Acid-alkali titration

Pearson Edexcel 1CH0 Separate Chemistry · Foundation and Higher

Show your working where needed. Check the worked answers when you finish.

Name _____ Date _____

1. Calculate the titre

A burette reads 1.20 cm^3 before a titration and 23.65 cm^3 at the end point. Calculate the volume delivered.

2. Find the final reading

The initial reading is 2.45 cm^3. The titre is 19.80 cm^3. What is the final burette reading?

3. Use the repeat titres

The rough titre is 21.60 cm^3. Further titres are 21.45, 21.50 and 22.10 cm^3.

Choose two repeat titres within 0.10 cm^3 of one another. Give a reason for your choice and calculate the mean to two decimal places.

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4. Transfer the alkali

A student plans to transfer 25.0 cm^3 of alkali to a conical flask using a measuring cylinder. Name a more suitable piece of apparatus for that transfer and explain why it is better suited to the job.

5. Near the end point

A student has put a suitable indicator into the flask. Explain how they can tell when enough acid has been added. Describe how they should add the acid just before that point.

6. Rinsing the flask wall

A student rinses drops of alkali from the wall of the conical flask with distilled water. No alkali leaves the flask. Predict whether the volume of acid needed to neutralise the alkali increases, decreases or stays the same. Explain your answer.

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7. Sodium hydroxide concentration (Higher)

$HCl + NaOH \rightarrow NaCl + H_2O$. A 25.0 cm^3 sample of NaOH reacts with 19.5 cm^3 of 0.100 mol/dm^3 HCl. Calculate the NaOH concentration in mol/dm^3.

8. Sulfuric acid concentration (Higher)

$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$. A 20.0 cm^3 sample of H_2SO_4 reacts with 24.0 cm^3 of 0.150 mol/dm^3 NaOH. Calculate the H_2SO_4 concentration in mol/dm^3.

9. Extra challenge · A trapped bubble

A student takes a starting reading with an air bubble in the burette tip. During the titration the bubble disappears and the tip fills with acid. The student uses the difference between readings as the volume that reached the flask. Explain the error and its effect on the apparent titre. Describe how to prevent it next time.

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Worked answers

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1. Calculate the titre

Titre = final reading − initial reading = 23.65 − 1.20 = 22.45 cm^3.

2. Find the final reading

Final reading = initial reading + titre = 2.45 + 19.80 = 22.25 cm^3.

3. Use the repeat titres

21.45 and 21.50 cm^3 differ by 0.05 cm^3. The rough titre was an estimate and 22.10 cm^3 is outside the agreement range.

Mean = (21.45 + 21.50) ÷ 2 = 21.475 cm^3, or 21.48 cm^3 to two decimal places.

4. Transfer the alkali

Use a 25.0 cm^3 volumetric pipette with a pipette filler. It is calibrated to deliver that fixed volume more accurately than the measuring cylinder.

5. Near the end point

The first colour change that persists identifies the end point. It shows that enough acid has been added to neutralise the alkali in this titration.

Add the acid one drop at a time, swirling the flask after each drop so the acid mixes with the alkali.

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Worked answers

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6. Rinsing the flask wall

The acid volume stays the same. The water dilutes the alkali, but the amount of alkali in the flask is unchanged. It still takes the same amount of acid to neutralise it.

7. Sodium hydroxide concentration (Higher)

19.5 cm^3 = 0.0195 dm^3. n(HCl) = 0.100 × 0.0195 = 0.00195 mol.

The ratio is 1:1. c(NaOH) = 0.00195 ÷ 0.0250 = 0.0780 mol/dm^3.

8. Sulfuric acid concentration (Higher)

n(NaOH) = 0.150 × 0.0240 = 0.00360 mol. The equation needs half as much H_2SO_4: 0.00180 mol.

c(H_2SO_4) = 0.00180 ÷ 0.0200 = 0.0900 mol/dm^3.

9. Extra challenge · A trapped bubble

Some of the acid measured by the fall in the burette level fills the tip instead of reaching the flask. The recorded titre is therefore higher than the volume delivered to the flask.

Before taking the starting reading, run a little acid through the tap into a waste beaker until the tip is full and contains no trapped air. Then record the initial reading at eye level.

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