Scaffolding titration calculations

Education in Chemistry
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Titration calculations are difficult. You can reduce the cognitive load by careful scaffolding using the table method.

Table method example

A student titrated a 25.0 cm^3 sample of sulfuric acid, H_2SO_4, with a 0.102 mol/dm^3 solution of potassium hydroxide, KOH. 23.1 cm^3 was the mean volume of potassium hydroxide required.

The equation for the reaction is $H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$.

1. Construct a table with the row titles shown below and the reagents used in the column headers.

	KOH	H_2SO_4
Concentration (mol/dm^3)		
Volume (cm^3)		
Moles		
Mole **r**atio		

2. Find the numbers in the question and put them in the right place in the table. The gaps make it easy to know what needs calculating.

	KOH	H_2SO_4
Concentration (mol/dm^3)	0.102	
Volume (cm^3)	23.1	25.0
Moles		
Mole **r**atio	2	1

3. The calculation begins with the reagent for which we have both concentration and volume, allowing us to calculate the moles.

	KOH	H_2SO_4
Concentration (mol/dm^3)	0.102*	
Volume (cm^3)	23.1*	25.0
Moles	2.36×10^{-3}	
Mole **r**atio	2	1

n(KOH)

$$m = \frac{cv}{1000} \rightarrow \frac{0.102}{1000} \text{x } 23.1 = 2.36 \text{ x } 10^{-3} \text{mol}$$

4. Now the column for KOH has been filled, we use the mole ratio to find the moles of H_2SO_4.

	KOH	H_2SO_4
Concentration (mol/dm^3)	0.102	
Volume (cm^3)	23.1	25.0
Moles	2.36 x 10^{-3} ÷2 →	1.18 x 10^{-3}
Mole **r**atio	2 ÷2 →	1

n(H_2SO_4)

$$\frac{2.36 \times 10^{-3}}{2} = 1.18 \times 10^{-3} \text{mol}$$

5. The final step is to use the moles and volume to find the concentration.

	KOH	H_2SO_4
Concentration (mol/dm^3)	0.102	0.047
Volume (cm^3)	23.1	25.0*
Moles	2.36 x 10^{-3}	1.18 x 10^{-3}*
Mole **r**atio	2 ÷2—›	1

C(H_2SO_4)

$$n = \frac{cv}{1000} \rightarrow c = \frac{n}{v} \times 1000 \rightarrow \frac{1.18 \times 10^{-3}}{25} \times 1000 = 0.047 \text{ mol/dm}^3$$