Atomic Structure:

1. What is important about the atomic number?

2. How do you figure out the number of…
   a. Protons in an atom?

   b. Electrons in an atom?

   c. Neutrons in an atom?

3. What are **isotopes**?

   Isotopes are different forms of the _____ that have a _____

   Isotopes of the same element have the _____ but _____

4. What are **ions**?

   Ions are atoms that have a _____

   In an ion, the _____

5. What is standard nuclear notation?

$$^{A}_{Z}X^{+/-n}$$
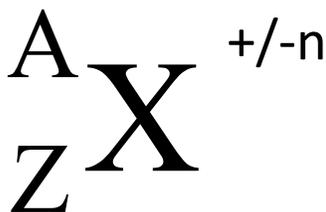
6. What is the *one thing* that determines the ***identity*** of an atom?

7. If the number of protons remains the same, but the number of neutrons change, what property of the element changes? Is this an ion or an isotope?

8. If the number of protons remain the same, but the number of electrons change, what property of the element changes? Is this an ion or an isotope?

9. Complete the following table: assume these are all **neutral atoms**

Element	Nuclear Notation	Mass Number	Atomic Number	# Protons	# Neutrons	# Electrons
Sodium – 23	$^{23}_{11}Na$			11	12	11
Aluminum - 27						
				28	30	
	$^{184}_{74}W$					
					51	40

10. Indicate the number of protons, neutrons and electrons for the following **ions**:

Element	Nuclear Notation	Mass Number	Atomic Number	# Protons	# Neutrons	# Electrons
Sodium (+1)	$^{23}_{11}Na^+$	23	11	11	12	10
Sulfur (-2)		32				
	$^{80}_{35}Br^-$					
		25	12			10

Average Atomic Mass

How are the masses on the periodic table determined?

Most elements have more than one naturally occurring isotope. As you learned previously, the atoms of those isotopes have the same atomic number (number of protons), making them belong to the same element, but they have different mass numbers (total number of protons and neutrons) giving them different atomic masses. So which mass is put on the periodic table for each element? Is it the most common isotope's mass? The heaviest mass? This activity will help answer that question.

Model 1 – A Strip of Magnesium Metal
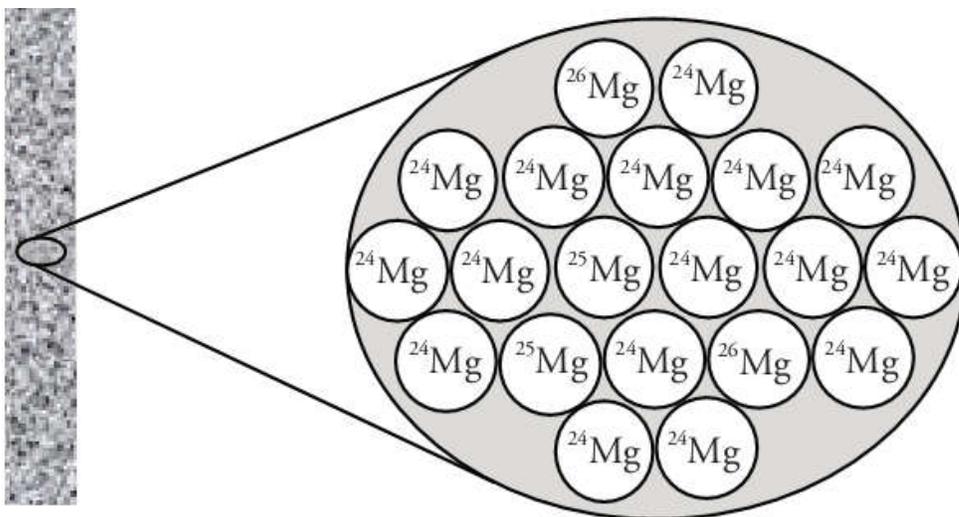
1. Even though the Mg atoms above have different masses (24, 25, or 26), what is the atomic number for each Mg atom in Model 1? Why?

2. Since the mass number is equal to the total number of protons and neutrons, if each Mg atom has the same atomic number, what causes them to have a different mass (i.e. 24, 25, or 26)?

3. For the sample of 20 atoms of magnesium shown in Model 1, complete the table indicating the mass numbers of the three isotopes and the number of atoms of each isotope present.

mass number	number of atoms present
24	
25	
26	

4. Which isotope of magnesium is the most common in Model 1?

Model 2 – Natural Abundance Information for Magnesium

Isotope	Natural Abundance on Earth (%)	Atomic Mass (amu)
^{24}Mg	78.99	23.9850
^{25}Mg	10.00	24.9858
^{26}Mg	11.01	25.9826

Note: The **natural (percent) abundance** of an element is a measure of how much of a particular isotope exists. For example, if the natural abundance for Mg-24 is 78.99%, that means 78.99% of all naturally occurring magnesium atoms have a mass of 24 amu.

5. If you could pick up a single atom of magnesium and put it on a balance, the mass of that atom would most likely be _____ amu. Why?

6. Refer to a periodic table and find the box for magnesium.
   a. Write down the atomic mass decimal number shown in that box _____
   b. Does the decimal number shown on the periodic table for magnesium match any of the atomic masses listed in Model 2?

Model 3 – Proposed Average Atomic Mass of Magnesium Calculations

Jack's Method

$(0.7899)(23.9850 \text{ amu}) + (0.1000)(24.9858 \text{ amu}) + (0.1101)(25.9826 \text{ amu}) = $ _____

Alan's Method

$$\frac{23.9850 \text{ amu} + 24.9858 \text{ amu} + 25.9826 \text{ amu}}{3} = $$ _____

7. Complete the 2 proposed calculations for the average atomic mass of Mg in Model 3 and put your answers in the blanks above.

8. Consider the calculations in Model 3.
   a. Which method shown in Model 3 gives an answer for average atomic mass that matches the mass of magnesium on the periodic table?

   b. Why do you think the other method did not give the correct answer for average atomic mass (the one on the periodic table)?

Average Mass Practice: *Show all work for the following problems.*

1. What is the average atomic mass for element X?

Isotope	Atomic Mass (amu)	Natural Abundance (%)
X-22	22.03256	78.33
X-23	22.99893	2.56
X-24	24.04562	19.11

2. An unknown element has the following atomic masses for three isotopes. Determine the average atomic mass and identify the element (write in standard nuclear notation).

Isotope	Atomic Mass (amu)	Natural Abundance (%)
1	27.9769271	92.2297
2	28.9764949	4.6832
3	29.9737707	3.0872

3. An unknown element exists in nature as two isotopes: Isotope 1 has a mass of 150.9196 amu in a 47.81% abundance and Isotope 2 has a mass of 152.9209 amu in 52.19%. What is the identity and average atomic mass of the unknown element?

4. The following is the mass spectrum for the stable isotopes of Boron. Determine the average atomic mass of Boron from the information provided. (note: you need to calculate the percent abundance first)