Student 2: High Merit

Intended for teacher use only

RESULTS (of trials):

trial 1 - 1ml of NH_3 and 5ml of H_2SO_4 it took 7ml of

trial 2 - 1ml of NH_3 and 7.2ml of H_2SO_4 around 7ml

trial 3 - 1 ml of NH_3 and 7.4 ml of H_2SO_4 of H_2SO_4

trial 4 - 1 ml of NH_3 and 7.0 ml of H_2SO_4 needed to react with 1ml of NH_3. This means I will dilute it 10x so it only take 0.7 ml of H_2SO_4 to react with 1ml of NH_3

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PROPOSED PROCEDURE:

To do this experiment, the **original cloudy ammonia** needs to be diluted 10 x times.

This dilution can be achieved by pipetting 26 mL of the original cloudy ammonia into a 200 mL volumetric flask and adding distilled water to make it up to the mark.

In the actual titration I will use a 20 mL pipette to deliver an aliquot of the diluted cloudy ammonia into a titration flask, add a few drops of methyl orange indicator and titrate with the standardised sulfuric acid in the burette until a colour change from orange to red occurs.

Using this procedure, I would predict an average titre volume of approximately 14 mL.

Justification:

By diluting the NH_3 by 10 this will improve the quality of my data. This is because the ammonia is about 7 time stronger than the H_2SO_4. If I was to use this and not dilute it to do a titration if I was to use 20mL of the fully concentrated NH_3 it would take around 140mL. This would mean that I would have to fill up the burette 3 times to do 1 titration. So by diluting the NH_3 x10 it will improve my titration as I will only have to fill it up once. By diluting the acid I will get a range of 10-30mL which I want as below 10mL it is unaccurate and can have large percentage error and over 30mL it will be too large and too time consuming.

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1. The molar mass of sodium carbonate $M(Na_2CO_3)$ = **106 g mol^{-1}** and M =m/n.
   Calculate the amount, in moles, of sodium carbonate dissolved in the volumetric flask.

   $n(Na_2CO_3) = \frac{m}{M}$ $m = 0.639$ $M = 106\ g\ mol^{-1}$

   $n = \frac{0.639}{106}$ $n = 0.006028301$ mol

2. Use the known amount of anhydrous sodium carbonate calculated above, the volume of the volumetric flask used and the relationship c = n/V, to calculate the concentration of the sodium carbonate standard solution.

   $c(Na_2CO_3) = \frac{n}{V}$ $n = 0.006028301$ $V = 0.25$ L

   $c = \frac{n}{V}$ $c = \frac{0.006028301}{0.25}$ $c = 0.024113207$ M

6. Use the known volume of sulfuric acid solution used in this titration and your answer to Q5 to calculate the concentration of the sulfuric solution (to 3 sig figs and including units).

   $c(H_2SO_4)$ = $V = 0.01$ L $n = 0.000512164$ mol

   $c = \frac{n}{V}$ $c = \frac{0.000512164}{0.01}$ $c = 0.0512164$

   $c = 0.0512$ mol/L

CALCULATIONS ($c = n/V$)

7. Calculate the average volume of your concordant titres (to 3 sig figs and including units)

$V(H_2SO_4)$ = $\frac{15.09 + 15.05 + 14.98 + 15.16}{4}$ $V = \frac{15.05}{1000}$ $V = 0.01505\ L$

8. Use your average titre from Q7 and the known concentration of sulfuric acid (**0.0512 mol L^{-1}**) to calculate the amount, in moles, of sulfuric acid present in the titration flask.

$n(H_2SO_4)$ = $n = c \times V$ $n = 0.0512 \times 0.01505$ $n = 0.0007710048$ mol $n = 0.000771584$ mol

$V = 0.01504$ $c = 0.0512$

9. The balanced equation for the reaction occurring in this titration is: (2)

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

Use the mole ratio in this equation and your answer to Q8 to determine the amount, in moles, of ammonia present in each titration at the endpoint.

$n(NH_3)$ = $2NH_3 : 1\ H_2SO_4$ 2:1 ratio 0.000771584×2 $n = 0.0007710048 \times 2$ $n = 0.00154$ mol $n(NH_3) = 0.00154$ mol

10. Use the volume of ammonia solution used in each titration and your answer to Q9 to calculate the concentration of ammonia in the **diluted** household cleaner (**to 3 sig figs and including units**).

$c(NH_3) = \frac{n}{V}$ $c = \frac{0.00154}{0.02}$ $c = 0.07715$ mol/L (diluted) $c = 0.0771$ mol/L

$V = 0.02$ $n = 0.00154$ $c = 0.077$ mol/L

Summary Report:

The aim of this investigation was to determine the concentration of Ammonia present. Before starting my investigation I rinsed out my pipette out with the NH_3. I washed out my burette with H_2SO_4 and I washed my flask out with water. I did this too so I could know that there wasn't any left over particles in the equipment that could affect the concordancy of my results. Then I filled my burette with H_2SO_4 and made sure there were no bubbles in the burette. This made my results accurate as there were no air bubbles so the reading I took off the burette was more accurate. A variable I controlled was that I did a titration and added the indicator until it changed colour I then poured this into a beaker so I could compare the colour of each titration to make sure they were all the same. By controlling this variable it made my results accurate. I also prevented parallax error by making sure when I was reading the measurements I was always eye level. Another variable I controlled was that after every titration I rinsed out my flask with water so no left over NH_3 or H_2SO_4 could effect my results. (5) (6)

Also, I repeated my titration 7 times, then I took an average of the 4 results that were in a range of 0.3mL. This made the gL^{-1} to be 13.124gL^{-1} and the gL^{-1} concentration on the bottle says 18.0gL^{-1}. This means the the gL^{-1} concentration on the bottle is higher then the actual gL^{-1} concentration. This could be because the bottle is old and the concentration has diluted a little bit or because the company that made the cleaning agent didn't have as much concentration of ammonia in the cleaning agent as they said. (3)