Decomposition reaction between iron and copper (ii) chloride essay sample

When iron is mixed to Copper (Ⅱ) Chloride; the product will be copper and iron chloride. However, in this experiment, we do not have the information of the oxidation number for iron nails. There are 2 different oxidation numbers for iron; that are 2 or 3. We will need to check each of the equations to find out the moles of each element in the equation. Then we can compare the ratio between the mole and the mass of iron and copper; that will be measured during the experiment. Finally because of the balanced equation the ratio of the mass and the mole has to be the same; by this we can check the actual equation and the actual oxidation number of iron in this reaction. This process will finally end us up of finding out which oxidation number of iron is used in this experiment.

So, if the oxidation number is 2:

Fe (Ⅱ) + CuCl2 (aq) → Cu + FeCl2

If the oxidation number is 3 the reaction equation will be:

2Fe (ⅢⅠ) + 3CuCl2 (aq) → 3Cu + 2FeCl2

In addition, we will need to find the percent yield of copper. Percent yield is a measure of the mass of what was produced (“ experimental yield”) divided by the mass of what should have been produced (“ theoretical yield”). Hence, the equation will be:

Percent yield= experimental yield

theoretical yield

We will need to substitute the experimental yield and the theoretical yield of copper after we have found out the actual equation.

Purpose

Since there are two possible oxidation numbers for the iron nails, by this experiment we will need to determine the actual oxidation number of the iron in this experiment.

Hypothesis

As said in the introduction there will be two possible decomposition reactions:

Fe (Ⅱ) + CuCl2 (aq) → Cu + FeCl2

2Fe (Ⅲ) + 3CuCl2 (aq) → 3Cu + 2FeCl2

We can measure the mass of the two iron nails, and the copper after the reaction. Thus, we can compare the ratio of the mole and the mass of iron and copper.

Procedure

i) Clean two iron nails with sandpaper and steel wool

ii) Measure the mass of iron nails

iii) Add the two iron nails to the Erlenmeyer flask containing approximately 50ml of copper (II) chloride solution.

iv) Place a rubber stopper on the Erlenmeyer flask to stop the solution from evaporating.

v) Leave the reaction for at least one night.

vi) After leaving the reaction for a night; measure the mass of filter paper and then filter the solution.

vii) Then, take out the nails with the tweezers and rinse out the copper from the nails with a water bottle.

viii) Since the unreacted iron and the copper + filter paper are wet; we will need to put these inside the oven.

ix) After the unreacted iron and the copper + filter paper has dried up; measure the mass.

Materials

Support stand

Ring clamp

Filter paper

Glass funnel

Balance

Two iron nails

Sandpaper

Steel wool

Erlenmeyer flask

Approximately 50ml of copper (Ⅱ) chloride solution

Tweezers

Wash bottle

Oven

Rubber stopper

Data Table

Table 1 – Change of the mass of iron before and after the reaction

Mass of Original ironMass of unreacted iron

Mass

(±0. 002g)

3. 335g

0. 831g

State of 2 iron nailsSolid, silver colored Brown colored, ragged

Table 2 – Change of the mass of the copper + filter paper and the filter paper

Mass of copper + filter paper Mass of filter paper

Mass

(±0. 002g)

7. 260g

2. 581g

Data Analysis

First, we will need to calculate the mass of copper by using Table 2:

7. 260(g) Cu – 2. 581(g) Cu

= 4. 679(g) Cu

Also, since the mass of the original iron is 3. 335g and the unreacted mass of the iron is 0. 831g; it is possible to calculate the mass of the reacted iron.

3. 335(g) Fe – 0. 831(g) Fe

= 2. 504(g) Fe←reacted mass of iron

Next, we will need to find the ratio of the mole and the mass of iron and copper. In the first equation, we can see that the mole of iron and copper are both 1mole. Hence, the ratio of the mass has to be 1: 1

4. 679 (g) Cu /2. 504(g) Fe

= 1. 869

From the above, the ratio of the mass of copper that reacted to the reacted mass of iron is 1. 869.

Also, from the second balanced chemical equation, we see that the ratio of the number of moles of copper to the number of moles of iron that react is:

2/3

= 1. 5

Therefore, we can conclude that the reaction took place with the second balanced chemical equation.

Now, we have found out that the second equation is the actual equation for this experiment. It is possible to calculate the percent yield of copper; the experimental yield is 4. 679(g) but we will need to calculate the theoretical yield:

First, since we know the reacted mass of iron, we will need to convert it to mole:

2. 504 (g) Fe × 1 mol Fe

55. 85(g) Fe

= 0. 04483……mol Fe

Now, since the mole of iron is found; it is possible to calculate the theoretical yield of copper by using the ratio of the mole between iron and copper:

0. 04483……mol Fe ×1 mol Cu ×63. 55(g) Cu

1 mol Fe 1 mol Cu

= 2. 849.....(g) Cu

Finally, we have calculated the theoretical yield of copper; we can now calculate the percent yield of copper:

Percent yield of copper= 4. 679(g)Cu ×100

2. 849.....(g) Cu

= 164. 2%

Conclusion

When 2 solid iron nails is added to a solution of copper (II) chloride, a displacement reaction will occur. Also, products of reaction are iron (Ⅲ) chloride and copper (II).

In this experiment the actual oxidation number of iron is 3.

The percent yield of copper is approximately 164. 2%.