Chemistry 121, Fall 2010
Quiz 6

Please turn your cell phones off. There are a periodic table, equations and conversion factors provided on the second page. Show all your work (conversion factors) for each calculation.

1. [6 pts] Calculate the mass in grams of one molecule of isopropyl alcohol, C₃H₇O.

\[
\text{1 molecule C}_3\text{H}_7\text{O} \left(\frac{60.094 \text{ amu}}{1 \text{ molecule C}_3\text{H}_7\text{O}}\right) \left(\frac{1.6606 \times 10^{-24} \text{ g}}{1 \text{ amu}}\right) = 9.779 \times 10^{-23} \text{ g}
\]

2. [6 pts] A vitamin contains 60.0 mg of vitamin C, C₆H₈O₆. How many moles of vitamin C is that?

\[
60.0 \text{ mg C}_6\text{H}_8\text{O}_6 \left(\frac{0.001 \text{ g}}{1 \text{ mg}}\right) \left(\frac{1 \text{ mole}}{176.124 \text{ g}}\right) = 3.41 \times 10^{-4} \text{ mol}
\]

3. [6 pts] How many molecules of carbon dioxide are in a balloon with 0.012 moles of the gas?

\[
0.012 \text{ mol CO}_2 \left(\frac{6.022 \times 10^{23} \text{ molecules CO}_2}{1 \text{ mol CO}_2}\right) = 7.2 \times 10^{21} \text{ CO}_2 \text{ molecules}
\]

4. [8 pts] What mass of water, in kg, would contain 3.55 \times 10^{26} molecules of H₂O?

\[
3.55 \times 10^{26} \text{ molecules H}_2\text{O} \left(\frac{1 \text{ mole H}_2\text{O}}{6.022 \times 10^{23} \text{ H}_2\text{O molecules}}\right) \left(\frac{18.016 \text{ g H}_2\text{O}}{1 \text{ mole H}_2\text{O}}\right) \left(\frac{1 \text{ kg}}{1000 \text{ g}}\right) = 10.60 \text{ kg H}_2\text{O}
\]

5. [8 pts] How many anions would be present in a salt mixture that contains 0.990 grams of aluminum chloride? (Remember that Al take a +3 charge.)

\[
0.990 \text{ g AlCl}_3 \left(\frac{1 \text{ mole AlCl}_3}{133.33 \text{ g AlCl}_3}\right) \left(\frac{6.022 \times 10^{23} \text{ Cl}^- \text{ anions}}{1 \text{ mole AlCl}_3}\right) \left(\frac{3 \text{ Cl}^- \text{ anions}}{1 \text{ form. unit AlCl}_3}\right) = 1.34 \times 10^{22} \text{ Cl}^- \text{ anions}
\]
6. [12 points] Write a complete and balanced chemical equation for each of the following reactions. Don’t worry about including states of matter.

a) Diphosphorus pentoxide is created when phosphorus and oxygen react.

\[ 4P + 5O_2 \rightarrow 2P_2O_5 \]

b) Barium chloride and calcium phosphate solutions mix to form a white solid, barium phosphate, along with calcium chloride. (Remember that the formula for the phosphate anion is \( PO_4^{3-} \)).

\[ BaCl_2 + Ca_3(PO_4)_2 \rightarrow Ba_3(PO_4)_2 + CaCl_2 \]

c) Solid copper reacts with aluminum chloride to produce copper (II) chloride and solid aluminum.

\[ 3Cu + 2AlCl_3 \rightarrow 3CuCl_2 + 2Al \]

7. Refer to the following unbalanced reaction for questions a through c. Show all conversion factors in calculations.

\[ 2Co(s) + 6HCl(aq) \rightarrow 2CoCl_3(s) + 3H_2(g) \]

a. [3 pts] How many moles of HCl would be required to react with 88 moles of cobalt (Co)?

\[ \frac{88 \text{ mole Co}}{2 \text{ mole Co}} = \frac{264 \text{ mole HCl}}{} \]

b. [6 pts] What mass, in grams, of hydrogen would be produced by 17.1 g of cobalt?

\[ \frac{17.1 \text{ g Co}}{58.93 \text{ g Co}} \times \frac{3 \text{ mole H}_2}{2 \text{ mole Co}} \times \frac{2 \times 1.008 \text{ g H}_2}{1 \text{ mole H}_2} = 0.877 \text{ g H}_2 \]

c. [8 pts] If hydrogen gas has a density of 0.0071 g/L, how many L of hydrogen would be produced when 6.0 kg of HCl react?

\[ \frac{6.0 \text{ kg HCl}}{1 \text{ kg}} \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ mole HCl}}{36.458 \text{ g HCl}} \times \frac{3 \text{ mole H}_2}{2 \times 1.008 \text{ g H}_2} \times \frac{1 \text{ L}}{0.0071 \text{ g H}_2} = 2.3 \times 10^4 \text{ L H}_2 \text{ gas} \]