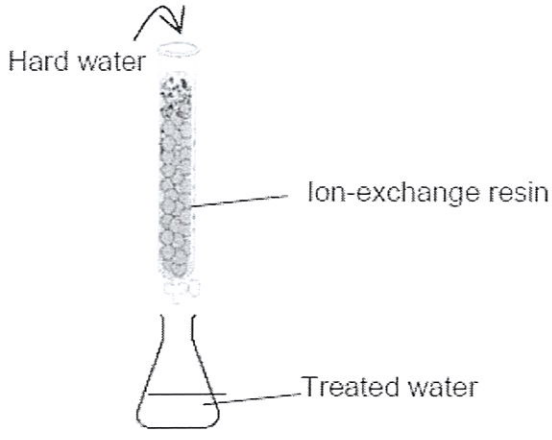
Atoms, Mole and Stoichiometry FAQ 1

The hardness present in a water sample due to dissolved calcium ions can be determined by using ion-exchange column as shown in the diagram.

$$Ca^{2+} + 2H^{+}\text{-resin} \rightarrow Ca^{2+}\text{-resin} + 2H^{+}$$

A 50 cm^3 sample of a solution containing calcium sulfate was passed through the ion-exchange resin. The calcium ions in the sample were quantitatively exchanged by hydrogen ions. The sample collected in the flask required 25 cm^3 of 1.0×10^{-2} mol dm^{-3} potassium hydroxide for complete neutralisation.



What was the concentration of the calcium sulfate in the original sample?

A	2.5×10^{-3} mol dm^{-3}	B	5.0×10^{-3} mol dm^{-3}
C	2.0×10^{-2} mol dm^{-3}	D	4.0×10^{-2} mol dm^{-3}

Solution

$n_{KOH} = \frac{25}{1000} \times 1.0 \times 10^{-2} = 2.5 \times 10^{-4}$

$n_{H^+} = 2.5 \times 10^{-4}$

From $Ca^{2+} + 2H^{+}\text{-resin} \rightarrow Ca^{2+}\text{-resin} + 2H^{+}$

$n_{Ca^{2+}} = \frac{1}{2} n_{H^+}$

$= 1.25 \times 10^{-4}$ in 50 cm^3

$[Ca^{2+}] = \frac{1.25 \times 10^{-4}}{\frac{50}{1000}} = 2.5 \times 10^{-3}$ mol dm^{-3}