

Isotopes, Percent Abundance, and AAM

Name: _____

General Chemistry

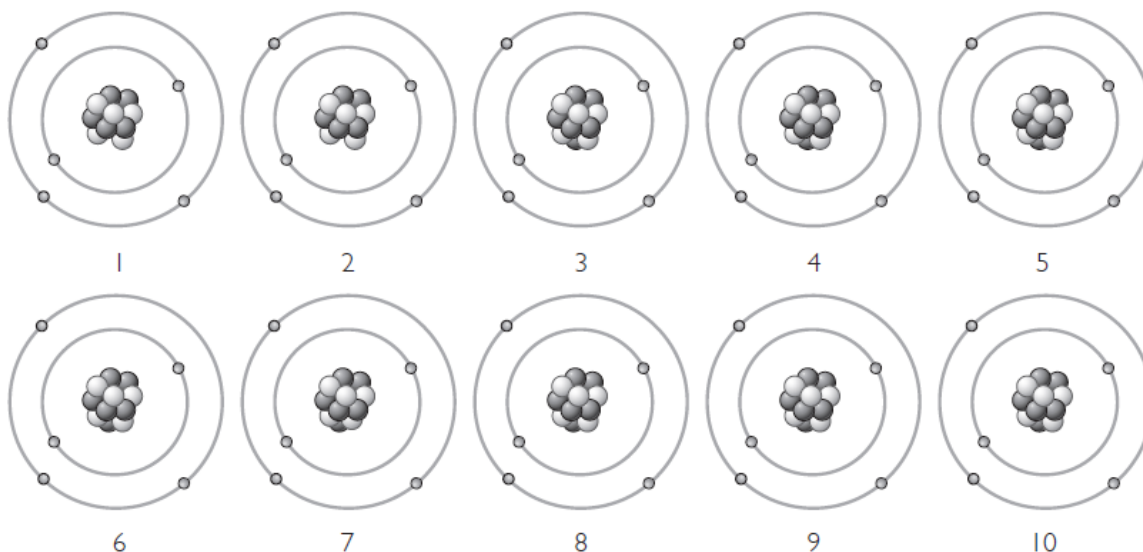
Date: _____ Hour _____

Purpose: To investigate the isotopes and the average atomic mass of a naturally occurring sample of atoms.

Part I: The Average Boron Atom

We have discovered that atoms of the same element can exist as **isotopes**. The images below represent a naturally occurring sample of boron. Complete the following questions after examining the sample of boron atoms.

1. Identify the subatomic particles and complete the key:



2. Use the naturally occurring sample of boron atoms above, to fill in the table below.

Boron Atom	1	2	3	4	5	6	7	8	9	10
# of protons										
# of neutrons										
# of electrons										
Mass number										

3. There are 2 types of naturally occurring isotopes represented in this sample. Identify them by completing the table. *Percent abundance is the percentage of each isotope. Include your calculation in the table.*

	Boron isotope 1	Boron isotope 2
Isotope Name		
Isotope Symbol		
Percent abundance		

- What is the average atomic mass of the ten atoms? How does this answer compare to the average atomic mass of boron listed in the periodic table?
- Imagine that you could examine a randomly chosen sample of 100 boron atoms. What isotopes would you expect to find? How many of each? Express your answers as percents.

Part II: The Number of Neutrons

Consider the samples of naturally occurring isotopes of other elements presented in the table below.

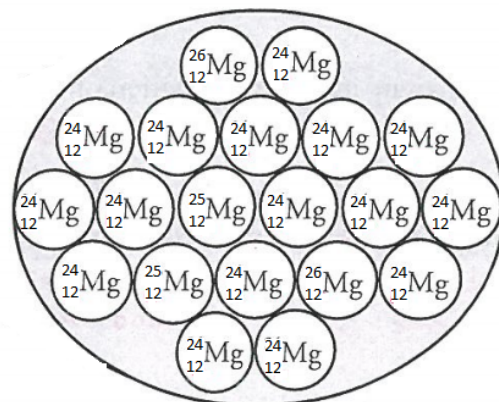
- The first row has been completed for your. Complete the rest of the table.

Element	Element Symbol	A #	AAM	# of p ⁺	# of e ⁻ (neutral)	Possible # of n ⁰	Possible isotope symbol(s)	Possible isotope name(s)
<i>boron</i>	<i>B</i>	<i>5</i>	<i>10.81</i>	<i>5</i>	<i>5</i>	<i>5 or 6</i>	$^{10}_5\text{B}$ or $^{11}_5\text{B}$	<i>Boron-10</i> <i>Boron-11</i>
chlorine				17				
lithium			6.94 amu					
	V	23						

- How many possible isotopes does chlorine have? How do you know?
- Which isotope of chlorine must be most common? Explain your reasoning.
- If you isolate a single atom of lithium, how many neutrons would it probably have in its nucleus? Explain.
- Explain why the average atomic masses of the elements listed in the periodic table usually are not whole numbers.

Part III: Calculate the Average Atomic Mass

The image to the right represents a naturally occurring sample of magnesium. Consider the image as you answer the questions below.



11. Determine the number of naturally occurring isotopes represented in this sample. How many **different isotopes** did you find?

Identify these isotopes by completing the table. **You will need to create a column for each isotope you identified.** Recall that percent abundance is the percentage of each isotope. Include your calculation in the table.

	CLASS EXAMPLE	Isotopes of Magnesium from the sample above		
Isotope Name	Element Name - M#			
Isotope Symbol	$\begin{matrix} M\# \\ A\# \end{matrix}$ Element Symbol			
Percent abundance	$\frac{\# \text{ atoms of isotope}}{\text{total \# atoms in sample}}$			
Mass of ONE atom <i>*HINT 4 LAB!*</i>	$\frac{\text{total mass of one isotope}}{\text{total mass of atoms in sample}}$			

On page 14, we calculated the average atomic mass (AAM) of the boron atoms by adding up their masses and dividing by 10. Since some isotopes are more common than others, we need to calculate AAM by using a special equation. Record the AAM equation in the box below, then use the information about the magnesium isotopes to practice.

2. Calculate the average atomic mass of magnesium.

Part VI: Average Atomic Mass Word Problems

Calculate the average atomic mass by using the equation we practiced above. A complete answer will show work and include an answer that is rounded to significant figures and includes a unit.

13. The element copper, Cu, has two naturally occurring isotopes: 69.2% of all copper samples consist of atoms with 34 neutrons, and 30.8% of all samples consist of atoms with 36 neutrons. Calculate the average atomic mass of copper atoms.
14. Rubidium is a soft, silvery-white metal that has two common isotopes, rubidium-85 and rubidium-87. If the abundance of rubidium-85 is 72.2% and the abundance of rubidium-87 is 27.8%, what is the average atomic mass of rubidium?
15. Titanium has five common isotopes: titanium-46 (8.0%), titanium-47 (7.8%), titanium-48 (73.4%), titanium-49 (5.5%), titanium-50 (5.3%). What is the average atomic mass of titanium?
16. Naturally occurring chlorine that is put in pools is 75.53 percent chlorine-35 and 24.47 percent chlorine-37. Calculate the average atomic mass.
17. Calculate the average atomic mass of sulfur if 95.00% of all sulfur atoms have a mass of 32 amu, 0.76% has a mass of 33 amu and 4.22% have a mass of 34 amu.

18. Naturally occurring strontium consists of four isotopes, Sr-84, Sr-86, Sr-87 and Sr-88. Below is the data concerning strontium:

Sr-84	Sr-86	Sr-87	Sr-88
0.56%	9.86%	7.00%	82.58%

What is the average atomic mass of strontium?

19. *Challenge* Uranium is used in nuclear reactors and is a rare element on Earth. This element has three common isotopes, and has an average atomic mass of 237.98 amu. The abundance of uranium-234 is 0.01% and the abundance of uranium-235 is 0.71%. What is the mass of the third isotope if its abundance is 99.28%?

