

Chemistry 2000 Spring 2001 Section B Assignment 4

Due: Thursday, April 5, 10:50 a.m.

Note: You may have to hunt around your textbook for relevant data. Most of the data you need can be found in the appendices.

1. Calculate the solubility of magnesium hydroxide in
 - (a) neutral water [7 marks], and
 - (b) a pH 4 buffer [4 marks].
2. The solubility of GaF_3 is 0.02 g/L.¹ Calculate the solubility product of this compound. [6 marks]
3. Maple sugar is made by evaporating water from sap. Sugar maple sap is approximately 98% water by weight.
 - (a) How much sap does it take to make 1 kg of maple sugar? [3 marks]
 - (b) Maple sap is typically harvested at 5°C. How much heat would it take to produce 1 kg of maple sugar starting from sap at 5°C? Assume that the thermal properties of sap are similar to those of water. [6 marks]
 - (c) In a traditional production facility, the heat required is provided by burning wood. Dry wood typically provides about 4 MJ of heat for every kg burned. Assuming that no heat is lost to the environment, how much wood must be burned to produce 1 kg of maple sugar? [2 marks]
4.
 - (a) Calculate the amount of heat released when 10 g of sodium metal reacts with an excess of water. [6 marks]
Note: Your textbook does not give enthalpies of formation for individual aqueous ions. Rather, it gives enthalpies for dissolved ionic compounds. In this case, you will have to imagine combining the sodium and hydroxide ions into $\text{NaOH}_{(\text{aq})}$ to use the table in your textbook.
 - (b) Suppose that the reaction occurs in a beaker containing 400 g of water and that all of the heat is held in the water. If the initial temperature of the water was 15°C, what is the final temperature? [4 marks]
 - (c) Since the reaction produces hydroxide ions, the solution becomes basic.² Calculate the pH of the solution at 25°C. The density of water at this temperature is 0.9971 g/mL. [5 marks]

¹I got this value from the CRC Handbook. They say that this is the solubility in “cold water”. Since solubility varies with temperature, they should probably do better than that and give us the actual temperature. However, it isn’t necessary to know the temperature to calculate a solubility product.

²Sodium is an alkali metal and alkali is an old word for base.