HW 4-4: Unit 4 Review
Basics and Structure of Atoms

Name Answer Key
Period_____ Date_____

Topics:

- Evidence for structure of atom—Thomson CRT, Millikan Oil Drop, Rutherford Gold Foil, ~~Rutherford Protons Chadwick Neutron~~
- Protons, neutrons, electrons, atomic number, mass number, symbols & properties
- Calculations of average atomic mass of an element given % abundance data.
- Mass spectrometer (mass & percent abundance of isotopes)

1) What property of electrons ("cathode rays") did Thomson determine? charge/mass ratio
2) How did Thomson know that electrons had a much lower mass than H atoms?
Their deflection, which depends on q/m, in the CRT was much larger than observed for charged H atoms.

3) Describe JJ. Thomson's model of the atom.
In the Plum Pudding model, the electrons were particles of negative charge evenly distributed throughout a matrix of evenly distributed positive charge of equal amount to the negative charge.

4) In the gold foil experiment, why had Rutherford predicted that all of the alpha particles should go straight through the gold foil?
According to the Plum Pudding model, the charge and mass of the atom should have been evenly distributed, so there would have been nothing to deflect the alpha particles passing through it.

5) Why did most of the alpha particles go straight through the foil?
Most of the volume of the atom consists of the electron "cloud" and electrons are far too light to deflect the substantially more massive alpha particles.

6) Why were a small number of alpha particles deflected?
About 1 in 10,000 particles were repelled by coming close to the positively charged, very small, massive, dense nucleus, which is about 1×10^{-5} × the diameter of the atom.

7) Fill in all missing information for each question: All symbols must have atomic # & mass #

Isotope	Symbol	Number of Protons	Number of Neutrons	Mass Number
a. Helium-3	$^{3}_{2}He$	2	1	3
b. Lithium-6	$^{6}_{3}Li$	3	3	6
c. Fluorine-20	$^{20}_{9}F$	9	11	20
d. Nickel-61	$^{61}_{28}Ni$	28	33	61
e. Thorium-232	$^{232}_{90}Th$	90	142	232
f. Rhodium-103	$^{103}_{45}Rh$	45	58	103

8) Determine the average atomic mass of iron (Fe) on Mars if it were to have the following % abundance of Fe isotopes on Mars: 20.0% ^{54}Fe (53.940 amu), 75.0% ^{56}Fe (55.935 amu), and 5.0% ^{58}Fe (57.933 amu). Why is this value different from what is listed on the periodic table?

$$\text{Mass}_{Fe} = 53.940\ \text{amu} \times \frac{20.0\%}{100\%} + 55.935\ \text{amu} \times \frac{75.0\%}{100\%} + 57.933\ \text{amu} \times \frac{5.0\%}{100\%}$$

$$= 10.79\ \text{amu} + 41.95\ \text{amu} + 2.90\ \text{amu} = \boxed{55.6\ \text{amu}}$$

Isotope masses independent of location

extra

This is different from the value on the periodic table because the % abundance values are different than those on earth.

9) In nature, copper exists as two different isotopes, ^{63}Cu and ^{65}Cu. If one looks at the periodic table, one finds that the average atomic mass of copper is 63.55.

a. Which isotope must be more abundant in nature? ^{63}Cu is more abundant

b. Explain reasoning.
Since the average atomic mass of Cu is closer to 63 than to 65, it is more heavily weighted toward isotope ^{63}Cu, which must be more abundant.

63 63.55 64 65

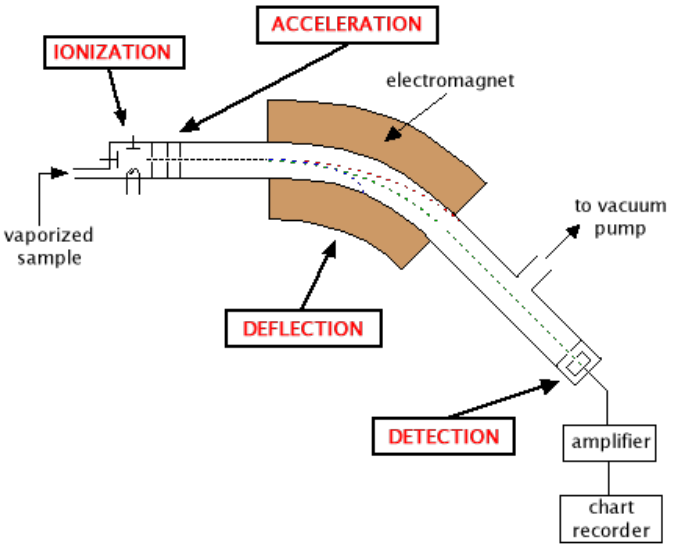
10) Element Z is composed of the following four isotopes: 1.40% Z-204 (203.973 amu), 24.10 % Z-206 (205.974 amu), 22.10% Z-207 (206.976 amu) and 52.40% Z-208 (207.977 amu). Determine the average atomic mass of Z and identify it.

$$\text{Mass}_Z = 203.973\ \text{amu} \times \frac{1.40\%}{100\%} + 205.974\ \text{amu} \times \frac{24.10\%}{100\%} + 206.976\ \text{amu} \times \frac{22.10\%}{100\%} + 207.977\ \text{amu} \times \frac{52.40\%}{100\%}$$

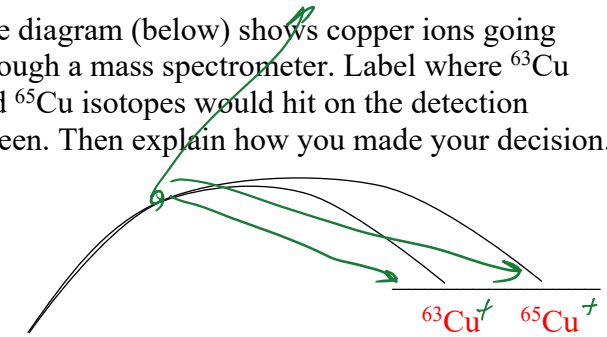
$$= 2.856\ \text{amu} + 49.640\ \text{amu} + 45.742\ \text{amu} + 108.98\ \text{amu}$$

$$= \boxed{207.2\ \text{amu; Z is Pb}}$$

11) Label the parts of the mass spectrometer on the diagram at right with the process that occurs at the indicated location.



12) The diagram (below) shows copper ions going through a mass spectrometer. Label where ^{63}Cu and ^{65}Cu isotopes would hit on the detection screen. Then explain how you made your decision.



EXPLANATION:

$^{63}Cu^+$

Since ^{10}B is lighter, it is more easily deflected in a magnetic field, ~~so it has a larger deflection~~.

has higher charge/mass ratio, deflected more