Mass Spectrograph Worksheet

Name: Key

Use the atomic masses from the periodic table to answer the following questions: The first three require no calculations... just logical thinking!

1. Indium has only two stable isotopes: In-113 (mass = 112.904) and In-115 (mass 114.904). Which of these two isotopes do you think is more abundant ("abundant" means common or plentiful)? In-115

How can you tell? The mass of In is 114.82amu, which indicates the In-115 isotope is more abundant

2. Silver has only two stable isotopes: Ag-107 (mass = 106.905) & Ag-109 (mass 108.905). Which of the following best describes the relative proportions of these two isotopes? (circle your choices)

a) exactly equal: 50%-50% (b) slightly more of one than the other c) a lot more of one d) almost entirely one -- very little of the other. Which is more abundant? (Ag-107) Ag-109 neither

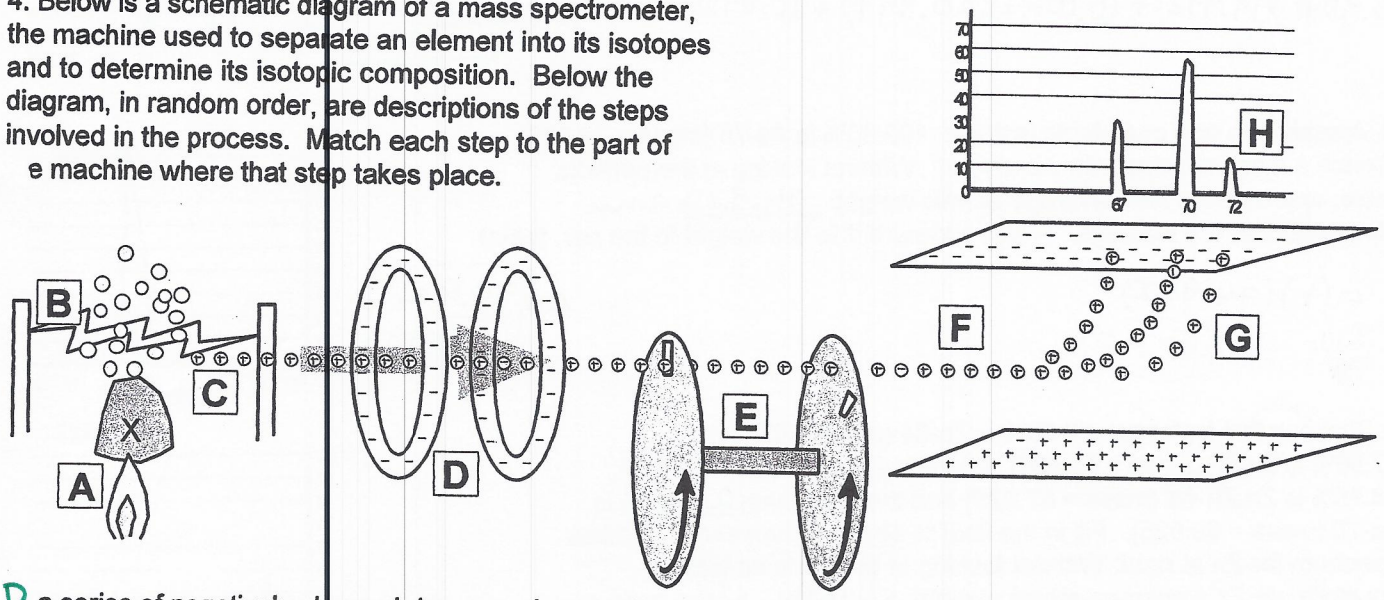
How can you tell? The mass of Ag is 107.87, which is slightly less than the average of Ag-107 + Ag-109 masses.

3. Oxygen has three stable isotopes: O-16 (mass = 15.995), O-17 (mass = 16.999) and O-18 (mass = 17.999) Which of the following best describes the relative proportions of these three:

a) exactly equal: 33%-33%-33% b) slightly more of one than the other two c) a lot more of one (d) almost entirely one -- very little of the others. Which is most abundant? (O-16) O-17 O-18

How can you tell? The average mass of O (16.00amu) is very close to the mass of O-16.

4. Below is a schematic diagram of a mass spectrometer, the machine used to separate an element into its isotopes and to determine its isotopic composition. Below the diagram, in random order, are descriptions of the steps involved in the process. Match each step to the part of the machine where that step takes place.



D a series of negatively-charged rings accelerates the positively-charged ions (opposites attract)
F the beam is then passed between two oppositely-charged parallel plates
A a sample of the element (X) is heated to vaporize it -- converting it into individual gaseous atoms
H particle detectors keep count and translate the information into a bar graph known as a mass spectrum; it shows the isotope masses on the x-axis and their relative percentages on the y-axis.
E the beam of ions is passed through two rotating disks with staggered slits -- this part of the machine allows only ions with a certain velocity to make it through
B high voltage electric current is passed through the gaseous atoms
G the ions are deflected toward the negative plate -- the lighter ones get deflected more and hit the plate sooner; the heavier ones have more momentum and hit the plate farther down.
C this knocks electrons off the atoms and changes them into positively-charged ions

ording to the mass spectrum shown above, what are the three isotopes of X and what are their corresponding percent abundances? X-67 (30%) X-70 (55%) X-72 (15%)

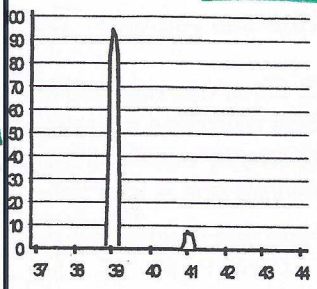
For the following problems, show all work neatly in the space provided.

5. Based on your reading of the relative abundances for element X in problem #4 above, make an approximation of the average atomic weight for X. slightly less than 70 amu
Now calculate the average using the equation: **average = % x mass + % x mass + ...**

$= (0.30)(67) + (0.55)(70) + (0.15)(72)$

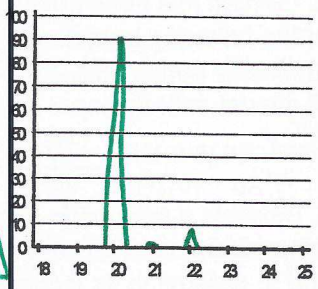
Ans: 69.4 amu

6. Element Y has a mass spectrum shown at right. what are the two isotopes of Y and what are their corresponding percent abundances? Y-39 (92%) Y-41 (8%)
_____, make an approximation of the average atomic weight for Y. slightly > 39 amu
Now calculate the average using the equation above: _____



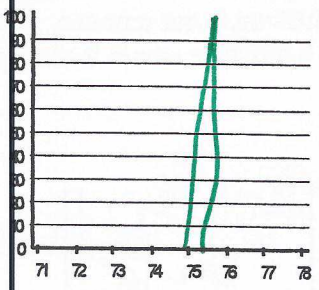
$= (0.92)(39) + (0.08)(41)$ $= 39.16$ amu

7. Neon has three isotopes: 90.48% is Ne-20 (mass = 19.992), 0.27% is Ne-21 (mass = 20.994), and the remaining 9.25% is Ne-22 (mass = 21.991). Sketch a mass spectrum for Ne at right: Without looking at the periodic table, approximate Ne's average atomic weight: slightly > 20 amu
Now calculate the average. (Then compare it to the weight in the per. table)



$= (0.9048)(19.992) + (0.0027)(20.994) + (0.0925)(21.991)$ Ans: 20.18 amu

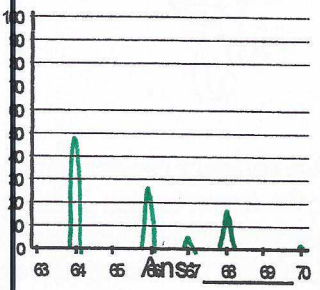
8. Arsenic has only one stable isotope: 100.00% is As-75 (mass = 74.922), Sketch a mass spectrum for As at right: Without looking at the periodic table, approximate As's average atomic weight: 74.922 amu
Now calculate the average. (Then compare it to the weight in the per. table)



$= (1)(74.922)$

Ans: 74.922 amu

9. Zinc has five isotopes: 48.63% is Zn-64 (mass = 63.929), 27.90% is Zn-66 (mass = 65.926), 4.10% is Zn-67 (mass = 66.927), 18.75% is Zn Zn-68 (mass = 67.925) and the remaining 0.62 % is Zn-70 (mass = 69.925). Fill in the final % above. Then sketch a mass spectrum for Zn at right: Without looking at the periodic table, approximate Zn's average atomic weight: slightly < 66 amu
Now calculate the average. (Then compare it to the weight in the per. table)



$= (0.4863)(63.929) + (0.2790)(65.926) + (0.0410)(66.927)$
$+ (0.1875)(67.925) + (0.0062)(69.925)$ $= 65.40$ amu

10. In a previous worksheet, you categorized substances as being either elements, compounds or mixtures. In view of what this worksheet is all about, is it possible for something to be a pure element and a mixture at the same time? Yes Explain: A pure element is actually a mixture of different isotopes.

Are any of the elements on this worksheet not mixtures? Yes Which one(s)? Arsenic

Is it possible for something to be a pure compound and a mixture at the same time? Yes Explain: If the compounds contain elements of different isotopes:
ex) H_2O : (2) Hydrogen-1, (1) Oxygen-16 vs. (2) Hydrogen-2, (1) Oxygen-17