Chemistry Name: _____

Section _____ ATOMIC STRUCTURE LAB Date: _____

Atomic Structure Lab #9

Pre-Lab Discussion:

Atoms are composed of three elementary subatomic particles, protons, neutrons, and electrons. Experimenting on actual atoms to determine how changes in these particles is beyond the scope of the equipment found in most chemical laboratories. There are other problems as well. These particles are too small to see, it is difficult to control adding or subtracting particles in the nucleus (called nucleons which include protons and neutrons), and doing such manipulations is generally hazardous to human health.

Therefore, we will undertake an exercise using holes punched from colored paper to represent protons, neutrons, and electrons and then determine how changes to the numbers of each elementary particle affects the atom. To aid us in our investigation, a small portion of a table of naturally occurring isotopes (NIST) is presented below.

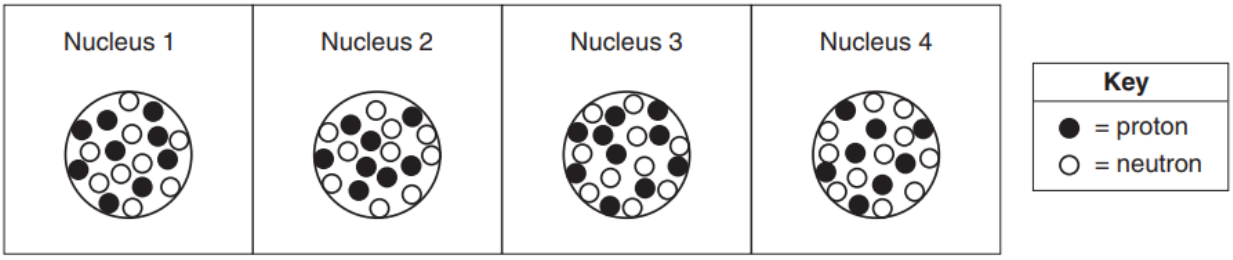
Isotopes and Naturally Occurring Abundance

Z	Symbol	Mass Number	Nuclide Mass (u)	Natural Abundance (mole fraction)
1	H	1	1.007 825 032 23(9)	0.999 885(70)
	D	2	2.014 101 778 12(12)	0.000 115(70)
	T	3	3.016 049 2779(24)	
2	He	3	3.016 029 3201(25)	0.000 001 34(3)
		4	4.002 603 254 13(6)	0.999 998 66(3)
3	Li	6	6.015 122 8874(16)	0.0759(4)
		7	7.016 003 4366(45)	0.9241(4)
4	Be	9	9.012 183 065(82)	1
5	B	10	10.012 936 95(41)	0.199(7)
		11	11.009 305 36(45)	0.801(7)
6	C	12	12.000 0000(00)	0.9893(8)
		13	13.003 354 835 07(23)	0.0107(8)
7	N	14	14.003 074 004 43(20)	0.996 36(20)
		15	15.000 108 898 88(64)	0.003 64(20)
8	O	16	15.994 914 619 57(17)	0.997 57(16)
		17	16.999 131 756 50(69)	0.000 38(1)
		18	17.999 159 612 86(76)	0.002 05(14)
9	F	19	18.998 403 162 273(92)	1

From NIST (https://physics.nist.gov/cgi-bin/Compositions/stand_alone.pl?ele=&ascii=ascii&isotype=some)

It is also important to decide how to represent atoms. We will use a system that is a cross between the simplified atoms (Bohr planetary model) and electron configurations to represent the electrons and the models used in the June 2017 NYS Regents exam to represent nuclei. (See the diagram at the top of the next page.) Fill in the missing information below the diagrams and then answer the questions.

Four Atomic Nuclei



p^+ = _____ # p^+ = _____ # p^+ = _____ # p^+ = _____

n^0 = _____ # n^0 = _____ # n^0 = _____ # n^0 = _____

How many elements are represented by the four nuclei? _____

Which nuclei are isotopes of the same element? _____

Research Question:

How does a change in any of the three elementary subatomic particles change an atom?

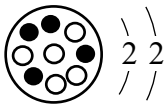
Materials:

Wide clear tape narrow tape colored dots pen or pencil

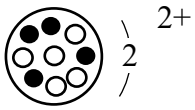
Method:

1. Using punch holes made from colored paper or small, round stickers, make a key for protons, neutrons and electrons.
2. In the **Data Collection and Processing** section below, draw a simplified atom complete with a nucleus (as in the Regents example above) and diagram the three nuclides of the hydrogen isotope. (A sample for the one nuclide of Be and Be^{2+} appears below.)
3. Repeat Step 2 for the two nuclides of helium. Also diagram the expected ***ions*** of the ***most common*** nuclide of lithium and oxygen.

Beryllium example:

$^{9}_{4}Be$ 

beryllium atom

$^{9}_{4}Be^{2+}$ 

most common beryllium ion

Data Collection and Processing:

Three hydrogen isotopes:

Most common lithium atom: **most common lithium ion:**

Conclusions and Evaluations:

1. What atomic changes occur when the number of electrons changes?

   _____

2. What atomic changes occur when the number of protons changes?

   _____

3. What atomic changes occur when the number of neutrons changes?

   _____

4. For an atom to be neutral, which two elementary particles must have balanced numbers?

   _____

5. What happens to the number of electrons when metals become ions?

   _____

6. What happens to the number of electrons when nonmetals become ions?

   _____

7. Define the terms:

   Mass number _____

   Atomic number _____

   Atomic mass _____

   Isotope _____

   Nuclide _____

   Ion _____

8. Using data from the isotope table on page one, calculate the atomic mass of oxygen.

Applications:

1. What did YOU (personally) learn?

   _____

2. How can any idea, principle, or activity in this lab be used in the real world?

   _____

   _____

   _____