Chemistry Name: _____

Section _____ INSIDE AN ATOM WS Date: _____

Inside an Atom

This activity focuses on questions about the atom: How do we characterize an atom? What makes a carbon atom different from an oxygen atom? How are isotopes and ions related to atoms? Use the atomic diagrams on the last page, plus your Reference Tables, to answer the following questions.

1. Look at the Atomic Diagrams of carbon. What do all carbon particles have in common?

   They all have 6 protons in the nucleus.

2. What do all hydrogen particles have in common?

   They all have 1 proton in the nucleus.

3. What do all magnesium particles have in common?

   They all have 12 protons in the nucleus.

4. Now look at the Periodic Table, Find the atomic number of each. What does the atomic number represent?

   Atomic numbers are $_{6}C$, $_{1}H$, and $_{12}Mg$. The atomic number is the number of protons.

5. How many protons are in any chlorine atom? Do you think there are chlorine atoms with 16 protons in them? Why or why not?

   They all have 17 protons in the nucleus. Sulfur atoms have 16 protons, not chlorine.

6. In the corner of each Atomic Diagram is the element symbol and the mass number for the atom. How is the mass number determined? Why is it called the mass number?

   The mass number is the sum of the number of protons and neutrons. It's called the mass because the protons and neutrons account for nearly all the mass of an atom.

7. Find the mass number for oxygen with:
   - 8 neutrons 16
   - 9 neutrons 17
   - 10 neutrons 18

8. Atoms of the same element that have different mass numbers are called isotopes. What structural component do all the isotopes of magnesium have in common? How are these isotopes different?

   All magnesium atoms will have 12 protons in their nucleus. The isotopes will have differing numbers of neutrons.

9. Considering what you now know about isotopes, do you expect all atoms of an element to have the same mass? Why or why not?

Since both p^+ and n^0 have about the same mass (1 u), atoms with the same number of p^+ and a different number of n^0 will have different masses.

We often need to know the mass of an element. But if different isotopes exist, how can you know the mass of that element? First, record the likelihood (percent natural abundance) of getting any particular isotope. This information is found in a Table of Natural Abundance. An example of this type of table appears below.

Isotope	**Natural Abundance**	**Atomic Mass (u)**
^{1}H	99.985%	1.0078
^{2}H	0.015%	2.0140
^{12}C	98.89%	12.0000
^{13}C	1.11%	13.0034
^{16}O	99.76%	15.9949
^{17}O	0.04%	16.9991
^{18}O	0.20%	17.9992
^{24}Mg	78.99%	23.9850
^{25}Mg	10.00%	24.9858
^{26}Mg	11.01%	25.9826

10. If you could just pick up and weigh a single atom of magnesium, what would the mass of that atom most likely be? Explain your answer.

A random Mg atom would most likely have a mass of 24 u because 79% of them do.

11. Look at your Periodic Table. In each box, there is a number representing the atomic mass. What is the atomic mass of magnesium? Does that number match any of the magnesium masses shown in the table of natural abundance above

The atomic mass of Mg is 24.305 u which does not match any of the listed masses.

12. Find the weighted average mass of magnesium using the data from the Table of Natural Abundance.

$$\frac{(23.9850\text{ u})(78.99\%) + (24.9858\text{ u})(10.00\%) + (25.9826\text{ u})(11.01\%)}{100\%} = 24.305\text{ u}$$

13. The weighted average mass is called the atomic mass. Does the weighted average mass of magnesium match the mass of magnesium found on your Periodic Table?

To the precision of the data, it is a very good match.

14. Calculate the atomic mass for oxygen. 15.999 u

$$\frac{(15.9949\text{ u})(99.76\%) + (16.9991\text{ u})(0.04\%) + (17.9992\text{ u})(0.20\%)}{100\%} = 15.999\text{ u}$$

15. Define mass number and atomic mass. Be sure to explain how they are similar and different.

Mass number is the sum of the number of p^+ and n^0 (a whole number). The atomic mass is the weighted average of the mass of all the naturally occurring nuclides.

16. What feature distinguishes a neutral atom from an ion? (See the Atomic Diagrams.)

The number of electrons will determine the charge of an atom or ion.

17. If an ion has a –2 charge, what has been altered from the neutral atom? By how much?

The number of e^- changed. The ion has gained two electrons.

18. If an ion has a +2 charge, what has been altered from the neutral atom? By how much?

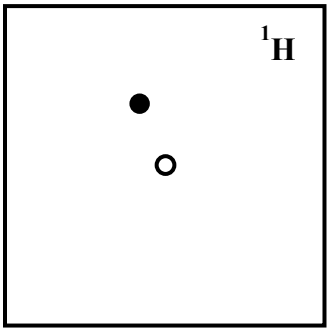
The number of e^- changed. The ion has lost two electrons.

19. Use your Periodic Table to fill in the empty boxes in the table below. (Include charges.)

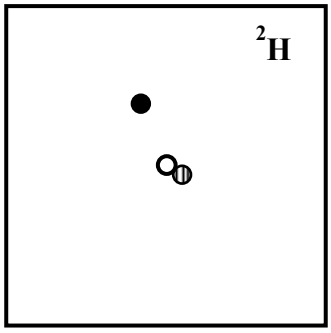
Symbol	^{40}K	^{18}F	^{31}S	$^{65}Cu^{+2}$	$^{57}Fe^{3+}$	$^{77}Br^{-1}$
Atomic #	19	9	16	29	26	35
Mass #	40	18	31	65	57	77
Of protons	19	9	16	29	26	35
# of electrons	19	9	16	27	23	36
# of neutrons	21	9	15	36	31	42

Atomic Diagrams

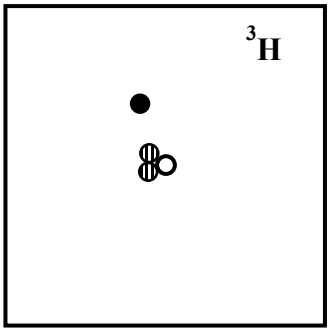
● electrons (e^-)
○ protons (p^+)
◍ neutrons (n^0)



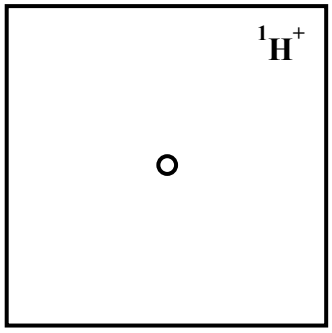
nucleus = 1 p^+
1.0078 amu



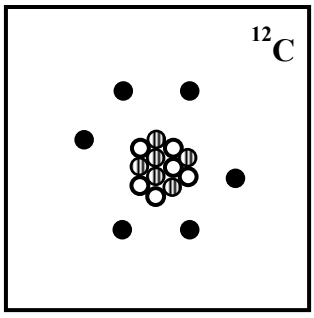
nucleus = 1 p^+, 1 n^0
2.0140 amu



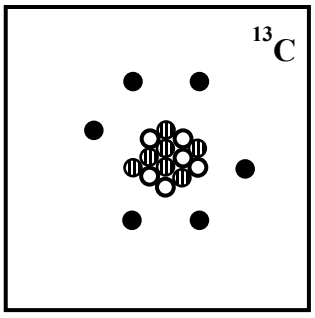
nucleus = 1 p^+, 2 n^0
3.01605 amu



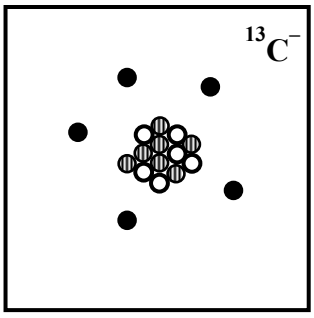
nucleus = 1 p^+
1.0073 amu



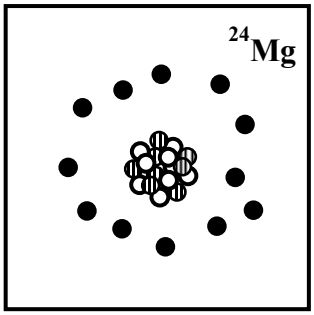
nucleus = 6 p^+, 6 n^0
exactly 12 amu



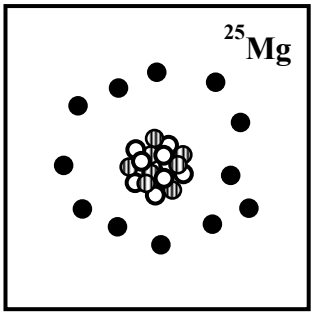
nucleus = 6 p^+, 7 n^0
13.0034 amu



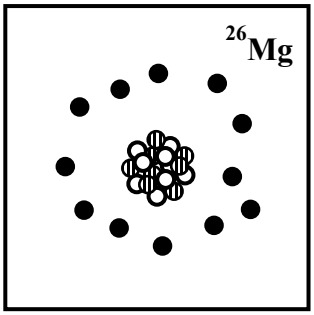
nucleus = 6 p^+, 7 n^0
13.0039 amu



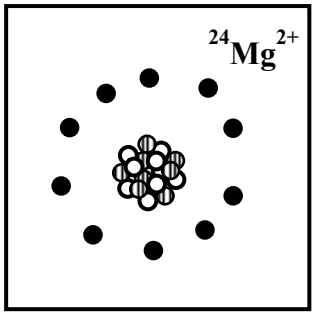
nucleus = 12 p^+, 12 n^0
23.9850 amu



nucleus = 12 p^+, 13 p^+
24.9858 amu



nucleus = 12 p^+, 14 n^0
25. 9826 amu



nucleus = 12 p^+, 12 n^0
23.9839 amu