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IB III

Lab-report

Date: 98-10-20

Backtitration:

Work to be done:

To find out the atomic mass of a substance using a method called backtitration.

Chemicals and apparatus:

Magnesium
Beaker
Glass
Burette
Distilled water
Methylred
0.5 M sodium hydroxide, NaOH
1.0 M hydrochloric acid, HCl

Lab-work:

The name of the experiment explains the way of doing it quite well. You do measure how much you have of the substances and then do the titration.

My mission was to find out the atomic mass of magnesium. I took a sample and weighted it, removed parts of the sample so that it would weigh approximately 0.1500 g. The scale was a very sensitive one and we could weigh with a margin of error of 0.0001g. Then I placed the sample in a beaker that contained 20.0 ml 1.0 M hydrochloric acid, and there was a reaction. To be sure that nothing of the substances would escape, we put a lid on the beaker, a glass. After a while, when the reaction had ended, we used some distilled water to pour into the beaker so all of the magnesium would come along later and no would stay in the beaker. The reaction will look like this:

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

But since the hydrochloric acid was in excess there will also be a lot of HCl in the beaker and the solution will therefor be an acid solution.

The next thing to do was to put 0.5 M sodium hydroxide in a burette and a beaker with the solution, magnesium and hydrochloric acid, also containing three drops of mythylred as an indicator. Then, just start to titrate carefully.

After a while the color of the solution in the beaker turned from red to yellow and I stopped the titration and I could read how much NaOH I had used for the solution to become neutral. I then knew that I had the same amount of NaOH as HCl, since the formula for this reaction is:

$$NaOH + HCl \rightarrow NaCl + H_2O$$

The amount of NaOH is very simple to calculate, n = c * v.

Now, let's look back. We used one Mg atom with two Cl atoms for the reaction above. And now we know how much Mg we had.

Since we know how many atoms HCl we have now, and how many we had from the beginning we can calculate how many atoms that reacted with the magnesium. That is;

$$n\ HCl_{now} = n\ HCl_{initially} - n\ HCl_{reacted\ with\ Mg}$$

Quite simple? Now, let's use this result in the formula that I described above,
$1\ Mg + 2\ HCl \rightarrow MgCl_2 + H_2$, now that we know how many atoms HCl that reacted and divide it by two. And we then know how many atoms that was in the first sample of Mg. Then use the formula:

$$M = m / n$$

And you got the atomic mass of magnesium.

So I, along with my two fellow students, did this and here are our results and conclusions:

Experiment 1:
0.1500 g Mg
20.0 ml 1.0 M HCl (initially)
After the reaction with Mg 15.5 ml NaOH was titrated until equilibrium.

$$mol\ NaOH = 15.5 \cdot 10^{-3} \cdot 0.5$$

$$mol\ HCl = 20.0 \cdot 10^{-3} \cdot 1.0$$

$$mol\ HCl\ reacting\ with\ Mg = 20.0 \cdot 10^{-3} \cdot 1.0 - 15.5 \cdot 10^{-3} \cdot 0.5 = 12.25 \cdot 10^{-3}$$

$$\frac{12.25 \cdot 10^{-3}}{2} 6.125 \cdot 10^{-3}\ mol\ Mg$$

$$M = \frac{m}{n} = \frac{0.1500}{6.125 \cdot 10^{-3}} = 24.5$$

Experiment 2:
0.1516 g Mg
20.0 ml 1.0 M HCl (initially)
After the reaction with Mg 15.0 ml NaOH was titrated until equilibrium.

$$mol\ NaOH = 15.0 \cdot 10^{-3} \cdot 0.5$$

$$mol\ HCl = 20.0 \cdot 10^{-3} \cdot 1.0$$

$$mol\ HCl\ reacting\ with\ Mg = 20.0 \cdot 10^{-3} \cdot 1.0 - 15.0 \cdot 10^{-3} \cdot 0.5 = 12.5 \cdot 10^{-3}$$

$$\frac{12.5 \cdot 10^{-3}}{2} 6.25 \cdot 10^{-3}\ mol\ Mg$$

$$M = \frac{m}{n} = \frac{0.1500}{6.25 \cdot 10^{-3}} = 24.3$$

The results in the other groups varied from 24.3 to 24.9

The real value of the atomic mass of Mg is 24.3.