



Year 12 Chemistry

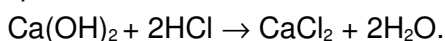
Analytical Techniques

Assignment 2

1. An acid-base titration was performed to determine the concentration of a dilute solution of calcium hydroxide, $\text{Ca}(\text{OH})_{2(aq)}$. A standard solution of $0.0934 \text{ mol L}^{-1}$ hydrochloric acid was used for the titration, and methyl orange was the indicator. For 20.0 mL samples of calcium hydroxide, the titre values of the hydrochloric acid are shown.

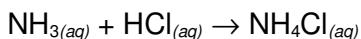
Titration no.	1	2	3	4
Titre value (mL)	24.2	23.9	23.8	23.9

The equation for the reaction is:



- (a) Name the apparatus used to deliver the
- (i) calcium hydroxide, and /1
- (ii) hydrochloric acid. /1
- (b) State the meaning of "standard solution". /1
- (c) State how the end-point of the titration is determined. /1
- (d) Calculate the average titre value, and state a reason for your choice of values for this calculation. /2
- (e) Calculate the concentration of the calcium hydroxide solution. /3
2. A titration was performed on a household ammonia solution. The original solution was diluted ten times, and then 20.0 mL samples of this solution were titrated with $0.1015 \text{ mol L}^{-1}$ hydrochloric acid. The titre values gave an average of 21.2 mL.

The equation for the reaction is:

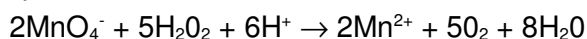


- (a) Describe how the original solution could be diluted to one tenth of its concentration. /1
- (b) Calculate the concentration of
- (i) the dilute ammonia (mol L^{-1}) /3
- (ii) the original ammonia (mol L^{-1}) /1
- (iii) the original ammonia (g L^{-1}) /1
- (c) Convert the concentration in g L^{-1} to a percentage w/v. /1

3. A 100 mL sample of 0.200 mol L⁻¹ potassium permanganate is used to determine the concentration of a 100 mL sample of hydrogen peroxide by titration. The titration results, for 20.0 mL of hydrogen peroxide are

	1 st titration	2 nd titration	3 rd titration	4 th titration
Final V (mL)	26.2	28.7	24.8	25.9
Initial V (mL)	1.8	4.1	0.2	1.3

The equation for the reaction is:



- (a) Name the apparatus used to deliver
- (i) the hydrogen peroxide /1
- (ii) the potassium permanganate /1
- (b) State how the end-point would be detected. /1
- (c) State and explain what must be added to the hydrogen peroxide before titrating. /2
- (d) Calculate the average titre value. /1
- (e) Calculate the concentration of the hydrogen peroxide. /3
4. Ascorbic acid tablets may be analysed by the following procedure:

Step 1:

Two ascorbic acid tablets are dissolved in water and made up to 100.0 mL.

Step 2:

25.0 mL of this solution is then titrated against 0.0500 mol L⁻¹ sodium hydrogen carbonate solution, as shown in the following equation:



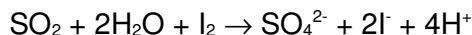
In one such procedure, a titre of 28.2 mL was recorded.

- (a) Calculate the number of moles of hydrogen carbonate anion in 28.2 mL of 0.0500 mol L⁻¹ sodium hydrogen carbonate solution. /1
- (b) Determine the number of moles of ascorbic acid in the 25.0 mL aliquot. /1
- (c) Calculate the number of moles of ascorbic acid in the two tablets. /1
- (d) The molar mass of ascorbic acid is 176.1 g mol⁻¹. Calculate the mass of ascorbic acid in each tablet. /1

5. The amount of sulfur dioxide dissolved in a sample of wine was determined by volumetric analysis using the following procedure:

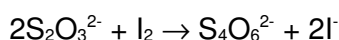
Step 1:

A sample of wine containing dissolved sulfur dioxide was transferred to a conical flask containing 0.00375 moles of iodine in dilute sulfuric acid. The sulfur dioxide reacted with the iodine as shown in the following equation:



Step 2:

The excess iodine that remained after the reaction was determined by titrating with 0.200 mol L⁻¹ sodium thiosulfate solution from a burette, using starch as an indicator. The average titre was 30.3 mL. The reaction that occurred during the titration is shown in the following equation:



- (a) (i) Identify the liquid used to rinse the conical flask in step 1. /1
(ii) Identify the liquid used to rinse the burette in step 2. /1
(b) Calculate the number of moles of thiosulfate ions in the average titre. /1
(c) State the mole ratio of iodine to thiosulfate ion (mol I₂ : mole S₂O₃²⁻). /1
(d) Calculate the number of moles of iodine that reacted with the thiosulfate ions. /1
(e) It was the iodine that remained after step 1 that reacted with the thiosulfate ions in step 2. Determine the number of moles of iodine that reacted with the sulfur dioxide. /1
(f) Hence determine the number of moles of sulfur dioxide in the sample of wine. /1

TOTAL /39