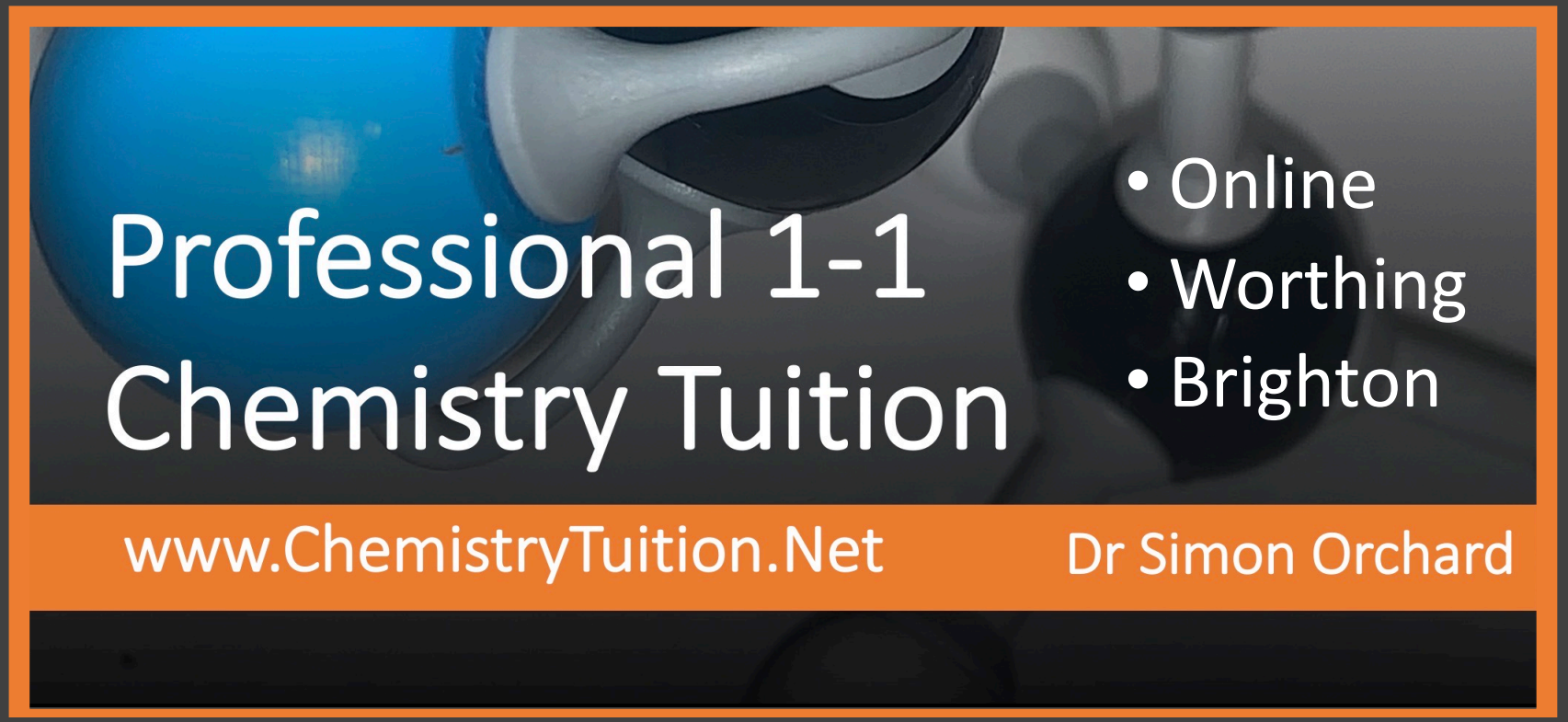


Introduction to Chemistry Calculations

Moles in Solution

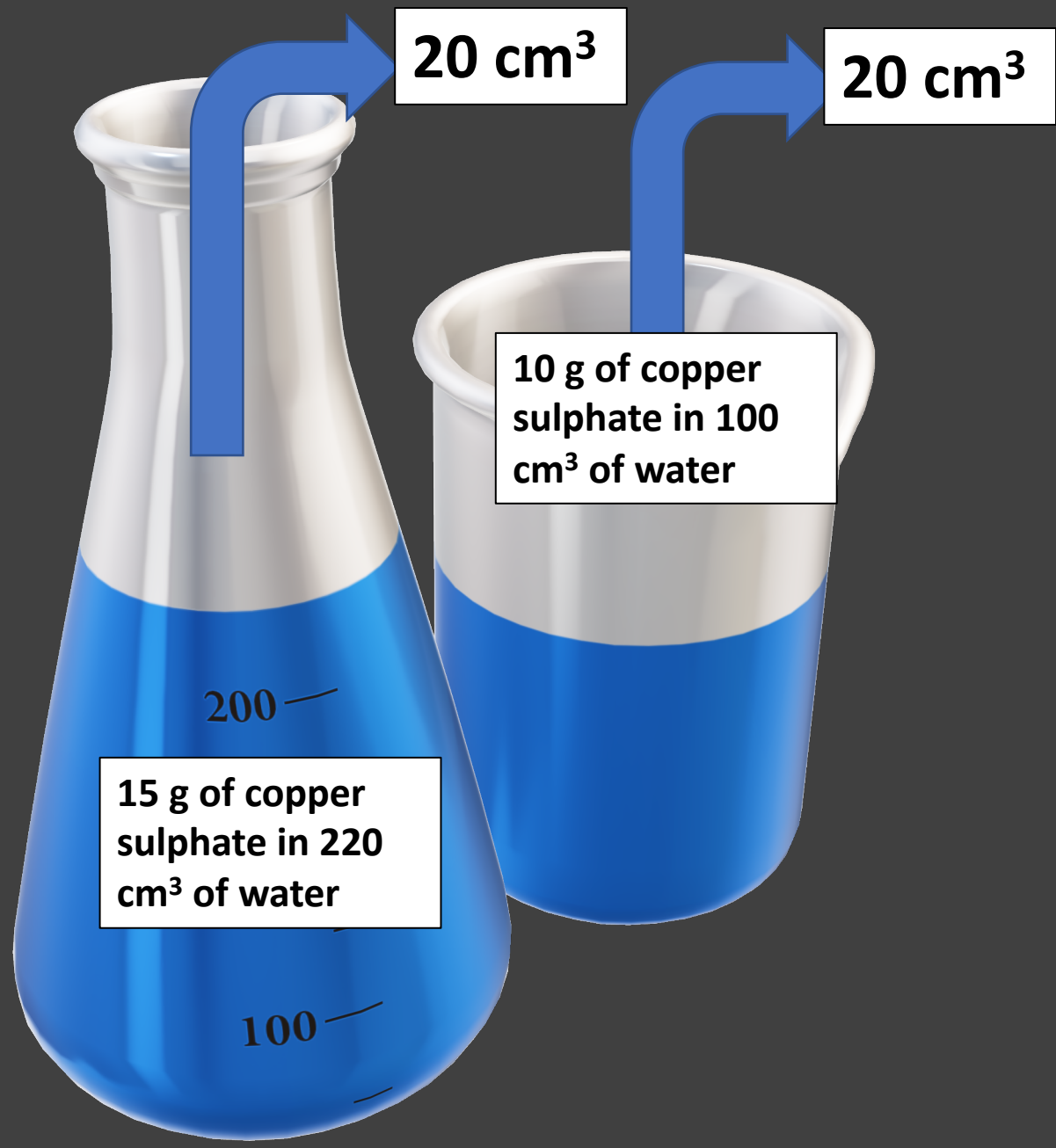
These slides may be downloaded at https://www.chemistrytuition.net/

So far, we have been able to find the number of moles in solids and gases.

How can we deal with substances dissolved in water?

For example, I have two solutions of copper sulphate and I take 20 cm^3 from each one.

How many moles of copper sulphate I have taken from each?



Concentration of Solutions

When a substance is dissolved in water, we refer to its **concentration** as

the number of moles dissolved in 1000 cm^3

However instead of saying 1000 cm^3 all the time we use the units decimetre cubed (dm^3)

1000 cm^3 = 1 dm^3

So, this becomes number of moles dissolved in 1 dm^3

Units are **moles per dm^3** or **mol/dm^3**

$$\text{Concentration in mol/dm}^3 = \frac{\text{Number of moles dissolved}}{\text{Volume in dm}^3}$$

Before using this equation, we need to:

- **Convert the mass of copper sulphate into moles**
- **Convert cm^3 into dm^3**

Example 1 - 15 g of copper sulphate ($CuSO_4$) in 220 cm^3 of water.

Molar mass of $CuSO_4$ = 63.5 + 32.1 + (4 x16) =159.6

$$\text{Moles of } CuSO_4 = \frac{\text{Mass}}{\text{Molar mass}} = \frac{15}{159.6} = \mathbf{0.0940 \text{ moles}}$$

$$\text{Volume} = 220 \text{ cm}^3 = \frac{220}{1000} \text{ dm}^3 = \mathbf{0.220 \text{ dm}^3}$$

$$\text{Concentration in mol/dm}^3 = \frac{\text{Number of moles dissolved}}{\text{Volume in dm}^3} = \frac{\mathbf{0.0940}}{\mathbf{0.220}} = \underline{\mathbf{0.427 \text{ mol/dm}^3}}$$

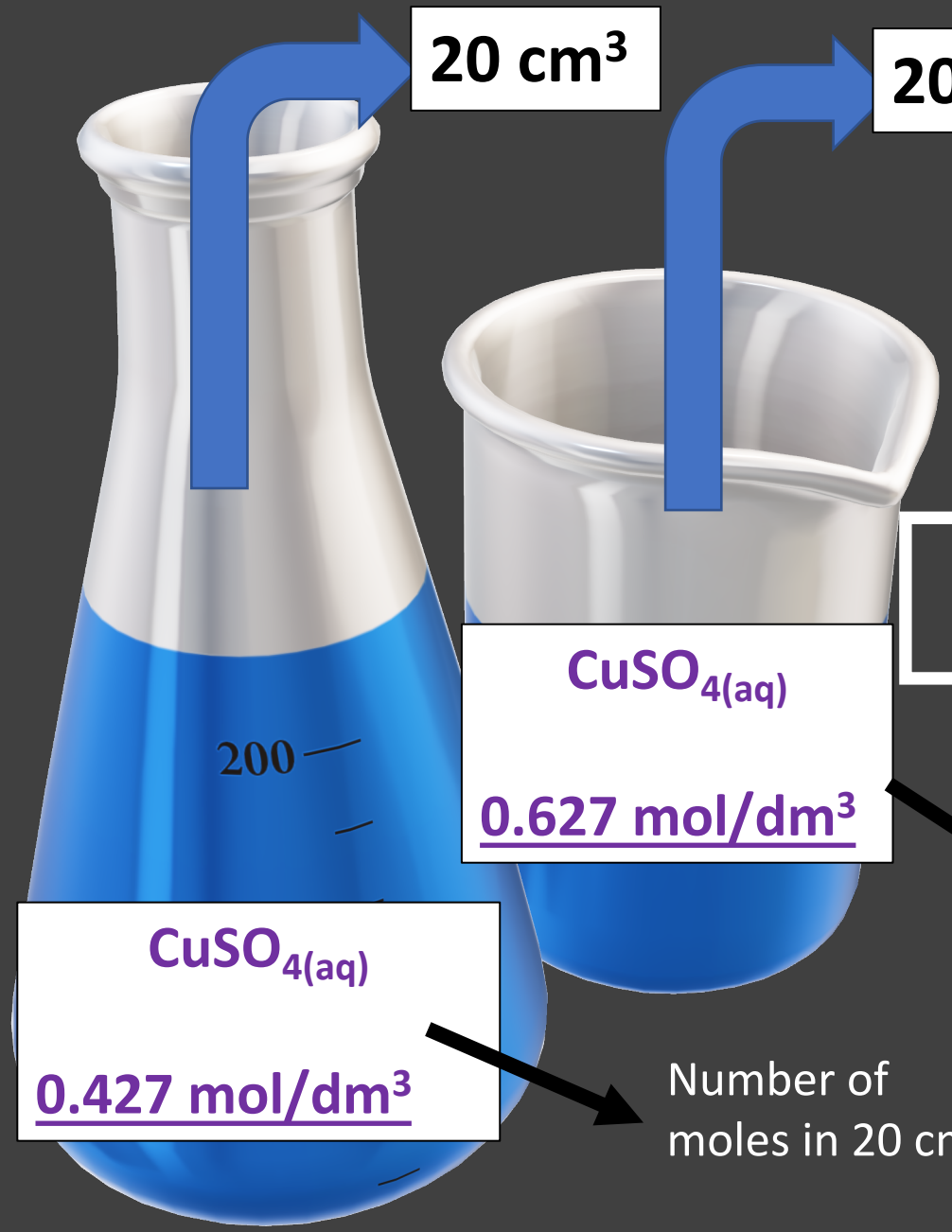
Example 2 -10 g of copper sulphate ($CuSO_4$) in 100 cm^3 of water

Molar mass of $CuSO_4$ = 63.5 + 32.1 + (4 x16) =159.6

$$\text{Moles of } CuSO_4 = \frac{\text{Mass}}{\text{Molar mass}} = \frac{10}{159.6} = \mathbf{0.0627 \text{ moles}}$$

$$\text{Volume} = 100\ cm^3 = \frac{100}{1000}\ dm^3 = \mathbf{0.100\ dm^3}$$

$$\text{Concentration in mol/dm}^3 = \frac{\text{Number of moles dissolved}}{\text{Volume in dm}^3} = \frac{\mathbf{0.0627}}{\mathbf{0.100}} = \underline{\mathbf{0.627\ mol/dm^3}}$$



We can now calculate how many moles of copper sulphate are in 20 cm³ of each solution.

$$\text{Concentration in mol/dm}^3 = \frac{\text{Number of moles}}{\text{Volume in dm}^3}$$

Can be rearranged to give:

$$\text{Number of moles} = \text{Concentration in mol/dm}^3 \times \text{Volume in dm}^3$$

Number of moles in 20 cm³ = $0.627 \times \frac{20}{1000} = \underline{\mathbf{0.0125\ moles}}$

Number of moles in 20 cm³ = $0.427 \times \frac{20}{1000} = \underline{\mathbf{0.00854\ moles}}$

Question 1

9.2 grams of cobalt chloride ($CoCl_2$) was dissolved in 490 cm^3 of water.

Find the concentration in mol/dm^3.

Hints:

9.2 grams of cobalt chloride ($CoCl_2$) was dissolved in 490 cm^3 of water.

Find the concentration in mol/dm^3.

$$\text{Moles of } CoCl_2 = \frac{\text{Mass}}{\text{Molar mass}}$$

$$\text{Concentration in } mol/dm^3 = \frac{\text{Number of moles dissolved}}{\text{Volume in } dm^3}$$

9.2 grams of cobalt chloride ($CoCl_2$) was dissolved in 490 cm^3 of water. Find the concentration in mol/dm^3.

Molar mass of $CoCl_2$ = 58.9 + (2 x 35.5) = 129.9

$$\text{Moles of } CoCl_2 = \frac{\text{Mass}}{\text{Molar mass}} = \frac{9.2}{129.9} = \textbf{0.0708 moles}$$

$$\text{Volume} = 490\ cm^3 = \frac{490}{1000}\ dm^3 = \textbf{0.490 } \textbf{dm}^3$$

$$\text{Concentration in } mol/dm^3 = \frac{\text{Number of moles dissolved}}{\text{Volume in } dm^3} = \frac{\textbf{0..0708}}{\textbf{0.490}} = \underline{\textbf{0.145 mol/dm}^3}$$

Question 2

Calculate the volume required to obtain 0.0500 moles of NaOH from 0.100 mol/dm^3 solution.

Hints:

Calculate the volume of required to obtain 0.0500 moles of NaOH from 0.100 mol/dm^3 solution

Volume in dm^3 = Concentration x Number of moles dissolved

Volume in cm^3 = Volume in dm^3 x 1000

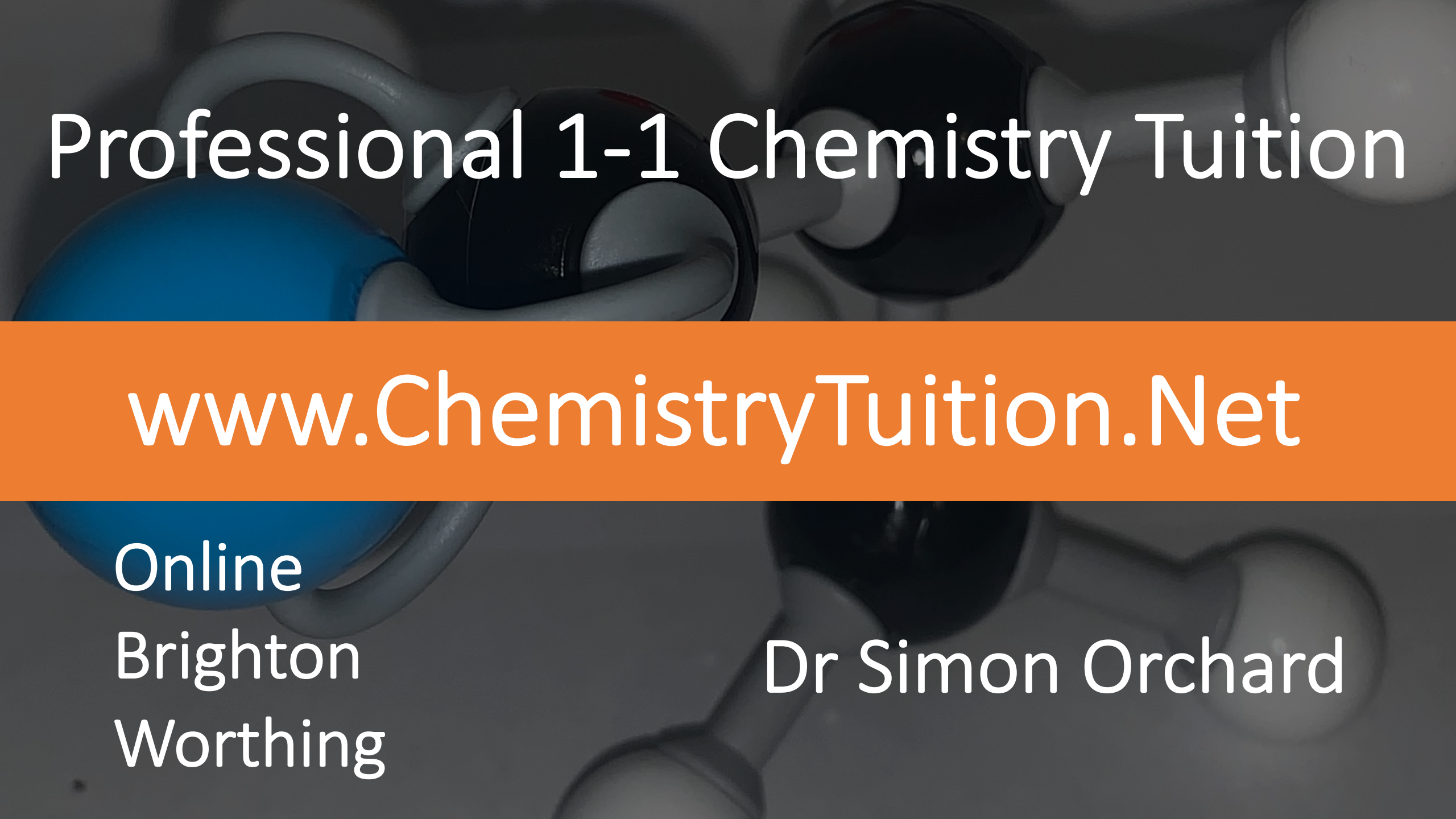
Calculate the volume in cm^3 required to obtain 0.0500 moles of NaOH from 0.100 mol dm^{-3} solution.

Volume in dm^3 = Concentration x Number of moles dissolved

Volume in dm^3 = 0.100 x 0.0500 = 0.00500 dm^3

Volume in cm^3 = Volume in dm^3 x 1000

Volume in cm^3 = 0.00500 x 1000 = **5.00 cm^3**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