P C2 (pg 1 of 2) **Isotopes**

Name___________________

Calculating average molar mass; Do not use the mass in the chart in your calculation. Look up the average mass in the Periodic Table as a check to see how your calculation came out. (use NS C.2 for guidance as necessary.)

1. Calculate the average atomic mass for the element copper which has two naturally occurring isotopes. Check to see that your work is correct by comparing your answer to the average mass in the periodic chart.

    ^{63}Cu mass = ~62.93, 69.2% abundance

    ^{65}Cu mass = ~64.93, 30.8% abundance

2. Calculate the average atomic mass for the element neon which has three naturally occurring isotopes. Check to see that your work is correct by comparing your answer to the average mass in the periodic chart.

    ^{20}Ne mass = ~20.0, 90.6% abundance

    ^{21}Ne mass = 21.0, 0.30% abundance

    ^{22}Ne mass = 22.0, 9.1% abundance

3. Calculate the average atomic mass for the element magnesium which has three naturally occurring isotopes. Check to see that your work is correct by comparing your answer to the average mass in the periodic chart.

    ^{24}Mg mass = ~23.99, 79% abundance

    ^{25}Mg mass = ~24.99, 10% abundance

    ^{26}Mg mass = ~25.99, 11% abundance

Calculating the % natural abundances using the average molar mass found in the periodic chart.

4. There are two naturally occurring isotopes of boron listed below. By checking out the average atomic mass in the periodic chart, which isotope is more common? Calculate the % abundance of each of the two isotopes.

    ^{10}B mass = ~10.01

    ^{11}B mass = ~11.01

5. There are two naturally occurring isotopes of carbon listed below. By checking out the average atomic mass in the periodic chart, which isotope is more common? Calculate the % abundance of each of the two isotopes.

    ^{12}C mass = ~12

    ^{13}C mass = ~13

6. There are two naturally occurring isotopes of lithium listed below. By checking out the average atomic mass in the periodic chart, which isotope is more common? Calculate the % abundance of each of the two isotopes.

    ^{6}Li mass = ~6.015

    ^{7}Li mass = ~7.016

7. There are two naturally occurring isotopes of chlorine listed below. By checking out the average atomic mass in the periodic chart, which isotope is more common? Calculate the % abundance of each of the two isotopes.

    ^{35}Cl mass = ~35.0

    ^{37}Cl mass = ~37.0

For the following problems, do not use a calculator. Just use your periodic table and your logic to arrive at a response.

8. Silver (Ag) exists as 3 naturally occurring isotopes: ^{107}Ag, ^{108}Ag, and ^{110}Ag. Using only the periodic table, which isotope is likely to be the most abundant?

9. ^{32}S and ^{34}S are two naturally occurring isotopes of sulfur. There is one other naturally occurring isotope for this element as well. What is it most likely to be:

    a ^{23}S b ^{31}S c ^{33}S d ^{35}S

10. Bromine occurs as only two <u>similarly abundant</u> isotopes. Look up the average atomic mass of bromine in the periodic chart, and choose the most likely set of mass numbers for these two naturally occurring bromine isotopes.

    a ^{80}Br and ^{81}Br b ^{79}Br and ^{80}Br c ^{79}Br and ^{81}Br

11. An imaginary element “X” has only two naturally occurring isotopes: ^{90}X and ^{100}X. Each of these isotopes makes up half of the “X” atoms in nature. What is the average atomic mass of element “X”?

12. Another imaginary element “Z” has only two isotopes: ^{80}Z and ^{70}Z. There is more ^{80}Z in nature than ^{70}Z. What is the value of element “Z”s atomic mass likely to be? Use words like “less than” or “closer to”…

1. $62.93 \times 0.692 =$ 19.998
   $64.93 \times 0.308 =$ 43.548
   It is interesting to note the that the average atomic mass for copper implies that the most common isotope would be copper-64, and yet there actually is not an isotope copper-64. This is one of the few isotopes that this occurs (although this is also true for zinc's five naturally occurring isotopes). Most of the time it is a valid assumption that the average atomic mass rounded to the nearest whole number is indeed the most common isotope of that element

2. $20.0 \times 0.906 =$ 18.12
   $21.0 \times 0.003 =$ 0.06
   $22.0 \times 0.091 =$ + 2.00
   20.18

3. $23.99 \times 0.79 =$ 18.95
   $24.99 \times 0.1 =$ 2.50
   $25.99 \times 0.11 =$ + 2.86
   24.31

4. First you must look up the average atomic mass in the periodic chart. $10.81 = 11.01x + 10.01(1 - x)$ use algebra to solve for x = 0.010 thus: **^{11}B = 80.0%** and **^{10}B = 10.0%**

5. First you must look up the average atomic mass in the periodic chart. $12.01 = 13x + 12(1 - x)$ use algebra to solve for x = 0.010 thus: **^{13}C = 1.00%** and **^{12}C = 99.0%**

6. First you must look up the average atomic mass in the periodic chart. $6.94 = 7.016x + 6.015(1 - x)$ use algebra to solve for x = 0.924 thus: **^{7}Li = 92.4% and ^{6}Li = 7.59%**

7. First you must look up the average atomic mass in the periodic chart. $35.45 = 37x + 35(1 - x)$ use algebra to solve for x = 0.225 thus **^{35}Cl = 77.5% and ^{37}Cl = 22.5%**

8. **^{108}Ag** Without any further information we will make the assumption that when you round the average atomic mass up or down to the nearest whole number, this will be the most common isotope.

9. **b** ^{31}S Only an isotope lower than 32 can cause the average mass to end up so close to 32.07 It could not be the ^{35}S isotope because the average mass would be higher with all high mass isotopes. ^{23}S is too far away in mass to be a *naturally* occurring isotope.

10. **c** **^{79}Br and ^{81}Br** Since the two are *similarly* abundant, this combination would place the average mass nearly halfway in between at 79.9

11. **95 amu** If there were 50 % of each isotope the average can be calculated by the usual method (add together and divide by 2)

12. The atomic mass will be **closer to 80 amu** than to 70 amu because ^{80}Z is more abundant than ^{70}Z