**Final Exam Review**

As you are already abundantly aware, the exams I give in this class are very similar to the review sheets I give. I strongly encourage you to keep this in mind when working on this review sheet!

1. Consider the reaction of magnesium hydroxide with sodium phosphide.
2. What type of reaction is taking place: **Double displacement**
3. Will this reaction take place at all? Explain why or why not.

**It will not take place because magnesium hydroxide is not soluble in water.**

1. What are the products of this reaction? (Assuming that it does occur).

**3 Mg(OH)2 + 2 Na3P 🡪 Mg3P2 + 6 NaOH**

1. Assuming the reaction does occur, how much of the product containing magnesium will be formed if 55.9 grams of magnesium hydroxide reacts with 85.3 grams of sodium phosphide?

**43.1 grams.**

1. What is the limiting reagent for the reaction above?

**Mg(OH)2**

1. How much of the excess reagent will remain after this reaction is performed?

**21.4 grams**

1. If 29.7 grams of the product containing magnesium is actually formed in this reaction, what is the percent yield of the reaction?

**69%**

1. What are some likely sources of systematic error that might be responsible for the error in part g above?

* **Spilled some of the limiting reagent or products**
* **Made some experimental error specific to the reaction (i.e. I splashed something when it was boiling, I heated a mixture too much, the filtration process needed to isolate the product went wrong in some fashion). In all of these cases, there should be evidence given to support your assertion.**
* **Equipment issues: If you pick this one, you need strong evidence that the equipment is at fault.**

g) Is the percent yield you found in part g reasonable? Explain your answer.

**While kind of a mediocre yield, the fact that it’s less than 100% makes it reasonable. Yields at or greater than 100% are not reasonable.**

1. What are the four postulates (assumptions) of the kinetic molecular theory of gases?

* **Gas molecules are infinitely small**
* **Gas molecules undergo no interactions with one another**
* **The energy of gas molecules is directly proportional to their temperature in Kelvin.**
* **Gas molecules are in constant, random motion.**

1. Each of these postulates is used to explain some aspect of how gases behave? Explain what these are for each of these postulates.

* **The idea that they are infinitely small removes the need to account for molecular volume, which would mean that all gases would behave differently because their compression would lead to different volumes.**
* **Gas molecules undergo no interactions eliminates the need to account for the attractions between gas molecules.**
* **Energy is proportional to Kelvin explains why gas molecules get faster (and their pressure increases!) as temperature rises.**
* **Gas molecules in constant random motion allows us to treat gases as having no particular favored direction in which they will travel.**

1. A hot air balloon has a volume of 24 million liters. The air it contains has a temperature of 230o C when it is flying. The balloon travels at a height of 500 meters, where the air pressure is about 0.94 atm. The pressure inside of a hot air balloon is the same as the pressure outside of the balloon.
2. How many moles of gas can be found inside of a hot air balloon? (R = 0.08206 Latm/molK).

**PV = nRT**

**(0.94 atm)(24,000,000 L) = n (0.08206 Latm/mol K)(506 K)**

**n = 543,300 moles**

1. Though air is a mixture, it’s a good rough approximation to say that it has a molar mass of about 29 grams/mol. If the temperature outside of a balloon at 500 meters is 13o C, how much mass will this balloon be able to lift when flying? Ignore the mass of the gondola and balloon when doing this calculation.

**From the last problem, the balloon displaces 543,000 moles of air. At this lower temperature, the balloon displaces a different amount of air, determined by PV=nRT.**

**(0.94 atm)(24,000,000 L) = n (0.08206 Latm/mol K)(286 K)**

**n = 961,300 moles**

**The difference between the number of moles at high temp and low temp is 418,000 moles. At 29 grams each, this corresponds to 12,122,000 grams of difference, or 12,122 kg of lifting power. If you wanted to terrify some animals, this is enough lifting power to lift two male African elephants.**

1. The woman working the balloon has lost her mind and decided to crank up the interior heat of the balloon to 330o C. Under these conditions, now much mass will this balloon be able to lift while flying?

**PV = nRT**

**(0.94 atm)(24,000,000 L) = n (0.08206 Latm/mol K)(703 K)**

**n = 391,100 moles**

**The difference between this and the number of moles at normal temp (part b) is 570,200 moles, which weighs 16,500 kg. That’s about 30 polar bears, which would be very unhappy if you put them all in a sack.**

1. Explain how I would make 500 mL of a 0.35 M NaOH solution.

**M = mol / V tells us how much NaOH I need, which is 0.175 moles. 0.175 moles of sodium hydroxide weighs 7 grams. As a result, you would add water until 7 grams of sodium hydroxide until the final volume of the solution was 500 mL.**

1. If I were to add 450 mL of water to the solution in problem 5, what would the concentration of the solution be?

**Using M1V1 = M2V2 to dilute, the concentration would be (0.35 M)(500 mL) = x M (950 mL)**

**x = 0.18 M**

1. Explain how I would make 500 mL of a 0.35 m NaOH solution.

**I’d add 500 mL of water to the 7 grams of sodium hydroxide I found earlier.**

1. Would the molarity be higher for the solution in problem 5 above or that in problem 7 above? Explain your answer.

**It’s difficult to say, because comparing molality and molarity doesn’t work very well. However, given the molarity of the solution in problem 6 is 0.18 M and the molality of the solution in problem 7 is 0.35 m, it’s probably pretty safe to guess that the solution in problem 7 is most concentrated. I wouldn’t ask this on the final, though!**

1. What would the freezing point of the solution in problem 7 be? (Kf = 1.86o C/m)

**The change in freezing point is equal to the effective molality times Kf. In this case, the molality is 0.35 m, but the effective molality is 0.70 m because there are two ions in NaOH. Given that, the change in freezing point would be (0.35 m)(2 ions)(1.86 C/m) = 13.0 degrees, making the overall freezing point -13.0 degrees Celsius.**

1. What is the only factor that determines the speed of a chemical reaction?

**The activation energy of the reaction.**

1. What is the difference between kinetics and thermodynamics?

**Kinetics measures how fast reactions proceed, and thermodynamics determines how much energy is absorbed/given off by these reactions.**

1. What is an equilibrium process?

**It’s a reaction that goes both forwards and backwards. The rates of the forward and backward reactions are the same.**

1. Consider the reaction NaOH + HCl D NaCl + H2O. This is a highly exothermic reaction. If I wanted to form the largest possible quantity of sodium chloride, list several ways in which I could do this.

**I could:**

* **Cool the reaction**
* **Add more NaOH**
* **Add more HCl**
* **Remove water**
* **Remove NaCl**