CH 221 Practice Problem Set #2

This is a practice problem set and not the actual graded problem set that you will turn in for credit. Answers to each problem can be found at the end of this assignment.

Covering: Chapter Two and Chapter Guide Two

Important Tables and/or Constants: 1 mol = 6.022 x 10²³

- 1. Give the mass number of each of the following atoms: a. magnesium with 15 neutrons, b. titanium with 26 neutrons, and c. zinc with 32 neutrons.
- 2. Give the complete symbol $\begin{pmatrix} A \\ Z \end{pmatrix}$ for each of the following atoms: a. potassium with 20 neutrons, b. krypton with 48 neutrons, and c. cobalt with 33 neutrons.
- 3. Thallium has two stable isotopes, ²⁰³Tl and ²⁰⁵Tl. Knowing that the atomic weight of thallium is 204.4, which isotope is the more abundant of the two?
- 4. Silver (Ag) has two stable isotopes, ¹⁰⁷Ag and ¹⁰⁹Ag. The isotopic mass of ¹⁰⁷Ag is 106.9051 and the isotopic mass of ¹⁰⁹Ag is 108.9047. The atomic weight of Ag, from the periodic table, is 107.868. Estimate the percentage of ¹⁰⁷Ag in a sample of the element.
 a. 0% b. 25% c. 50% d. 75%
- 5. Gallium has two naturally occurring isotopes, ⁶⁹Ga and ⁷¹Ga, with masses of 68.9257 u and 70.9249 u, respectively. Calculate the percent abundances of these isotopes of gallium.
- 6. Calculate the mass in grams of:
 a. 2.5 mol aluminum
 b. 1.25 x 10⁻³ mol of iron
 c. 0.015 mol of calcium
 d. 653 mol of neon
- 7. Calculate the amount (moles) represented by each of the following:
 - a. 127.08 g of Cu b. 0.012 g of lithium
 - c. 5.0 mg of americium d. 6.75 g of Al
- 8. Classify the following elements as metals, metalloids, or nonmetals: N, Na, Ni, Ne, and Np.
- 9. Fill in the blanks in the table (one column per element):

| Symbol | ⁵⁸ Ni | 33S | | |
|---|------------------|-----|----|----|
| Number of protons | | | 10 | |
| Number of neutrons | | | 10 | 30 |
| Number of electrons in the neutral atom | | | | 25 |
| Name of the element | | | | |

- 10. Put the following elements in order from smallest to largest mass:
 - a. 3.79 x 10^{24} atoms Fe b. 19.921 mol H₂ c. 8.576 mol C d. 7.4 mol Si
 - e. 9.221 mol Na f. 4.07 x 10^{24} atoms Al g. 9.2 mol Cl₂
- 11. Dilithium is the fuel for the *Starship Enterprise*. Because its density is quite low, however, you need a large space to store a large mass. To estimate the volume required, we shall use the element lithium. If you need 256 mol for an interplanetary trip, what must the volume of the piece of lithium be? If the piece of lithium is a cube, what is the dimension of an edge of the cube? (The density for the element lithium is 0.534 g/cm³ at 20 °C.)
- 12. A cylindrical piece of sodium is 12.00 cm long and has a diameter of 4.5 cm. The density of sodium is 0.971 g/cm³. How many atoms does the piece of sodium contain? (The volume of a cylinder is $V = \pi x r^2 x$ length.)

13. To estimate the radius of a lead atom:

a. You are given a cube of lead that is 1.000 cm on each side. The density of lead is $11.35 \text{ g/} \text{ cm}^3$. How many atoms of lead are in the sample?

b. Atoms are spherical; therefore, the lead atoms in this sample cannot fill all the available space. As an approximation, assume that 60% of the space of the cube is filled with spherical lead atoms. Calculate the volume of one lead atom from this information. From the calculated volume (V), and the formula $V = \frac{4}{3} \pi r^3$, estimate the radius (r) of a lead atom.

- 14. Reviewing the periodic table.
 - a. Name an element in Group 2A.
 - b. Name an element in the third period.
 - c. Which element is in the second period in Group 4A?
 - d. Which element is in the third period in Group 6A?
 - e. Which halogen is in the fifth period?
 - f. Which alkaline earth element is in the third period?
 - g. Which noble gas element is in the fourth period?
 - h. Name the nonmetal in Group 6A and the third period.
 - i. Name a metalloid in the fourth period.
- 15. Calculate the molar mass of each of the following compounds:
 - a. Fe₂O₃, iron(III) oxide
 - b. BCl₃, boron trichloride
 - c. C₆H₈O₆, ascorbic acid (vitamin C)
- 16. What mass is represented by 0.0255 mol of each of the following compounds?
 - a. C₃H₇OH, propanol, rubbing alcohol
 - b. C₁₁H₁₆O₂, an antioxidant in foods, also known as BHA (butylated hydroxyanisole)
 - c. C₉H₈O₄, aspirin
- 17. Give the mass number of:
 - a. a nickel atom with 31 neutrons
 - b. a plutonium atom with 150 neutrons, and
 - c. a tungsten atom with 110 neutrons
- 18. Strontium has four stable isotopes. Strontium-84 has a very low natural abundance, but ⁸⁶Sr, ⁸⁷Sr and ⁸⁸Sr are all reasonably abundant. Knowing that the atomic weight of strontium is 87.62, which of the more abundant isotopes predominates?
- 19. An object is coated with a layer of chromium 0.015 cm thick. The object has a surface area of 15.2 cm². How many atoms of chromium are used in the coating? (The density of chromium = 7.19 g/cm^3 .)
- 20. Consider at atom of ⁶⁴Zn:
 - a. Calculate the density of the nucleus in g/cm³ knowing that the nuclear radius is 4.8 x 10⁻⁶ nm and the mass of the ⁶⁴Zn atom is 1.06 x 10⁻²² g. [Recall that the volume of a sphere = $4/_3\pi r^3$]
 - b. Calculate the density (in g/cm³) of the space occupied by the electrons in the zinc atom, given that the atomic radius is 0.125 nm and the mass of a single electron is 9.11×10^{-28} g. Assume the zinc atom is neutral.
 - c. Having calculated these densities, what statement can you make about the relative densities of the parts of the atom?

21. Match the name on the left with the description on the right.

c. Dalton

- a. Democritus 1. ____ Discovered the neutron
- b. Aristotle 2. ____ The oil drop experiment for electron charge
 - 3. ____ Proposed a value for the mole
- d. Becquerel 4. ____ Observed radioactivity on photographic plates
- e. Curie (Marie) 5. ____ "The world is made of fire, earth, water and air"
- f. Avogadro 6. ___ Discovered the nucleus is very dense
- g. JJ Thomson 7. ____ Plum pudding model for the atom
- h. Millikan 8. Discovered types of radiation, 2 Nobel Prizes
- i. Rutherford 9. ____ Matter made of atoms, proposed atomic mass scale
- j. Chadwick 10 ____ First to propose the concept of the atom
- k. alpha 11 ____ Radioactive negative electron
- 1. beta 12 ____ Electromagnetic radiation, pure energy, massless
- m. gamma 13 ____ Radioactive positive helium nucleus

22. Fill in the blanks in the table (one column per element):

| Symbol | 65Cu | ⁸⁶ Kr | | |
|---|------|------------------|-----|----|
| Number of protons | | | 78 | |
| Number of neutrons | | | 117 | 46 |
| Number of electrons in the neutral atom | | | | 35 |
| Name of the element | | | | |

Answers to the Practice Problem Set:

1. a. 27 b. 48 c. 62 2. a. ${}^{39}_{19}K$ b. ${}^{84}_{36}Kr$ c. ${}^{60}_{27}Co$ 3. Thallium-205 4. 50% 5. ⁶⁹Ga abundance is 60.12%, ⁷¹Ga abundance is 39.88% 6. a. 68 g Al b. 0.0698 g Fe c. 0.60 g Ca d. 1.32 x 10⁴ g Ne 7. a. 1.9998 mol Cu b. 1.7 x 10⁻² mol Li c. 2.1 x 10⁻⁵ mol Am d. 0.250 mol Al 8. Metals: Na Ni Np Nonmetals: N, Ne 9. (left to right): Nickel-58, sulfur-33, neon-20, manganese-55 10. H_2 (b) < C (c) < Al (f) < Si (d) < Na (e) < Fe (a) < Cl₂ (g) 11. 3.33 x 10³ cm³ and 14.9 cm 12. 190 cm³ and 4.9 x 10²⁴ atoms 13. 3.299 x 10²² atoms and 1.631 x 10⁻⁸ cm 14. Possible answers: a. Ba b. Si c. C d. S e. I f. Mg g. Kr h. S i. As 15.a. Fe₂O₃ 159.69 g/mol b. BCl₃ 117.17 g/mol c. C₆H₈O₆ 176.13 g/mol 16.a. 1.53 g b. 4.60 g c. 4.60 g 17. a. 59 b. 244 c. 184 18. ⁸⁸Sr 19. 1.9 x 10²² atoms 20. a. V = 4.6 x 10^{-37} cm³, d = 2.3 x 10^{14} g/cm³ b. V = 8.18 x 10^{-24} cm³, d = 3.34 x 10^{-3} g/cm³ c. nucleus **much** more dense than electron space! 21. j, h, f, d, b, i, g, e, c, a, l, m, k 22. Symbol 65Cu ⁸⁶Kr ¹⁹⁵Pt ^{81}Br

| ~ | | | | |
|---------------------|--------|---------|----------|---------|
| Number of protons | 29 | 36 | 78 | 35 |
| Number of neutrons | 36 | 50 | 117 | 46 |
| Number of electrons | 29 | 36 | 78 | 35 |
| Name of element | copper | krypton | platinum | bromine |
| | | | | |