Synthesis of Zinc Iodide

In this lab you will synthesize zinc iodide from zinc metal and solid iodine.

Stockroom

You will need one 50 mL beaker, an evaporating dish, a 250 mL or 400 mL beaker, crucible tongs, and a hot plate.

Chemicals

You will need about 1.2 g of zinc and about 1.2 grams of iodine. You will also need about 20 mL of 0.2 **M** acetic acid.

CAUTION! IODINE IS TOXIC! BE CAREFUL TO NOT GET IT ON YOUR SKIN!

Introduction

In this experiment we will study a combination reaction between zinc metal and iodine. The expected reaction is given by the balanced chemical equation:

$$Zn(s)+I_2(aq)\rightarrow ZnI_2(aq)$$ **(Equation 1)**

You will synthesize zinc iodide and calculate your experimental formula. This may or may not be ZnI_2. If it is not, the reason is that there was some experimental error.

You will also isolate the zinc iodide you synthesized and compare it's mass to the mass of zinc and iodine that reacted.

The law of conservation of mass tells us that if we perform the experiment carefully, the mass of zinc iodide collected should be the same as the sum of the mass of the zinc and iodine that reacted.

$$m(ZnI_2) = m(Zn \text{ reacted}) + m(I_2 \text{ reacted})$$ **(Equation 2)**

Procedure

1.) Weigh your 50 mL beaker, recording the mass to 3 places past the decimal. **(A1)**

2.) With the beaker still on the balance tare the balance. Remove the beaker from the balance, making sure the balance remains tared.

3.) Place about 1.2 grams of zinc into the beaker and place it back on the balance. Record the mass of zinc to 3 places past the decimal. **(A2)**

4.) Tare the balance again and remove the beaker from the balance, making sure the balance remains tared.

5.) Add about 1.2 grams of iodine to the beaker and place it back on the balance. Record the mass of iodine to 3 places past the decimal. **(A3)**

6.) Weigh your evaporating dish. Record the mass to 3 places past the decimal. **(A4)**

7.) Add about 5 mL of 0.2 M acetic acid to the zinc and iodine in the beaker.

8.) Swirl the beaker occasionally, recording your observations as the reaction proceeds in the data section below. The reaction is complete when the solution is colorless. To make sure of this, put the beaker on a piece of white paper, or hold a piece of white paper behind the beaker. Even a faint tinge of yellow means the reaction is not complete.

9.) Once the reaction is complete all of the iodine will have reacted. The solution will contain aqueous zinc iodide and acetic acid. There will be excess zinc in the beaker.

Decant the solution into your evaporating dish. Make sure that all of the excess zinc metal remains in the original beaker.

Some of the solution will remain with the zinc, it is more important to keep all of the zinc in the beaker than it is to get all of the solution out.

10.) Add about 3 mL of 0.2 **M** acetic acid to the beaker with the solid zinc. Swirl it a few times, then decant most of the solution into your evaporating dish, making sure to leave all of the solid zinc in the original beaker. This is called washing the zinc.

11.) Wash the zinc 2 more times with the acetic acid (for a total of 3 washings), decanting the solution into your evaporating dish.

12.) Wash the solid zinc 3 times with D.I. water, discarding the D.I. water.

13.) Fill a 400 mL or 250 mL beaker about ¾ full with tap water. This will be your steam bath. Place the beaker on a hot plate, and place your evaporating dish with the solution containing zinc iodide on top of the beaker.

Turn on the hot plate so that the water boils. Keep the evaporating dish on top of the steam bath until it appears dry.

MAKE SURE ALL OF THE WATER IN THE BEAKER DOES NOT EVAPORATE! IF IT GETS LOW REFILL IT BEFORE THE STEAM BATH DRIES UP!

14.) While waiting for the zinc iodide to dry put beaker with the wet zinc on your hot plate. Heat gently until the zinc appears dry.

15.) Remove the beaker with the zinc from the hot plate and let it cool. Weigh the beaker with the zinc. **(A5)**

15.) Heat the beaker with the zinc again on the hot plate for about 5 minutes. Remove the beaker from the hot plate and let it cool.

16.) Weigh the beaker with the zinc in it. Record the mass to 3 places past the decimal. **(A6)**

If **(A6)** is closer than 0.01 grams to **(A5)**, you are finished.

17.) If **(A6)** is 0.01 grams or more away from **(A5)** repeat the heating and cooling.

18.) Weigh the beaker with the zinc in it. Record the mass to 3 places past the decimal. ***(A7)If necessary.**

NOTE: If the mass starts to increase, stop and use the smallest mass.

19.) When the zinc iodide in the evaporating dish appears dry, remove it from the steam bath.

20.) Turn a hot plate on low and place the evaporating dish on the hot plate for 10 minutes.

21.) After 10 minutes remove the evaporating dish from the hot plate with crucible tongs.

22.) When the evaporating dish is cool enough to touch, weigh the evaporating dish with dry zinc iodide in it to 3 places past the decimal. **(A8)**

23.) Place the evaporating dish on the hot plate for another 10 minutes. Turn up the heat a little.

24.) After 10 minutes remove the evaporating dish from the hot plate with crucible tongs.

25.) When the evaporating dish is cool enough to touch, weigh the evaporating dish with dry zinc iodide in it to 3 places past the decimal. **(A9)**

26.) If **(A9)** is closer than 0.01 grams to **(A8)** stop.

27.) If **(A9)** is more than 0.01 grams from **(A8)** heat the zinc iodide for another 10 minutes on the hot plate, turning up the heat a little.

28.) When the evaporating dish is cool enough to touch, weigh the evaporating dish with dry zinc iodide in it to 3 places past the decimal. ***(A10)If necessary.**

Data and Analysis

DATA

Mass of 100 mL beaker_____(A1)

Original mass of zinc_____(A2)

Mass of iodine_____(A3)

Mass of evaporating dish_____(A4)

Zinc iodide reaction observations:_____

_____

_____

_____

Mass of beaker+zinc after first heating_____(A5)

Mass of beaker+zinc after second heating_____(A6)

***Mass of beaker+zinc after third heating_____(A7)**

Mass of evaporating dish after first heating_____(A8)

Mass of evaporating dish after second heating_____(A9)

***Mass of evaporating dish after third heating_____(A10)**

Analysis

1.) Calculate the mass of unreacted zinc (the zinc left in the beaker). **(A6) – (A1) or (A7) – (A1).** Show your work, including units and significant figures. Write your answer on the line provided.

Mass of unreacted zinc_____(A11)

2.) Calculate the mass of zinc that reacted. This will be the mass that you weighed out minus the zinc that did not react. **(A2) – (A11)** Show your work, including units and significant figures. Write your answer on the line provided.

Mass of reacted zinc_____(A12)

3.) Calculate the moles of zinc that reacted. This will be the mass of zinc reacted, **(A12)**, divided by the molar mass of zinc (65.39g/mol). Show your work, including units and significant figures. Write your answer on the line provided.

Moles of zinc reacted_____(A13)

4.) Calculate the moles of iodine atoms that reacted. Since all of the iodine was used in this reaction, this is just the amount of iodine you weighed out, **(A3)**, divided by the molar mass of atomic iodine (126.9 g/mol). Show your work, including units and significant figures. Write your answer on the line provided.

Moles of iodine atoms that reacted_____(A14)

5.) Find the ratio of moles I to moles Zn in the compound you synthesized. To do this divide the moles of iodine that reacted by the moles of zinc that reacted: **(A14)/(A13).** Write the result as a decimal number, with units of mol I on top and mol Zn on the bottom. Show your work, including units and significant figures. Write your answer on the line provided.

Ratio of moles I to moles Zn_____(A15)

6.) If everything went well, **(A15)** should be close to 2.

We know the formula for zinc iodide is ZnI_2. This means that the ratio of iodine atoms to zinc atoms is 2:1. That is why we expect **(A15)** to be close to 2.

Calculate your percent error using the following formula (**the 2 is exact**). Show your work, including units and significant figures. Write your answer on the line provided.

$$\%\ \text{Error} = \frac{|\mathbf{(A15)} - 2|}{2} \times 100$$

% Error_____**(A16)**

7.) Calculate the mass of zinc iodide that you recovered. This is the white powder in the evaporating dish. To do this subtract the mass of the evaporating dish from the mass of the evaporating dish after the last heating. **(A9) – (A4) or (A10) – (A4).** Show your work, including units and significant figures. Write your answer on the line provided.

Mass of ZnI_2 recovered_____**(A17)**

8.) Find the difference between the mass of your reactants and the mass of your products. **|(A3) + (A12) – (A17)|** Show your work, including units and significant figures. Write your answer on the line provided.

Difference between reactants and products_____**(A18)**

TURN IN PAGES 5 – 7