

**SL HL** Paper 3 Section A Experimental work (7)

An experiment was performed to find the concentration of a solution of sodium hydroxide.

1.203 g of hydrated oxalic acid crystals,  $(\text{COOH})_2 \cdot 2\text{H}_2\text{O}$ , were dissolved in distilled water and the total volume made up to  $100 \text{ cm}^3$ . This solution was used to fill a burette.

$10.0 \text{ cm}^3$  of sodium hydroxide solution of unknown concentration were added to a conical flask and titrated with the oxalic acid solution. Phenolphthalein was used as the indicator.

The titration was repeated two more times to determine the average volume of the oxalic acid solution required to reach the end point.

- (a)** A student calculated the concentration of the oxalic acid solution to be  $0.134 \text{ mol dm}^{-3}$ . He arrived at this answer by multiplying the mass taken by ten to give the mass in  $1.00 \text{ dm}^3$  of solution and then dividing by the molar mass of oxalic acid.

$$(10 \times 1.203) \div ((2 \times 12.01) + (4 \times 16.00) + (2 \times 1.01)) = 0.134 \text{ mol dm}^{-3}$$

Outline the major error in the student's calculation and determine the correct value for the concentration. **[2]**

- (b)** Identify the piece of glassware that should be used to ensure the total volume of  $100 \text{ cm}^3$  is as accurate as possible when preparing a standard solution. **[1]**
- (c)** Before placing the oxalic acid solution in the burette the student washed out the burette with distilled water but then omitted to dry it before adding the oxalic acid solution. Explain how this would affect the final result for the concentration of the sodium hydroxide solution. **[1]**
- (d)** The student also washed out the conical flask with distilled water and omitted to dry it before adding the  $10.0 \text{ cm}^3$  of the sodium hydroxide solution and then performing the titration with the oxalic acid solution. Explain the effect this would have on the final result for the concentration of the sodium hydroxide solution. **[1]**
- (e)** Oxalic acid is a diprotic acid. Assuming the sodium hydroxide solution has a very similar concentration to the solution of oxalic that was prepared, predict how the electrical conductivities of the two solutions will compare. **[1]**