Mrs. Nielsen AP Chemistry

Name _____ Date _____ Period _____

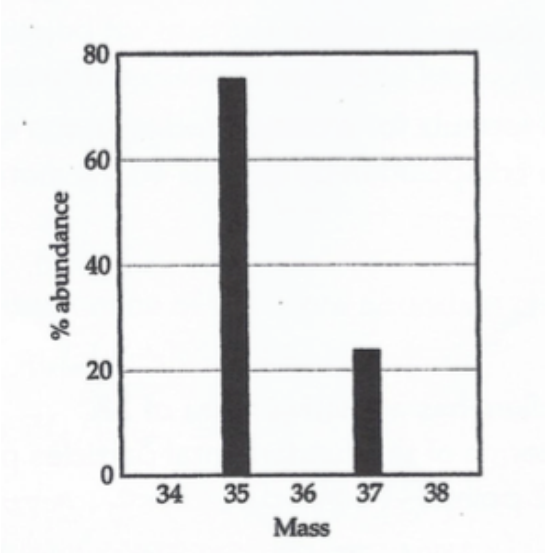
Isotopes and Mass Spectrometry
Multiple Choice and FRQ Practice

Multiple Choice: (1 point each)

1. _____ Bromine has two major isotopes giving it an atomic mass of 79.904 amu. Based on this information, which of the following statements can explain the atomic mass value?
   a. The isotope Bromine-81 is more common than Bromine-79
   b. Bromine-79 and Bromine-81 exist in approximately equal proportions.
   c. Bromine-78 is about twice as abundant as Bromine-81.
   d. The two major isotopes of Bromine have 45 and 46 neutrons

2. _____ Which is true of the $^{243}Am^{3+}$ ion?
   a. 148 protons, 148 electrons, 243 neutrons
   b. 95 protons, 98 electrons, 243 neutrons
   c. 95 protons, 95 electrons, 148 neutrons
   d. 95 protons, 92 electrons, 148 neutrons

Use the following information to answer questions 3-8. The mass spectrum of a natural abundance of chlorine atoms is shown in the figure. Detailed analysis shows that the two stable isotopes of chlorine have masses of 34.969 amu and 36.966 amu.



3. _____ What are the mass numbers of the two isotopes of chlorine?
   a. 34.969 amu and 36.966 amu
   b. 34 and 36
   c. 35 and 37
   d. 17 and 17

4. _____ What is the approximate % abundance of the lighter isotope?
   a. 20
   b. 25
   c. 50
   d. 75

5. _____ How many types of molecules with different masses exist in a sample of chlorine gas if the sample exists entirely as diatomic molecules?
   a. 1
   b. 2
   c. 3
   d. 4

6. _____ What is the approximate mass of the most abundant naturally occurring Cl_2 molecule?
   a. 70
   b. 71
   c. 72
   d. 74

7. _____ How many neutrons does the less abundant chlorine atom have?
   a. 17
   b. 18
   c. 19
   d. 20

8. _____ Why are the individual masses of the two isotopes not integers?
   a. Atomic mass of an element is the average mass of all isotopes
   b. The masses of a proton and a neutron are not integers
   c. Atomic mass of an element is the sum of the number of protons and neutrons in an atom
   d. Mass number of an element is the average mass of all isotopes

9. _____ A compound whose empirical formula is C_2H_4O has a molar mass that lies between 100 and 150 g/mol. What is the molecular formula of the compound?
   a. C_2H_4O
   b. $C_4H_8O_2$
   c. $C_6H_{12}O_3$
   d. $C_6H_{12}O_2$

10. _____ Find the empirical formula for a compound only one element of which is a metal. The compound's percentage composition by mass is 40.0% metal, 12.0% C, and 48% O.
   a. $CaCO_3$
   b. Na_2CO_3
   c. $NaHCO_3$
   d. $Al_2(CO_3)_3$

M/C Total _____/10

Free Response:

1. a. One isotope of sodium has a relative mass of 23 amu.
   i. Define, in terms of the fundamental particles present, the meaning of the term *isotopes*. (2 points)

   ii. Explain why isotopes of the same element have the same chemical properties. (1 point)

   iii. Calculate the mass, in grams, of a single atom of this isotope of sodium. (2 points)

b. Provide the electron configuration for a sodium atom, include all sublevels. (1 point)

c. Explain why chromium is placed in the d block of the periodic table. (1 point)

d. An atom has half as many protons as an atom of ^{28}Si and also has six fewer neutrons than an atom of ^{28}Si. Provide the symbol notation for this isotope. (2 points)

2. Analysis by mass spectrometry shows that a compound contains 36.5% of sodium and 25.5% sulfur by mass. The remaining mass is due to oxygen.
   a. Use this information to determine the empirical formula of the compound. (Hint: Assume 100g of the compound.) (3 points)

   b. The molecule from part (a) is treated with excess hydrochloric acid. In a double replacement reaction, aqueous sodium chloride is formed and sulfur dioxide gas is evolved. Write an equation to represent this reaction. (Hint: Sulfur dioxide gas is created from an unstable product and there are 3 total products.) (1 point)

3. Use the information provided for multiple choice questions 3-8 to answer the following:
   a. Calculate the mass of the chlorine molecule having the largest molecular mass. (2 points)

   b. Calculate the % abundance of the more abundant chlorine isotope. (2 points)

   c. Like chlorine, iodine is a halogen and forms similar polyatomic ions. Write the names and formulas of the 4 oxyanions and 4 oxyacids of iodine. (3 points)

FRQ Total _____/20