Chem 1014
In-Class Problem Set #2
Week of August 30, 1999
Fall 1999

Name______________________

TA Name ____________________

Lab Section #______

1. Define each of the following terms and give two examples of each (You can not use any of the examples on this activity as examples in this question);

a) Atom

The atom is considered to be the smallest piece of matter. It is reasonable to think of an atom as a very tiny sphere. We'll talk later about what atoms are composed of, but for now it is the smallest unit of matter. Classic definitions imply that the atom is the smallest unit that still retains the properties of the sample. It is hard to imagine an atom melting because melting and boiling as well as other physical properties, are properties associated with large quantities of atoms. Examples of atoms; we have carbon atoms, hydrogen atom, lead atoms, etc.

b) Compound

A compound is a pure substance that contains two or more different elements (atoms) combined together. The idea of combining atoms to get a compound is pretty sophisticated and we'll talk more about that later. Examples of compounds include water (hydrogen and oxygen combined together), glucose or sugar (atoms of carbon, hydrogen and oxygen), sodium chloride ('atoms' of sodium and chlorine), etc.

c) Molecule

While an atom is the smallest unit of matter, a molecule is the smallest unit of two or more atoms combined together. For example water, H_2O, consists of three atoms. At the atomic level water consists of molecules of H_2O.

d) Solution

A solution is a homogeneous mixture of two or more components. The composition and properties of a homogeneous mixture are uniform throughout the mixture. That is, if I took a sample of the mixture from near the top, a sample from the center, and a sample from the bottom the composition and properties would be identical for all three samples. A solution can be prepared by dissolving solid sodium chloride, or sugar, in water. Such a mixture looks like pure water. We would have to taste the solution to detect the difference between a solution of sodium chloride and pure water. One additional characteristic of solution is that they will not 'settle out', by setting untouched over a long period.

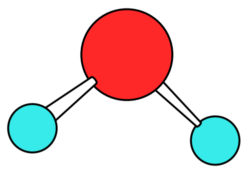
e) Heterogeneous mixture

A heterogeneous mixture consists of two or more components, but the composition, properties and appearance of the mixture is not uniform. One can see distinct regions where the composition is different. The composition of samples taken from various points in the mixture is different. In class we prepared a heterogeneous mixture by mixing toluene and water. Two distinct liquid phases were observed.

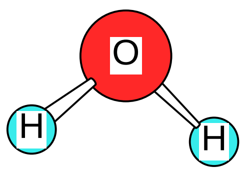
2a. What is the formula for water?

The formula for water is H_2O.

b) Draw a picture, using circles, showing a single water molecule.



c) Draw the picture, using the element symbols, showing a single water molecule.

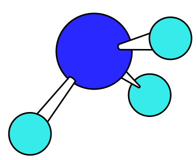


3. Ammonia is an example a compound that contains the elements nitrogen and hydrogen. There are three hydrogen atoms for every nitrogen atom.

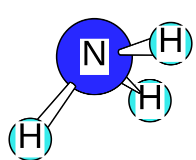
a) Write the formula of ammonia

The formula for ammonia is NH_3.

b) Draw a picture, using circles, showing a single molecule of ammonia



c) Draw a picture, using the elements symbols, showing a single molecule of ammonia

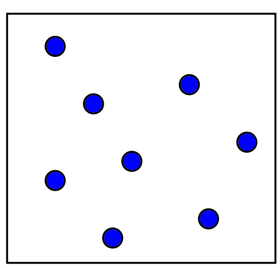


4. Complete the following table;

Name	Symbol	Formula
Nitrogen	**N**	**N_2**
hydrogen	H	**H_2**
Oxygen	**O**	O_2
fluorine	F	**F_2**
Sulfur	**S**	**S_8**
phosphorus	**P**	P_4
Helium	**He**	**He**
bromine	Br	**Br_2**
Chlorine	**Cl**	**Cl_2**

5. In the box below draw a picture showing at the atomic level of a sample of helium at room temperature.

Helium is a gas at room temperature and exists as atoms in the elemental state. So we must represent helium as a collection of atoms (circles) with space between adjacent atoms. The atoms must be distributed evenly within the container since a gas by definition completely fills the container.



6. If a sample of iron melts at 1538 ˚C, calculate the melting point in ˚F and Kelvins.

$$\mathbf{{}^\circ F = \frac{9}{5}({}^\circ C) + 32 = \frac{9}{5}(1538) + 32 = 2800\ {}^\circ F}$$

$$\mathbf{K = 273.15 + {}^\circ C = 1811\ K}$$

Do not worry about the .15 when converting between Kelvins and Celsius temperature scales. Also remember not to say degrees K (˚K), just Kelvins (K).

7. If it is –40 ˚F outside what is the temperature in ˚C and in K?

$$\mathbf{{}^\circ C = \frac{5}{9}({}^\circ F - 32) = \frac{5}{9}(-40 - 32) = -40\ {}^\circ C}$$

Interesting, it turns out that at –40 ˚ the temperature in Celsius and Fahrenheit are equal.

8. Calculate the density of a sample which weighs 122.4 g and occupies a volume of 5.5 mLs.

$$\mathbf{density = \frac{122.4\ grams}{5.5\ mLs} = 23\ g\ mL^{-1}}$$

9. Calculate the volume of one kilogram (1000 grams) of a sample of gold. The density of gold is 19.32 g mL^{-1}.

$$\mathbf{1000\ grams\left(\frac{1\ mL}{19.32\ grams}\right) = 5 \times 10^1\ mL}$$