1. a)substance b)substance (water) c)mixture d) substance e) mixture

2. There are many ways to approach this problem. First, remove the bowling ball by hand. You could then use a magnet to remove the iron filings. You could remove the beads by adding water and removing them from the top since the plastic is less dense than water (or you could pass the remaining mixture through a sieve with openings just smaller than 4 mm; allowing the sugar and sand to pass through). The sand and sugar could be separated by adding water(if you did not do so in the previous step) and using a filter to remove the sand. The sugar could be reclaimed by evaporating off the water.

3. Identify each of the following elements:

a) $^{91}_{40}Zr$ b) $^{108}_{47}Ag$

c) How many electrons are present in each?
Zr has 40 and Ag has 47

4. Aspartame is an artificial sweetener that is 160 times sweeter than sucrose (table sugar) when dissolved in water. It is marketed as Nutra-Sweet. The molecular formula of aspartame is $C_{14}H_{18}N_2O_5$.

a.) Calculate the molar mass of aspartame.

294.29 g/mol

b) How many moles of molecules are in 10.0 g of aspartame?

$$\frac{10.0\text{g}}{294.29\text{g/mol}} = 3.40 \times 10^{-2}\text{moles}$$

c) How many molecules are in 5.0 mg of aspartame?

$$\frac{5.0 \times 10^{-3}\text{g}}{294.29\text{g/mole}} \times \frac{6.022 \times 10^{23}\text{molecules}}{\text{mole}} = 1.0 \times 10^{19}\text{molecules}$$

d) How many atoms of nitrogen are in 1.2 g of aspartame?

$$\frac{1.2\text{g}}{294.29\text{g/mole}} \times \frac{6.022 \times 10^{23}\ \text{atoms}}{\text{mole}} \times \frac{2\text{N atoms}}{\text{mole}} = 4.9 \times 10^{21}\ \text{N atoms}$$

e) What is the mass in grams of 1.0 x 10^9 molecules of aspartame?

$$5.0 \times 10^{9}\ \text{molecules} \times 294.29\text{g/mole} \frac{1\text{mole}}{6.022 \times 10^{23}\ \text{molecules}} = 4.9 \times 10^{-13}\ \text{g}$$

5. Under certain conditions, one mole of aspartame reacts with two moles of water to form one mole of aspartic acid ($C_4H_7NO_4$), one mole of methanol (CH_3OH) and one mole of phenylalanine. Determine the molecular formula of phenylalanine.

$$C_{14}H_{18}N_2O_5 + 2\ H_2O \rightarrow C_4H_7NO_4 + CH_3OH + C_9H_{11}NO_2$$

6. Balance the following equation by any means:

$$2\,H_2SO_{4(aq)} + 2\ NaBr_{(aq)} \rightarrow Br_{2(l)} + SO_{2(g)} + Na_2SO_{4(aq)} + 2\,H_2O_{(l)}$$

7. A compound that assists in the coagulation of blood has the mass percentage composition 76.71% C, 7.02% H, and 16.27% N. Determine the empirical formula of the compound.

Moles carbon in 100g=

$$\frac{76.71\text{g C}}{12.011\ \text{g/mol}} = 6.38665\ \text{moles}$$

$$\frac{7.02\text{g H}}{1.0079\ \text{g/mol}} = 6.9649\ \text{moles H}$$

$$\frac{16.27\text{g N}}{14.01\text{g/mol}} = 1.1613\ \text{moles N}$$

Dividing by the smallest number of moles (1.1613) we find that the coefficients are 5.5 for carbon, 6 for H and 1 for N. Since we cannot have fractions in the empirical formula, we multiply each by two to yield the empirical formula:

$C_{11}H_{12}N_2$

8 a) Write the balanced chemical equation for the following reaction: Magnesium metal reacts with aqueous hydrochloric acid to produce hydrogen gas and solid magnesium chloride.

$Mg(s) + 2\ HCl_{(aq)} \rightarrow H_{2(g)} + MgCl_{2(s)}$

b) Considering the above reaction, how many grams of $MgCl_2$ would be formed if we start with 3.00 grams of metallic magnesium and the reaction is allowed to run to completion?

FW Mg = 24.31 g/mol
FW $MgCl_2$= 95.21 g/mol

The theoretical yield would be 11.749 g or 11.7 g to the correct number of sig figs.

c) If only 2.50 grams of $MgCl_2$ are formed, what is the percent yield?

The percent yield would be (2.50/11.749)×100%= 21.3%

d) If 1.00 grams of magnesium were combined with 100 mL of 0.750 M HCl, would all of the reactants be consumed? If not, what would the limiting reagent be?

We need to calculate the number of moles of each first.

There are:

1.00g Mg/ (24.31g Mg/mole) or 4.11×10^{-2} moles of Mg

and

0.100L × 0.750 moles/L or 0.0750 moles of HCl.

Since the reaction requires 2 moles of HCl per mole of Mg, all of the reactants are not consumed and **HCl is the limiting reagent**.