Student 4: High Achieved

Intended for teacher use only

Preparation of anhydrous sodium carbonate solution

0.639 g of anhydrous Na_2CO_3 was weighed on a laboratory balance and added to a 250 mL volumetric flask. The flask was then made up to volume using distilled water and shaken until all had fully dissolved.

$M(Na_2CO_3) = 106\ g\ mol^{-1}$

$n = m / M$ $\qquad$ $C = n / V$

1. Calculate the concentration of the sodium carbonate standard solution using the information above.

$n_{Na_2CO_3} = 0,639 / 106 = 0,0060283\ mol$

$c(Na_2CO_3) = \frac{n}{V} = \frac{0,0060283}{0,250} = 0,0241132075 \approx 0,0241\ mol\ L^{-1}$

Standardisation of sulfuric acid solution

10.0 mL samples of the sulfuric acid were then titrated with the sodium carbonate standard solution, using phenolphthalein as the indicator.

The sodium carbonate burette readings gathered is provided in the table below:

Titration	1	2	3	4	5
Final Reading/mL	22.92	44.10	24.64	45.92	27.08
Initial Reading/mL	1.30	22.92	3.10	24.64	5.82
Titre / mL	21,62	21.18	21.54	21.28	21.26

2. Indicate the concordant titres and calculate the average volume.

$V(Na_2CO_3) = (21.18 + 21.28 + 21.26) : 3 = 21,24\ ml$

The balanced equation for this standardisation titration is

$$Na_2CO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + CO_2$$

3. Use your answers to Q1 and Q2 to calculate the concentration of the sulfuric acid solution (to 3 sig figs and with appropriate units).

	R	n	V	C
Na_2CO_3	1	0,0011346516	21.24	0,0241
H_2SO_4	1	0,0011346516	10	0,05411884

	R	n	V	C
Na_2CO_3	1	0,0005411884	21,24	0,0241
H_2SO_4	1	0,0005411884	10	0,05411884

$c(H_2SO_4) = 0,05411884 \approx 0,0512\ mol\ L^{-1}$ (3)

CALCULATIONS $C = n / V$

4. Indicate the concordant titres and calculate the average volume of sulfuric acid.

$V(H_2SO_4)$ = 19,5 mL

The balanced equation for the reaction occurring in the titration is

$$2NH_3 + H_2SO_4 \longrightarrow (NH_4)_2SO_4$$

5. Use your answer to Q4 and the information at the top of the sheet to calculate the concentration of ammonia in the **diluted** household cleaner (to 3 sig figs and including units).

	R	n	V mL	C mol L^{-1}
NH_3	2	~~0,0004992~~ 0,0019968	10	~~0,04992~~ 0,19968
H_2SO_4	1	0,0009984	19,5	0,0512

$c(NH_3)$ = ~~0,04992~~ 0,19968 ≈ ~~0,0499~~ 0,200 mol/L

Summary Report:

Aim of the investigation is to find out the concentration of ammonia in the real product and contrast it with claim of the producer.

To ensure the procedure has less error and improves the quality of the investigation I checked if there were any air bubbles in the tip of the burette and remove the funnel before titration. This will stop the incorrect readings from variables like air bubbles and dripping. I also dip the pipette just below the solution to give a correct reading of the aliquot. Another controlled variable was to rinse the burette and pipette with the appropriate solution to remove residual water. (4) (5)

The product I tested has a concentration of ammonia of 13.6gL^{-1} unlike what the producer claimed of 24gL^{-1}. This is due to factors like the manufacturer adding too much aliquot or adding a few chemicals or it could also be that the chemical was old and the chemical has degraded which reduced the concentration or too much exposure to the environment like sunlight or humidity. (2)

In the real world there is a huge variety of concentration. Therefore we need to dilute the chemical so that when we do the titration, the titration value is around 10mL to 25mL. This is because when it is lower than 10mL there is a large percentage error as one incorrect drop could make a big difference. When it is larger than 25mL, it would be time consuming, wasteful and might add other errors when we refill the burette. (1)