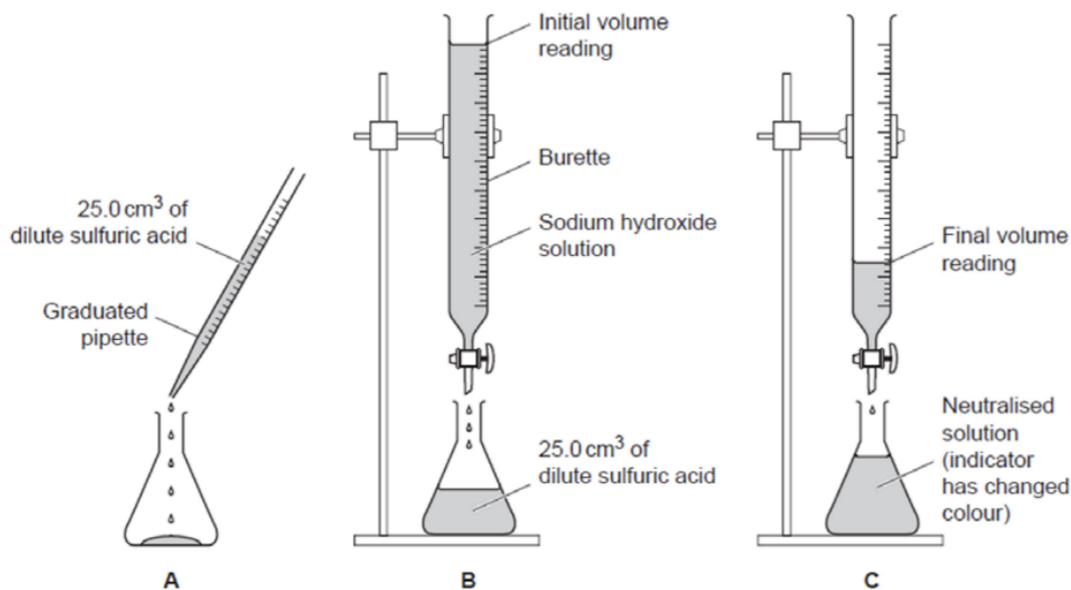# GCSE Chemistry A (Gateway Science)
J248/04 Chemistry A C4-C6 and C7 (Higher Tier)

Question Set 15

1 Student **A** does a titration with an acid and an alkali.

He uses dilute sulfuric acid, sodium hydroxide solution and an indicator solution.

The diagram shows the apparatus he uses.

The student adds sodium hydroxide solution from the burette to the sulfuric acid until the indicator changes colour.

He then adds a few more drops of sodium hydroxide to be certain the sulfuric acid is neutralised.

He takes the final volume reading on the burette to find out how much alkali reacts with 25.0 cm³ of dilute sulfuric acid.

(a)   Describe and explain how the student could improve his experiment to get a more accurate value.   **[4]**

- Stopping addition of alkali at the end point of the titration, rather than a few drops afterwards, as this would give a false reading of volume needed for neutralisation
- Adding alkali dropwise near the end point to reduce the chance of over-run, for accurate amount of volume being added
- Repeating the experiment in order to obtain an average value, and to reduce the effect of anomelous results.

- Using a pipette filler to ensure a consistent 25 cm³ of acid is used

(b)   Student **B** does a titration.
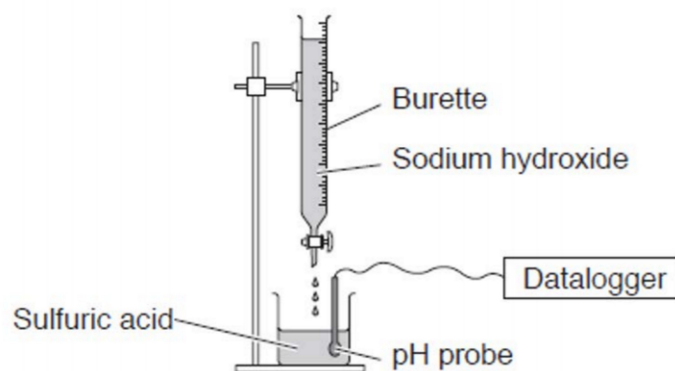
Sodium hydroxide solution is slowly added to the beaker of dilute sulfuric acid.
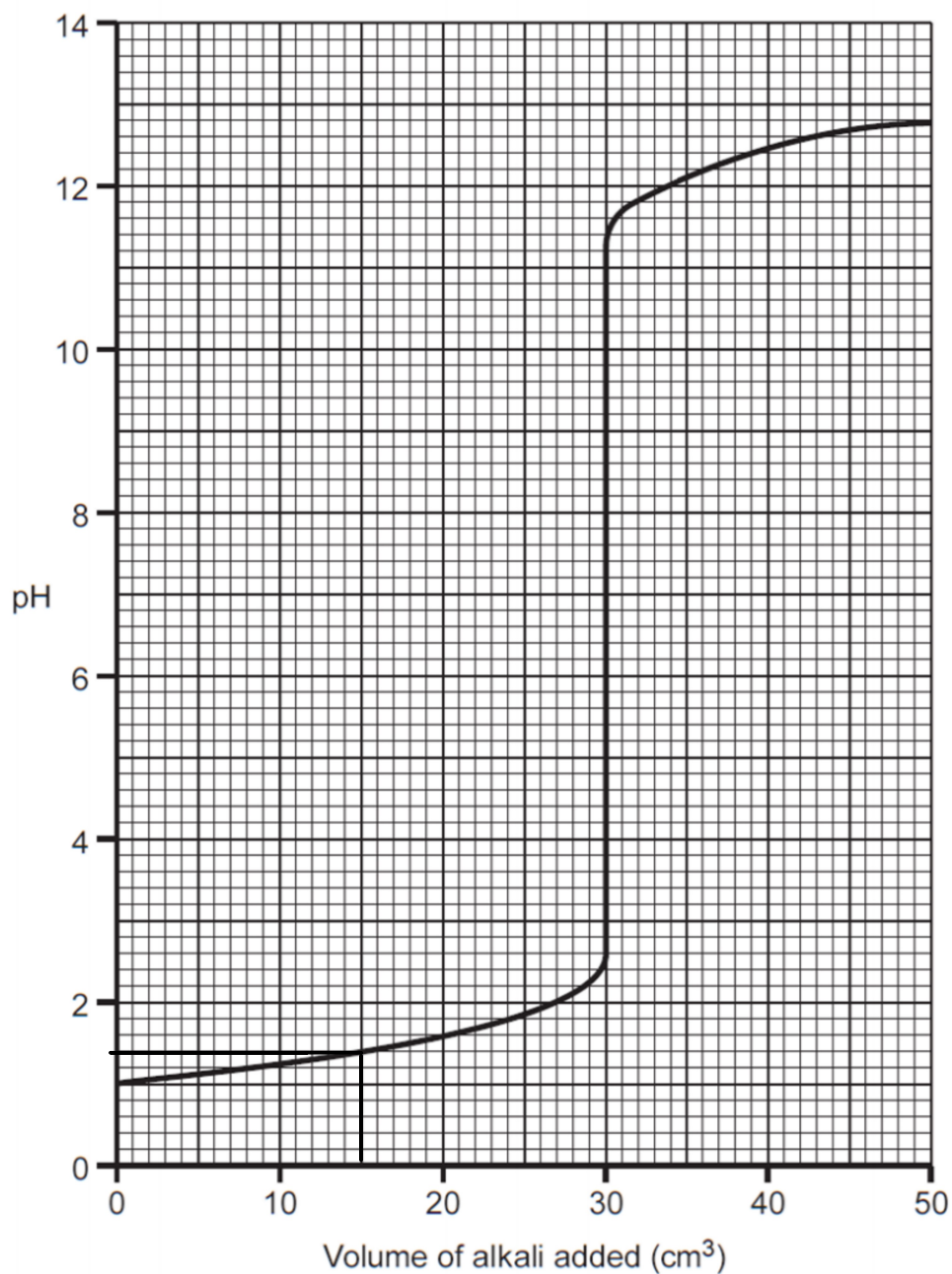
The pH probe is connected to a datalogger.

Suggest how student **B**'s method is better than student **A**'s.   **[1]**

The pH probe and datalogger setup is much more accurate than the use of an indicator.

(c)   Look at the display from the datalogger.

Volume of alkali added (cm³)

(i)   What is the pH value when 15 cm³ of alkali has been added?

Answer = ...1.4.................. cm³ **[1]**

(ii)   What volume of alkali is needed to exactly neutralise the sulfuric acid?

Answer = ...30.0.............. cm³ **[1]**

(d) Student **B** does another experiment.

This time she uses:

- 20.0 cm^3 of dilute hydrochloric acid in the beaker
- sodium hydroxide solution of concentration 0.200 mol/dm^3 in the burette.

Look at student **B**'s results.

Titration number	1	2	3	4
Final burette reading (cm^3)	26.9	27.6	27.0	28.2
Initial burette reading (cm^3)	0.5	2.5	1.2	3.2
Titre (volume of alkali used) (cm^3)	26.4	25.1	25.8	25.0

(i) Student **B** decides to only use the results from titration numbers **2** and **4**.

Explain why. The other titres are not within 0.2 cm^3 of each other, **[1]** they are anomalous. ⇒ 2 & 4 are the only ones concordant to each other

(ii) Look at the equation for the reaction between hydrochloric acid, HC*l*, and sodium hydroxide, NaOH.

HC*l* + NaOH → NaC*l* + H$_2$O
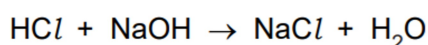
Calculate the concentration of hydrochloric acid in mol/dm^3. Use the average titre, in cm^3, from titration numbers **2** and **4**. → $\frac{25.1 + 25.0}{2} = 25.05$ cm^3

Give your answer to **2** significant figures.

HC*l*   NaOH
20 cm^3 25.05 cm^3 C = 0.2505 mol/dm^3
C   0.2 mol/dm^3
=   5.01×10^{-3} mol   Answer = ... 0.2505 ...... mol/dm^3 **[4]**

Total Marks for Question Set 15: 12