TQ16 Study guide

1. (16) Vessel A contains O_2 gas at 25°C and 1.0 atm. Vessel B contains Ne gas at 0 °C at 0.5 atm. The two vessels have the same volume. Answer A or B (or 'X' if neither) to the following questions:

Vessel with more molecules : _____ Vessel with more mass : _____

Vessel with higher average kinetic energy: _____ Vessel with smaller RMS velocity : _____

4. (9) Consider the following reaction:

$$2\ Mg_{(s)} + O_{2(g)} \rightarrow 2\ MgO_{(s)} \quad \Delta H° = -1204\ kJ$$

What is the ΔH associated with 1.322 g of $MgO_{(s)}$ **decomposing into** $Mg_{(s)}$ and $O_{2(g)}$ at constant pressure?

5. (8) A sample of 4.42 g of He and an unmeasured amount of O_2 are added to a flask of unknown volume and temperature. The partial pressure of the He is 49.5 torr and the partial pressure from the O_2 is 148.0 torr. What is the mass of O_2 is the container?

6. (18) Lets burn some isooctane:

$$1\ C_8H_{18} + 25/2\ O_{2(g)} \rightarrow 8\ CO_{2(g)} + 9\ H_2O_{(g)}\ \Delta H = -495.0\ kJ$$

We do the reaction in a calorimeter (heat capacity of 5.93 J/K) that contains exactly 253.4 g of water (specific heat 4.184 J/K g) The temperature of the water (and the calorimeter) went up by exactly 16.3 °C to a temp of 49.2 °C. What is the pressure (in torr) of the resultant CO_2 gas if the volume was held at 3.13 L? You might want to first figure out how much CO_2 was in fact made.

8. (10) I have a system that for the duration of this experiment is kept at a constant pressure. An endothermic reaction occurs where 76.3 of E is transferred. Whilst that E transfer occurs, the surroundings do 12.1 J of work on the system. What is the change in internal energy of the surroundings. You must be detailed in your explanation of how your determined the answer. **Giving the numerical answer only is not sufficient**.

3. (16) I have a large container of water. Into it I decide to pour a whole bunch of solids. These solids include ammonium bromide, lead (II) acetate, and lithium carbonate. I stir and stir and stir, and there is some solid in the container. I (of course) was not paying attention, so I do not know if at any point all of the solids were dissolved before any precipitation occurred. I also know not if there is only one solid in the container.

a. (6) Give the molecular formulae for each of the three salts poured into solution.

b. (10) Give ALL possible (based on solubility rules) identities of the solid on the bottom. For any precipitation reactions, give the net ionic equations.

5. (12) Consider the (unbalanced) decomposition of potassium chlorate:

$$KClO_{3(s)} \rightarrow KCl_{(s)} + O_{2(g)}$$

a. (6) Balance the above equation

b. (3) What is the species being oxidized?

c. (3) What is the species being reduced?

8. (12) A tanker truck carrying 5.00×10^3 kg of sulfuric acid solution that is 95% sulfuric acid by mass spills the load (oops!) If the sulfuric acid has a density of 1.84 g/mL, how many kilograms of sodium hydroxide are needed to **neutralize** the solution? HINT: what is the chemical reaction?

2. (20) Consider the neutralization reaction between nitric acid and barium hydroxide.

a. (4) Write the complete ionic equation for this reaction.

b. (10) I fill a beaker with 34.45 mL of 1.432 M nitric acid solution. How many mL of a 0.945 M barium hydroxide solution do I need to add to neutralize the nitric acid?

c. (6) Let us assume we added the exact volume as calculated in part b. What is the final concentration of barium ion in solution?

3. (12) Hydrogen gas passed through a solution of copper (II) chloride results in a reaction forming hydrochloric acid and solid copper.

a. (6) Write the complete ionic equation for this reaction.

b. (3) What is the substance being oxidized?

c. (3) What is the substance being reduced?

10. (4) What portion ('sphere') of the atmosphere is between 80 and 500 km up and it is really 'hot'?

11. (10) Your 8th grade nephew adores you and looks up to you as a future scientist. He wants to grow up to be just like you and really likes science. He is learning about water pollution. His science teacher at school is sortof an environmental extremist and says that all human activity is ruining the water supply. He rants about something having to do with the oxygen going away. Your nephew asks you to explain how mankind affects the quality of the water. He also needs to know what a 'point source' and a non-point source' is. This is your opportunity to flex your intelligence and inspire the next generation. Remember that you are talking to a 8th grader, so be elementary in your discussion.

The next 5 questions involve only one reaction: solid potassium hydroxide reacting with gaseous carbon dioxide to form solid potassium carbonate and liquid water.

1. (8) Write the complete balanced chemical equation for this reaction.
2. (6) What is the mass percent of oxygen in potassium carbonate?
3. (6) What is the molecular weight of potassium hydroxide?
4. (12) I have 53.4 g of potassium hydroxide that reacts with excess carbon dioxide. What mass of water will I get assuming complete reaction?
5. (18) In a different system I have 22.3 g of potassium hydroxide and 32.9 g of carbon dioxide. Assuming the reaction goes to 'completion', what is the total mass of all the products? Make sure you are <u>clear</u> in your response, as this problem involves many steps!

All questions below involve the same mixture of gases, that of cyclopropane (C_6H_6) and oxygen. The partial pressure of cyclopropane is 170 torr, partial pressure of oxygen is 570 torr, for all questions. **Only in question 3 is the temperature and volume of the mixture needed.**

1. The mixture is set at some T and V. (the absolute values don't make a difference) Under these conditions:

a.(5) which species has the greater kinetic energy? Explain.

b.(5) which species has the greater average velocity. Explain.

2. (10) I use the van der Waal's equation and find out this system doesn't behave like an ideal gas. I have the ability to change the volume, up or down, but not the ability to change the pressure. What can I do to the volume to make this species behave more like an ideal gas? Explain your choice using some sortof of equation. HINT: Why does a gas behave non-ideally?
3. (18) Cyclopropane is a flammable gas. *For this question only*, assume some dude puts this mixture in a 3.0 L tank at 23.1 ˚C and puts a match inside. Boom. I know, it seems silly, but go with me here.

a. (4) Write the balanced chemical equation for the combustion of cyclopropane.

b. (4) How many moles of oxygen are in the tank before combustion?

c. (4) How many moles of cyclopropane are in the tank before combustion?

d. (8) A little bird tells you that for every 1 mole of cyclopropane combusted 432.5 kJ of energy is released. From that datum, you should be able to put a ΔH value next to your chemical equation in part a. Go ahead, do that. That same little bird tells you that the limiting reagent in this reaction is oxygen gas. How much energy is released after the match is added?

4. (10) Some other dude puts some of this mixture into some other container (unknown V and unknown T) Let us assume his tank contains 160. g of oxygen gas. How many g of cyclopropane are present? Again, the temperature and volume are UNKNOWN for this system, so **don't** just assume some set of conditions. Hint: Dalton.

All the above plus the 'essence' of all the information given in Chpt 18.