

# Practice Questions for Chapter 2 AK

1. Write the correct symbol, with both superscript and subscript (nuclide symbol) for the ions and atoms listed below:

- a. The ion that has 30 protons and 36 neutrons and a +3 charge?



- b. The nuclide symbol for the element that has 79 electrons and 118 neutrons?



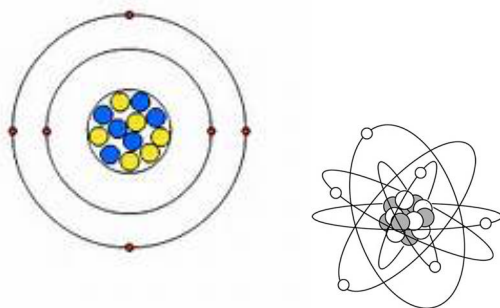
- c. The nuclide symbol for a bromine-80 atom.



2. Recently surfaced is "The Periodic Table of Rejected Elements," constructed by Gerber and Schwartz, noted table-ologists. There is something wrong with the name, the symbol or both. As a hint, they have included the atomic number, which is the only thing correct in this periodic table. Please correct the errors by writing BOTH the name and symbol.

## Artistic elements:

- a) 27 Mondrianium (Ma) **Co, cobalt**  
b) 3 Picasso (Pi) **Li, lithium**  
c) 24 Hopper (Hp) **Cr, chromium**
3. Draw the microscopic picture that represents an isotope of carbon with a mass number of 13 amu. Acceptable:



4. Each of the statements given below is true, but Dalton might have had trouble explaining some of them with his atomic theory. Give an explanation why the following statements are true, yet were not explained in Dalton's atomic theory.

- a) Ethyl alcohol and dimethyl ether have the same composition by mass (52% carbon, 13% hydrogen and 35% oxygen) yet the two have different melting points, boiling points, and solubility in water.

**Dalton did not have the ability to determine structure. In lecture, we discussed how isomers (compounds with the same formula, but different structures) have different physical properties. The composition of these compounds is the same, per Dalton, but the structure is not.**

- b) Burning wood leaves an ash that is only a small fraction of the mass of the original wood.

**If Dalton had the means to capture the gases that escaped when wood is burned, he would be able to weigh all the products. Then he would show that, indeed, mass is conserved in a chemical reaction, because matter is conserved.**

- c) Atoms can be broken down into smaller, subatomic particles.

**Dalton lived before the "atomic" age, so he could not have known that atoms were made of smaller particles. However, when the atom is broken apart, the function or unique chemical nature of that atom is destroyed. So in a way, Dalton is correct that matter is not infinitely divisible.**

5. What is the formula for caffeine: 8 carbons; 10 hydrogens, 4 nitrogens and 2 oxygens?



6. In Chapter 2, we studied the basic architecture of the atom. Answer the following by identifying the true and false statements. Correct the false statements and make them true. Use a complete sentence for full credit.

- a) [T] [F] The atomic number indicates the number of electrons and neutrons.

**The atomic number indicates the number of protons and the number of electrons because atoms are electronically neutral. For that to happen, the number of electrons must equal the number of protons**

- b) [T] [F] Protons and electrons reside in the atomic nucleus.

Protons and neutrons reside in the nucleus. Protons and neutrons have the most mass of the three particles important in chemistry. The nucleus is the most massive part of the atom, so that is where one would find the most massive particles.

- c) [T] [F] The electron and the proton have about the same mass to three significant figures, 1.00 amu.

Electrons and protons are not the same mass. The mass of the electron is 1/2000 an amu, while the proton is about 1.00amu. The neutron is also 1.00 amu.

- d) [T] [F] The charge of the proton and the neutron are equal but opposite in sign.

The proton and the electron have charges that are equal but opposite in sign. The neutron does not have a charge.

- e) [T] [F] The electron has most of the mass and comprises the volume of the atom.

The electron is not massive. The nucleus has most of the mass. this is where the protons and neutrons are found. The electron comprises the volume of the atom. We think of electrons in an atom as a misty cloud. We will see more about this in chapter 6.

7. Two isotopes of element Q (not its real symbol) are  $^{97}\text{Q}$  (23.4 % abundance) and  $^{94}\text{Q}$  (76.6% abundance).  $^{97}\text{Q}$  is 8.082 times heavier than  $^{12}\text{C}$  (12.000 000 amu) and  $^{94}\text{Q}$  is 7.833 times heavier than  $^{12}\text{C}$ . What is the weight atomic mass of element Q?

$$0.766 \times 7.833 \times 12.00 \text{ amu} + 0.234 \times 8.082 \times 12.000 \text{ amu} = 72.00 \text{ amu} + 22.69 \text{ amu} = 94.69 \text{ amu} \Rightarrow 94.7 \text{ amu}$$

Two isotopes of chlorine exist in nature, chlorine-35 and chlorine 37. The weighted atomic mass (atomic weight) of chlorine is 35.4527 amu. The atomic masses of  $^{35}\text{Cl}$  and  $^{37}\text{Cl}$  is 34.968 852 amu and 36.965 903 amu respectively. Calculate the percent abundance for each isotope.

Let X = the fractional abundance of chlorine-35. Then 1-X = the fractional abundance of chlorine-37.

$$X \cdot 34.968 \text{ 852 amu} + (1-X) \cdot 36.965 \text{ 903 amu} = 35.4527 \text{ amu}$$

$$-1.997 \text{ 051 amu} X = -1.513 \text{ 203 amu}$$

$$\text{chlorine-35} = X = 0.757 \text{ 72, } 75.772\%$$

$$\text{chlorine-37} = 0.242 \text{ 28, } 24.228 \%$$

8. Give one example (atomic symbol and name) for each of the following:
- A transition element, which is ferromagnetic besides Fe. **The ferromagnetic elements are part of the 8B triad: Ni, Co.**
  - The halogen that is a solid
    - Iodine is the halogen that is a solid, I. Fluorine and chlorine are gases; and bromine is a liquid.**
  - The main group (representative) element in the third period and 4th group
    - The main group element in the third period and 4<sup>th</sup> group is Si, silicon.**
  - An alkali metal in the fourth period
    - The alkali metal in the 4<sup>th</sup> period is K, potassium**
  - An alkaline earth metal in the second period
    - The alkaline earth metal in the 2<sup>nd</sup> period is Be, beryllium**
9. Torbernite is a mineral structurally similar to mica, The formula unit is  $\text{Cu}(\text{UO}_2)_2(\text{PO}_4) \cdot 10\text{H}_2\text{O}$ . [There are 10 waters in the formula]

- a) What is formula mass of torbernite? Use the following atomic masses for your calculation.

Cu-63.546 amu x1	<b>63.456</b>	<b>amu</b>
U-238.02891 amu x 2	<b>476.057182</b>	<b>amu</b>
O-15.9994 amu x15	<b>287.98912</b>	<b>amu</b>
P-30.973762 amu x1	<b>30.9731762</b>	<b>amu</b>
H-1.00794 amu x 20	<b>20.15818</b>	<b>amu</b>
	<hr/>	
	878.7251582	amu
	878.726	amu

- b) What is this mass in grams of one formula unit?

878.726 amu	$1.660 \times 10^{-24}\text{g}$	$=1.459158 \times 10^{-21}\text{g/Formula unit}$
1 formula unit	1 amu	

10. In Chapter 2, we are introduced to the periodic table. Answer the following by identifying the true and false statements. Correct the false statements and make them true by writing a complete sentence, not crossing out and repairing the answer.

- a) In the modern periodic table, the elements are arranged in order of increasing atomic mass. [T] [F]

**Elements are arranged by atomic number in the periodic table.**

- b) Elements in a period have similar chemical properties [T] [F]

**Elements in a family have similar properties**

- c) Elements can be classified as either metalloids or non metals. [T] [F]

**Elements can be classified as metals, non metals, and sometimes, metalloids.**

- d) Non-metals are ductile, malleable, lustrous solids (for the most part) that are good conductors of heat. [T] [F]

**Metals are ductile, malleable, lustrous solids (Hg is a liquid) that are good conductors of heat.**

- e) Aluminum is a metalloid. [T ] [F]

**Aluminum is near the region of the periodic table that has metalloids. It is not a metalloid. Aluminum has all of the properties of a metal, and none that make it a metalloid.**

11. Predict the formula formed from the following pairs of elements. DO NOT NAME THE COMPOUND!

- |             |                                    |
|-------------|------------------------------------|
| a) Ra and S | <b>RaS</b>                         |
| b) K and N  | <b>K<sub>3</sub>N</b>              |
| c) Mg and P | <b>Mg<sub>3</sub>P<sub>2</sub></b> |