Student 5: Low Achieved

Intended for teacher use only

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

0.639 g ÷ 106 = 0.6028301887 (5) 250 ÷ 1000 = 0.25

Ans ÷ 0.25 = 2.411320755

$c(Na_2CO_3)$ = 2.41 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.

$V(Na_2CO_3)$ = $\left(\frac{21.28 + 21.26 + 21.18}{3}\right)$ = 21.24 ml

The balanced equation for this standardisation titration is

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

1 : 1

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).

1 Na_2CO_3 = C x V = 2.41 x 0.02124 = 0.05118484

MOLE RATIO = 1:1

$n(H_2SO_4)$ = 0.05118484

K: C 2.41, V 0.02124, N 0.05118484

UK: C 5.11884, V 0.01, N 0.05118484

$c(H_2SO_4)$ = 5.12 mol L^{-1}

C = N/V

0.05118484 ÷ 0.01 = 5.11884 (3)

RESULTS

Titration	1	2	3	4	5
Final Reading / mL	27.5	40.6	20.10	46.40	~~3~~
Initial reading / mL	14.2	27.5	~~7.93~~	33.50	~~3.464~~
Titre / mL	13.3	13.1	12.8	12.9	13

5 ← 19.3 ← 6.3 ← ~~13~~

CALCULATIONS $C = n / V$

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

$V(H_2SO_4) = \left(\frac{12.8 + 12.9 + 13}{3}\right)$ = 12.9 ml = 0.0129 L

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).

(a) H_2SO_4 = 0.0512 mol L^{-1}

Molar ratio = 2 : 1

0.0512 x 2 = 0.1024

0.0512 X

$c(NH_3)$ = ~~0.00132~~ 0.00132 mol L^{-1}

c 0.0512 c
V 0.0129 V ~~0.01~~
N ~~0.0512~~ N ~~0.1024~~

H_2SO_4
C ~~6.6048 x 10^{-4}~~ 0.0512
V 0.0129
N ~~6.6048 x 10^{-6}~~ ~~0.0512~~

NH_3
C 1.32096 x 10^{-3}
V 0.01
N 1.32096 x 10^{-5}

The purpose of the investigation is to work out the concentration of NH_3 in a cleaning product. In order to ensure accurate results were obtained from the titration I rinsed the burette in the solution I was titrating sulfuric acid. I did this because if anything else was remaining in the burette it could have diluted the solution. When titrating I only filled the burette as high as I could read the measurements at eye level. I did this to avoid parallax error, not reading the measurements at eye level could have a significant impact on the result. When filling the pipette I made sure the bottom of the meniscus was on the line. The endpoint of each titration was met by one drop of H_2SO_4. If these variables aren't controlled it could significantly change the results. A titre volume lower than 10mL reflects a large % error when having to refill the burette, it is also very time consuming.

I found that the concentration was higher than the manufacturers claim. This is likely because they put more of the chemical in so that when it degrades overtime it doesn't fall below the concentration they stated.