

## It All Adds Up

You can use the periodic table to find the number of protons, neutrons, and electrons that the atoms of an element have.

Atomic number = number of protons

Number of protons = number of electrons

Mass number = number of protons + number of neutrons

so

Mass number – atomic number = number of neutrons

All atoms of a particular element have the same number of protons and electrons, but the atoms may differ in the number of neutrons they have. Atoms of the same element with different numbers of neutrons are called **isotopes**. Isotopes have the same atomic number but different atomic masses. In nature, an element is found as a mixture of different isotopes. The atomic masses or weights in the periodic table are the average for an element's isotopes.

Isotopes can be written in two ways:

Carbon-12

or



12 is the mass number of carbon.

6 is the atomic number of carbon.

C is the chemical symbol for carbon.

Use the periodic table to fill in information about the isotopes in the chart below.

Substance	Mass Number	Number of		
		Protons	Neutrons	Electrons
1. carbon-14				
2. lead-208				
3. uranium-239				
4. uranium-238				
5. tin-118				

# PARTS OF AN ATOM

Name \_\_\_\_\_

An atom is made up of protons and neutrons which are in the nucleus, and electrons which are in the electron cloud surrounding the atom.

The atomic number equals the number of protons. The electrons in a neutral atom equal the number of protons. The mass number equals the sum of the protons and neutrons.

The charge indicates the number of electrons that have been lost or gained. A positive charge indicates the number of electrons (which are negatively charged) lost.

A negative charge indicates the number of electrons gained.  
This structure can be written as part of a chemical symbol.

**Example:**

$$\begin{array}{c}
 \text{mass} \\
 \text{number} \\
 \downarrow \\
 12 \\
 \text{C} \\
 \uparrow \\
 6 \\
 \text{atomic} \\
 \text{number}
 \end{array}
 \begin{array}{c}
 \text{charge} \\
 \swarrow \\
 +4
 \end{array}$$

This carbon ion would have 6 protons, 6 neutrons and 2 electrons.

Complete the following chart.

Element/ Ion	Atomic Number	Mass Number	Charge	Protons	Neutrons	Electrons
${}^{24}_{12}\text{Mg}$						
${}^{39}_{19}\text{K}$						
${}^{23}_{11}\text{Na}^{+1}$						
${}^{19}_{9}\text{F}^{-1}$						
${}^{27}_{13}\text{Al}^{+3}$						
${}^1_1\text{H}$						
${}^{24}\text{Mg}^{2+}$						
${}^{109}\text{Ag}$						
${}^{32}\text{S}^{-2}$						
${}^2_1\text{H}$						
${}^{35}\text{Cl}^{-}$						
${}^4\text{Be}^{2+}$						

Regents Chemistry: Practice for atomic structure and the mole

Name: \_\_\_\_\_ Date: \_\_\_\_\_

1. What is the mass number of an atom that contains 19 protons, 19 electrons, and 20 neutrons?
2. What is the total number of protons and neutrons in an atom of  $^{86}_{37}\text{Rb}$ ?
3. Which subatomic particles have a mass of approximately 1 atomic mass unit each?
4. In all samples of the element potassium (K), each atom has  
a) 19 protons b) 20 neutrons c) 39 protons and neutrons d) 39 nucleons
5. The atomic number of any atom is equal to the number of \_\_\_\_\_.
6. What is the mass number of an element whose atoms each contain 47 protons, 60 neutrons, and 47 electrons?
7. The atoms in a sample of an element must contain nuclei with the same number of  
a) electrons b) protons c) neutrons d) nucleons
8. How many electrons are in a neutral atom of  $^7_3\text{Li}$ ?
9. Which of the following particles has the smallest mass?  
a) electron b) proton c) neutron d) hydrogen atom
10. What is the total number of electrons in a  $\text{Mg}^{2+}$  ion?
11. Different isotopes of the same element must have a different \_\_\_\_\_.
12. Which subatomic particle is electrically neutral? \_\_\_\_\_
13. A sample of element X contains 90%  $^{35}\text{X}$  atoms, 8.0%  $^{37}\text{X}$  atoms, and 2.0%  $^{38}\text{X}$  atoms. What is the average atomic mass of this element?
14. What is the nuclear charge of an atom with a mass of 23 and an atomic number of 11?
15. Which element has a nucleus that may contain 13 protons and 14 neutrons?
16. As a Na atom forms a  $\text{Na}^+$  ion, the number of protons in its nucleus  
a) increases b) decreases c) remains the same
17. How many neutrons and protons are in the nucleus of an atom of  $^{127}_{53}\text{I}$ ?
18. Which sample contains the same # of atoms as a gram-atomic mass of He?  
a) 6 g of C b) 7 g of Li c) 8 g of O d) 9 g of F

3-5 Practice Problems (continued)

15. Write the chemical symbol for the ion with 29 protons and 27 electrons.
16. How many protons, neutrons, and electrons are present in the  ${}^{59}_{28}\text{Ni}^{2+}$  ion?
17. How many protons, neutrons, and electrons are present in the  ${}^{91}_{40}\text{Zr}^{4+}$  ion?
18. How many protons, neutrons, and electrons are present in the  ${}^{140}_{58}\text{Ce}^{3+}$  ion?
19. How many protons, neutrons, and electrons are present in the  ${}^{79}_{34}\text{Se}^{2-}$  ion?
20. How many protons, neutrons, and electrons are present in the  ${}^{45}_{21}\text{Sc}^{3+}$  ion?
21. How many protons, neutrons, and electrons are present in the  ${}^{12}_{6}\text{C}^{14-}$  ion?
22. Write the complete chemical symbol for the ion with 84 protons, 125 neutrons, and 80 electrons.
23. Write the complete chemical symbol for the ion with 27 protons, 32 neutrons, and 25 electrons.
24. Write the complete chemical symbol for the ion with 73 protons, 108 neutrons, and 68 electrons.
25. Write the complete chemical symbol for the ion with 31 protons, 39 neutrons, and 28 electrons.

# ISOTOPES AND AVERAGE ATOMIC MASS

Name \_\_\_\_\_

Elements come in a variety of isotopes, meaning they are made up of atoms with the same atomic number but different atomic masses. These atoms differ in the number of neutrons.

The average atomic mass is the weighted average of all the isotopes of an element.

**Example:** A sample of cesium is 75%  $^{133}\text{Cs}$ , 20%  $^{132}\text{Cs}$  and 5%  $^{134}\text{Cs}$ . What is its average atomic mass?

$$\text{Answer: } .75 \times 133 = 99.75$$

$$.20 \times 132 = 26.4$$

$$.05 \times 134 = \underline{6.7}$$

$$\text{Total} = 132.85 \text{ amu} = \text{average atomic mass}$$

Determine the average atomic mass of the following mixtures of isotopes.

1. 80%  $^{127}\text{I}$ , 17%  $^{126}\text{I}$ , 3%  $^{128}\text{I}$

\_\_\_\_\_

2. 50%  $^{197}\text{Au}$ , 50%  $^{198}\text{Au}$

\_\_\_\_\_

3. 15%  $^{55}\text{Fe}$ , 85%  $^{56}\text{Fe}$

\_\_\_\_\_

4. 99%  $^1\text{H}$ , 0.8%  $^2\text{H}$ , 0.2%  $^3\text{H}$

\_\_\_\_\_

5. 95%  $^{14}\text{N}$ , 3%  $^{15}\text{N}$ , 2%  $^{16}\text{N}$

\_\_\_\_\_

6. 98%  $^{12}\text{C}$ , 2%  $^{14}\text{C}$

\_\_\_\_\_

# Unit 6

## A.5 BUILDING SKILLS SUPPLEMENT: FINDING AVERAGE ATOMIC WEIGHT

**Example:** There are three isotopes of neon found on the earth:  $^{20}\text{Ne}$  that accounts for 90.92% of the total,  $^{21}\text{Ne}$ , which makes up 0.2571%, and  $^{22}\text{Ne}$ , which makes up 8.822%. What is the average atomic weight of Ne?

$$\begin{aligned} \text{Atomic weight} &= (\text{weight of isotope}) \times (\text{decimal of percent}) + (\text{weight of isotope}) \times (\text{decimal of percent}) + \dots \\ &= (20) \times (0.9092) + (21) \times (0.002571) + (22) \times (0.08822) \\ &= 18.1840 + 0.053991 + 1.94084 \\ &= 20.1788 \text{ (rounded to least decimal place)} \end{aligned}$$

1.  $^{10}\text{B}$  (19.78%),  $^{11}\text{B}$  (80.22%)  
\_\_\_\_\_
2.  $^{63}\text{Cu}$  (69.46%),  $^{65}\text{Cu}$  (30.54%)  
\_\_\_\_\_
3.  $^{69}\text{Ga}$  (60.27%),  $^{71}\text{Ga}$  (39.73%)  
\_\_\_\_\_
4.  $^{79}\text{Br}$  (50.42%),  $^{81}\text{Br}$  (49.58%)  
\_\_\_\_\_
5.  $^{85}\text{Rb}$  (72.10%),  $^{87}\text{Rb}$  (27.90%)  
\_\_\_\_\_
6.  $^{35}\text{Cl}$  (77.30%),  $^{37}\text{Cl}$  (22.70%)  
\_\_\_\_\_
7.  $^{107}\text{Ag}$  (51.72%),  $^{109}\text{Ag}$  (48.28%)  
\_\_\_\_\_
8.  $^{28}\text{Si}$  (92.2%),  $^{29}\text{Si}$  (4.7%),  $^{30}\text{Si}$  (3.1%)  
\_\_\_\_\_
9.  $^{24}\text{Mg}$  (78.70%),  $^{25}\text{Mg}$  (10.13%),  $^{26}\text{Mg}$  (11.17%)  
\_\_\_\_\_
10.  $^{112}\text{Sn}$  (0.95%),  $^{114}\text{Sn}$  (0.65%),  $^{115}\text{Sn}$  (0.34%),  $^{116}\text{Sn}$  (14.24%),  $^{117}\text{Sn}$  (7.57%),  
 $^{118}\text{Sn}$  (24.01%),  $^{119}\text{Sn}$  (8.58%),  $^{120}\text{Sn}$  (32.97%),  $^{122}\text{Sn}$  (4.71%),  $^{124}\text{Sn}$  (5.98%)  
\_\_\_\_\_  
\_\_\_\_\_