CH 221 Fall 2022:
"Percent Potassium Chlorate"
(online) ***Lab*** *- Instructions*

Note: **This is the lab for section W1 of CH 221 only.**

- *If you are taking section 01 or section H1 of CH 221*, please use this link:
  http://mhchem.org/s/5a.htm

Step One:

Watch the lab video for the "%$KClO_3$" lab, found here: **http://mhchem.org/w/5.htm**
Record the data found at the ***end*** of the lab video on page Ib-5-3.

Step Two:

Complete pages Ib-5-3 through Ib-5-7 using the "%$KClO_3$" video and the actual lab instructions on pages Ib-5-3 through Ib-5-4. Include your name on page Ib-5-3!

Step Three:

Submit your lab (pages Ib-5-3 through Ib-5-7 *only* to avoid a point penalty**) as a *single* PDF file to the instructor via email (mike.russell@mhcc.edu) on Wednesday, November 2 by 11:59 PM.** I recommend a free program (ex: CamScanner, https://camscanner.com) or a website (ex: CombinePDF, https://combinepdf.com) to convert your work to a PDF file.

If you have any questions regarding this assignment, please email (mike.russell@mhcc.edu) the instructor! Good luck on this assignment!

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Percent Potassium Chlorate in a Mixture

YOUR NAME: ____

Potassium chlorate ($KClO_3$) decomposes on heating to produce potassium chloride and oxygen. The Law of Conservation of Mass states that the mass of the reactants (potassium chlorate) will equal the mass of the products (potassium chloride and oxygen). Since oxygen is a gas, the mass of the final solid will be less than the starting weight. The mass loss is equal to the mass of oxygen.

In this experiment, you will begin with a sample that is a mixture of potassium chlorate and potassium chloride. Your objective is to determine the percentage by mass of potassium chlorate in the original mixture. Upon heating, only the potassium chlorate will decompose. Using the balanced equation and the fact that all the mass that is lost is oxygen gas, you can use stoichiometry to calculate the mass of potassium chlorate in the original mixture.

A catalyst, manganese(IV) oxide, is added to the reaction mixture in order to speed up the reaction. Like all catalysts, the same amount of catalyst is present at the end of the reaction as in the beginning. Therefore, we will include the mass of the catalyst in with the mass of the crucible.

To ensure that the decomposition is complete, the product must be heated to a constant weight. After the first heating, cooling and weighing, the sample must be heated again, cooled and reweighed. This process is continued until two successive weights are within 5 mg of each other (up to four heating cycles.)

PROCEDURE (this is what we would have done in the lab room under "normal" circumstances)**:** - *You must wear safety goggles while performing this lab!* ***All*** *mass measurements should be recorded to the milligram (0.001 g.)*

1. Set up a ring stand with a triangle as demonstrated by your teacher. The small white crucible should fit inside the triangle.

2. Place about 0.5 g of manganese(IV) oxide into a clean, dry small white crucible. Heat the crucible and catalyst with a Bunsen burner for about 3 minutes to drive off any moisture that may be in the catalyst or crucible. Wear safety glasses at all times if a Bunsen burner is operational at your lab bench!

3. When the crucible is cool enough to touch, record the entire mass to the nearest 0.001g.

4. Add between 2.0 to 2.5 grams of the unknown mixture to the crucible. Mix the contents to obtain a somewhat uniform mixture. Record the mass of the crucible plus catalyst plus mixture to the nearest 0.001 g. Be sure to also record your unknown number!

5.Begin heating the crucible gently at first followed by a more aggressive treatment for a total of 10 minutes. Be aware that the sample may begin to bubble and spurt; if this happens, turn the flame down a bit.

6.Allow the sample to cool to room temperature. Record the mass to the nearest 0.001 g.

7.Reheat your sample for 5 minutes. Cool and record the mass. If your mass is within 0.005 g of the mass after the previous heating with the unknown sample, congratulations, you can move on to calculations. If not, you should reheat, cool, and weigh until you have two successive masses within 0.005 g of each other. Clean up and put away your equipment (all waste in this lab can be washed down the drain with water.)

DATA: *Watch the video (***http://mhchem.org/w/5.htm***) to acquire these values:*

mass of empty crucible (g): ______________________

crucible after heating with MnO_2 (g): ______________________

crucible, MnO_2 & $KClO_3$ mixture before heating (g): ______________________

crucible, MnO_2 & $KClO_3$ mixture after heating for ten minutes (g): ______________________

crucible, MnO_2 & $KClO_3$ mixture after heating for additional ten minutes (g):

____

CALCULATIONS: *The video (***http://mhchem.org/w/5.htm***) might help you with these calculations. Clearly* ***show all work*** *in the area provided,* ***watch significant figures*** *and circle final answers*

1. Write a balanced equation for the decomposition of potassium chlorate into potassium chloride and oxygen gas.

2. Using the data from the video, determine the **mass of the $KClO_3$ mixture** used in this experiment (no MnO_2!).

3. Using the data from the video, determine the **mass of oxygen lost** upon heating the mixture. This answer will be the **α** (below) in the equation.

4. Determine the **molar mass** of **oxygen** (**O_2**) to 0.01 g/mol. This answer will be the **β** (below) in the equation.

5. Determine the **molar mass** of **potassium chlorate** (**$KClO_3$**) to 0.01 g/mol. This answer will be the **δ** (below) in the equation.

6. Use the balanced equation and your values of **α** (the mass of oxygen lost), **β** (the molar mass of oxygen) and **δ** (the molar mass of potassium chlorate) to **determine the mass of potassium chlorate present in the original mixture** (this is the $KClO_3$ that decomposed in this experiment and is represented by **λ**, below, in the equation.) *Show your work!* The equation to use:

$$\lambda \text{ g } KClO_3 = (\alpha \text{ g } O_2 \text{ lost}) * \left(\frac{\text{mol } O_2}{\beta \text{ g } O_2}\right) * \left(\frac{2 \text{ mol } KClO_3}{3 \text{ mol } O_2}\right) * \left(\frac{\delta \text{ g } KClO_3}{1 \text{ mol } KClO_3}\right)$$

7. **Determine the percentage of potassium chlorate in the original white mixture** using your answers from step 6 (the pure KClO3) and step 2 (the mass of the original mixture.)

POSTLAB QUESTIONS:

1. A white powder is a mixture of magnesium carbonate and magnesium oxide. Upon heating, the magnesium carbonate decomposes into magnesium oxide and carbon dioxide. If you have 1.897 g of the mixture and after heating are left with 1.494 g of magnesium oxide, calculate the weight percent of magnesium carbonate in the original mixture. *Hint:* Start by writing a balanced reaction, and remember the 1.897 g value is not pure!

2. Calculate the % oxygen by mass for the following (show calculations): a) $LiNO_3$ b) $NaHCO_3$ *Hint:* first find the molar mass (to 0.01 g/mol) of the compound!

3. If we had doubled the mass of the original mixture and completed the lab as written, would the calculated $\%KClO_3$ have changed? Explain.

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