons = (b) _____
Number of neutrons = (c) _____
Atomic number = 23
Mass number = 51

4. Krypton⁰

Number of protons = (a) _____
Number of electrons = (b) _____
Number of neutrons = 48
Atomic number = 36
Mass number = (c) _____

3. a. _____

b. _____

c. _____

4. a. _____

b. _____

c. _____

5. Barium⁴⁺

Number of protons = 56
Number of electrons = (a) _____
Number of neutrons = (b) _____
Atomic number = (c) _____
Mass number = 137

6. Uranium⁵⁻

Number of protons = (a) _____
Number of electrons = 97
Number of neutrons = 146
Atomic number = (b) _____
Mass number = (c) _____

5. a. _____

b. _____

c. _____

6. a. _____

b. _____

c. _____

7. a. _____

b. _____

c. _____

7. Magnesium²⁺

Number of protons = 12
Number of electrons = (a) _____
Number of neutrons = (b) _____
Atomic number = (c) _____
Mass number = 24

8. Polonium²⁻

Number of protons = (a) _____
Number of electrons = (b) _____
Number of neutrons = (c) _____
Atomic number = 84
Mass number = 209

8. a. _____

b. _____

c. _____

Isotopes or Different Elements?

In each of the following statements, you are given a pair of elements and important information about each. Use this information to determine if the pair of elements are isotopes or different elements. Indicate your answer in the space provided.

Element D has 6 protons and 7 neutrons.

Element F has 7 protons and 7 neutrons.

Element J has 27 protons and 32 neutrons.

Element L has 27 protons and 33 neutrons.

Element X has 17 protons and 18 neutrons.

Element Y has 18 protons and 17 neutrons.

Element Q has 56 protons and 81 neutrons.

Element R has 56 protons and 82 neutrons.

Element T has an atomic number of 20 and an atomic mass of 40.

Element Z has an atomic number of 20 and an atomic mass of 41.

Element W has 8 protons and 8 neutrons.

Element V has 7 protons and 8 neutrons.

Element P has an atomic number of 92 and an atomic mass of 238.

Element S has 92 protons and 143 neutrons.

3-3 Practice Problems

1. How many protons and electrons are present in a vanadium atom?
2. How many protons and electrons are present in a nitrogen atom?
3. How many protons and electrons are present in an argon atom?
4. How many protons and electrons are present in a potassium atom?
5. How many protons and electrons are present in a platinum atom?
6. What is the name of the element that has atoms that contain 5 protons?
7. What is the name of the element that has atoms that contain 17 protons?
8. What is the name of the element that has atoms that contain 25 protons?
9. What is the name of the element that has atoms that contain 82 protons?
10. What is the name of the element that has atoms that contain 92 protons?
11. Write the chemical symbol for the ion with 12 protons and 10 electrons.
12. Write the chemical symbol for the ion with 74 protons and 68 electrons.
13. Write the chemical symbol for the ion with 95 protons and 89 electrons.
14. Write the chemical symbol for the ion with 33 protons and 36 electrons.

3-3 Practice Problems (continued)

15. Write the chemical symbol for the ion with 29 protons and 27 electrons.
21. How many protons, neutrons, and electrons are present in the ${}^{13}_{6}\text{C}^{4-}$ ion?
16. How many protons, neutrons, and electrons are present in the ${}^{59}_{28}\text{Ni}^{2+}$ ion?
22. Write the complete chemical symbol for the ion with 84 protons, 125 neutrons, and 80 electrons.
17. How many protons, neutrons, and electrons are present in the ${}^{91}_{40}\text{Zr}^{4+}$ ion?
23. Write the complete chemical symbol for the ion with 27 protons, 32 neutrons, and 25 electrons.
18. How many protons, neutrons, and electrons are present in the ${}^{140}_{58}\text{Ce}^{3+}$ ion?
24. Write the complete chemical symbol for the ion with 73 protons, 108 neutrons, and 68 electrons.
19. How many protons, neutrons, and electrons are present in the ${}^{79}_{34}\text{Se}^{2-}$ ion?
25. Write the complete chemical symbol for the ion with 31 protons, 39 neutrons, and 28 electrons.
20. How many protons, neutrons, and electrons are present in the ${}^{45}_{21}\text{Sc}^{3+}$ ion?

Atomic Structure

You can become more familiar with the atomic structure of some common substances by completing the chart below. For each substance, you have been given enough information to fill in all the blanks.

Substance	Symbol	Atomic Number	Mass Number	Number of Protons	Number of Neutrons	Number of Electrons
Helium	He	2	4			
Magnesium	Mg	12			12	
Zinc	Zn	30	65			
Bromine	Br		80			35
Aluminum	Al			13	14	
Uranium	U				146	92
Sodium	Na	11			12	
Krypton	Kr				48	36
Calcium	Ca		40	20		
Silver	Ag			47	61	

Atomic Dimensions

The table below contains information about several elements. Use this table to review the concepts of atomic number, mass number, numbers of subatomic particles, isotopes, and charged and uncharged atoms. In each case, enough information has been provided for you to fill in all the blanks.

Element	Symbol	Atomic Number	Mass Number	Number of Protons	Number of Neutrons	Number of Electrons	Isotope, Ion, or Neutral Atom
Aluminum	Al		27	13		13	
Bromine		35	80		45	36	
Uranium	U	92			146	92	
Helium	He	2	4				
Helium	He	2	5			2	
Lithium		3	7			2	
Tungsten	W		184		110	74	
Xenon					79	54	Neutral atom
Magnesium	Mg		24				Positive 2 ion
Carbon		6			6		Neutral atom
Carbon	C		14	6	8		
Nitrogen		7	14				