Performing a titration with potassium manganate biology essay

Science, Biology

Introduction:

The titration with potassium manganate(VII) means we will get something containing iron and filter it with sulfuric acid. After that we will add potassium managnate until the solution turns light pink.

Aims:

Performing a titration with potassium manganate to find out how much iron is present in iron tablets. Measure volume at which the solution turns light pink.

Equipment:

BalanceSulfuric acid (1. 500mol/dm-3)Beakers 2xConical flasks 2xStopper for conical flaskFilter funnel and paperDistilled waterWash bottleVolumetric flaskBuretteStand and ClampPipettePipette fillerMeasuring cylinderPotassium manganate(VII) (0. 005mol/dm-3)Iron tablets

Risk assessment:

Potassium Manganate (VII)Source: http://www. cleapss. org. uk/attachments/article/0/SSSPrint. pdf? Free%20Publications/Harmful and Oxidising. It is harmful if swallowed so extra care must be taken so that this can be prevented. Many hazardous reactions occur with reducing agents or concentrated acids. Oxidising if heated but we will not heat it. Sulfuric acidSource: http://www. cleapss. org. uk/attachments/article/0/SSSPrint. pdf? Free%20Publications/It’s a corrosive and is of 1. 500 mol/dm-3 concentration so can cause severe burns. I will wear gloves because potassium manganate is an irritant and sulfuric acid is a corrosive substance. I will wear goggles at

all times to prevent sulfuric acid and potassium manganate to splash accidentally in my eyes.

Preliminary method:

Using the balance, weigh the Iron containing substance or object. Put the Iron piece into a 100. 000 cm-3 conical flask and add approximately50. 000 cm3 of the 1. 000 mol/dm-3 sulfuric acid provided. Put the stopper on the conical flask, shake its contents well and then leave the iron to dissolve. Leave this for a day. The outer coating of the iron is insoluble in water, but breaks down in the acidic solution. Therefore the solution needs to be filtered before titrationWithout disturbing the residue, which will have settled to the bottom of theflask, carefully filter the solution directly into a 100. 000 cm3 volumetric flask. Rinse the residue that is in the filter paper with distilled water in a washer and into the flaskAdd dilute sulfuric acid to the flask to the markMake sure the contents of the graduated flask are fully mixed. You nowhave an acidified solution of iron (II) sulfate. Fill a burette with the 0. 020 mol dm-3 potassium manganate(VII) solutionPour some of the contents of the graduated flask into a clean 250. 000 cm-3 beakerand, using a 25. 000 cm-3 pipette and a pipette filler, measure out a 25. 000 cm-3sample of the iron (II) sulfate solution into a clean 250. 000 cm-3 conical flask. Using a 25. 000 cm-3 measuring cylinder, measure out 25. 000 cm-3 of the 1 mol dm-3sulfuric acid provided and add this to the contents of the conical flask. Titrate this acidified sample of iron(II) sulfate solution by adding potassiummanganate (VII) from the burette until the first permanent pink colour is seen. Repeat three times and record the measurements. Calculate

and record the mean volume of potassium manganate(VII) solutionused in the titration (the average titre).

Method:

We got three iron tablets and washed away the outer coating by running them under a tap. We then put a filter paper on the balance and tared the balance. We then placed the three tablets on the balance and recorded the resultThe mass was 1. 040gConsequently, we put the iron tablets in a mortar and pestle and crushed the iron tablets into a fine powder. We then scraped the powder off the mortar into the funnel containing the filter paper. Then we filter the iron powder with sulfuric acid(1. 500mol/dm3) into a 200ml conical flask. We did this by pouring the sulphuric acid in the funnel and with a stirrer, we stirred the solution gently. While it was filtering, we washed the mortar with sulphuric acid so that no significant amount of iron powder is left behind. We then added this to the filter to be filtered. We did this 3 timesWe waited until all the substance in the filter paper had been filteredThe iron reacted with the sulphuric acid and left behind impurities in the filter paper which was discarded. Once the solution was filtered, we filled the solution containing iron with sulphuric acid to the 250ml mark making sure the meniscus was on the line present in the volumetric flask. We then put the bung on the flask and shook it to make the solution homogeneous. We washed out a burette using potassium manganate vii and running it through it. We used a pipette to get 25. 000cm-3 of the solution containing iron and put it in a beaker. We filled the burette with potassium manganate(0. 005mol/dm-3) to the 17-20ml mark. We then dropped the potassium

manganate slowly into the iron containing solution while stirring until the solution turned light pink. The first run was out rough. We then recorded how much volume we used and then consequently worked out the titreWe repeated the experiment 4 times excluding our rough run.

Results:

Mass of 3 Iron tablets= 1. 040gTotal volume of Iron sulphate + sulphuric acid: 250 mlVolume of Iron sulphate +sulphuric acid in conical flask: 25mlRoughRun 1Run 2Run 3Run 4AverageFinal volume+-0. 05ml18. 8017. 3019. 7019. 7019. 7019. 10Initial volume+-0. 05ml5. 004. 006. 006. 006. 005. 50Titre13. 8013. 3013. 7013. 7013. 7013. 60MnO4 -(aq) + 8H+(aq) + 5e- ☾ Mn2+(aq) + 4H2O(l)Purple colourlessFe2+(aq) ☾ Fe3+(aq) + e-Combined half equations: MnO4 + 8H+5Fe ☾ Mn+4H2O+5FeBalanced equation of what happened: 2KMnO4 + 10FeSO4 + 8H2SO4 ☾ 5Fe2(SO4)3 + K2SO4 + 2MnSO4 + 8H2ORatio of KMnO4 : Ratio of iron2 : 101 : 5Concentration of Potassium Manganate= 0. 005mol/dm-3Average volume (titre)= 13. 60mln= 0. 005 x (13. 60/1000)n= 0. 000068 molesSince ratio is 1 manganate is to 5 iron, moles of iron= 0. 000068 * 5 = 0. 000340. 00034 = Mass/55. 8Mass= 0. 018972gMass of 3 iron tablets= 1. 040g ☾ mass of 1 iron tablet= 0. 35g(0. 018972/0. 35)x100= 5. 42%This means there is 5. 42% iron in the iron tablet. Iron is the reducing agent.

Comparison:

In comparison to the labeling on the Iron tablet pack, my calculations seemed to be inaccurate assuming the tablets were tested by certified institutes. In comparison, I found out that in my titration that the iron tablets

only contained 0. 01987g of iron while the package said it contained 0. 065g of iron.

Errors:

Balance error=+-0. 01(0. 01/1. 040)x100= 0. 96% ☾ 1% errorConical flask error= +-0. 5(0. 5/250)x100= 0. 2% errorBurette error= +-0. 05(0. 05/13. 60)x100= 0. 4% errorPipette error=+-0. 2(0. 2/25)x100= 0. 8% errorVolumetric flask= +-0. 05(0. 05/250)*100= 0. 02% errorTotal percentage error for 1 run= 2. 42%

Evaluation:

In conclusion, this experiment highlighted that there is a difference in iron content when the process is done in a classroom than when it is done in a professional environment with precise instruments. I got much lower iron content, 0. 018972g per tablet while on the package it said 0. 065g of iron was present. This difference stems from the fact that there were systematic errors present in my experiment. Even though the titration process was done with accuracy as my results were nearly always the same. However, I believe the difference in results is because of a systematic error where I thought all the iron in the powder had reacted with the sulphuric acid when filtering. I believed that the residue left in the filter paper were impurities so I discarded of the filter paper. To improve the experiment, not much can be made in my opinion. The accuracy of my method is fairly good and the total percentage error shows this. However I must be more careful because of the systematic error which was probably the reason why I did not gain the result I wanted. To prevent the filter paper to still contain iron, I propose to use a

sample of sulphuric acid that is more concentrated which would allow for most of the iron to react.