Approaching exam calculations

*Education in Chemistry*
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Build up the complexity of the calculations you set students until they are ready to tackle exam-style problems.

1. Begin with relatively simple questions that don’t involve any unit conversions or any rearrangement of the formula.

   eg What concentration would result if you dissolved 20 g of sodium chloride in 10 dm$^3$ water?

2. Introduce questions that ask for mass and so involve rearrangement of the formula.

   eg What mass of sodium chloride would be present in 10 dm$^3$ of a solution with a concentration of 2 g.dm$^{-3}$?

3. Introduce questions that ask for the volume of the solution and so involve rearrangement of the formula.

   eg What volume of a 2 g.dm$^{-3}$ solution would contain 10 g?

4. Ask students to invent their own questions using the following mix-and-match templates.

   What volume… have ___ g of _____ at a concentration of ___ g.dm$^{-3}$
   What mass of ______… in ____ dm$^3$ of solution at a concentration of ___ g.dm$^{-3}$
   What concentration…. have ___ g of _____ in ____ dm$^3$ of solution

5. Introduce questions that involve unit conversions but not rearrangement of the formula.

   eg What would the concentration be in g.dm$^{-3}$ if 50 g of sodium chloride was dissolved in 250 cm$^3$?

6. Finally tackle a past exam question such as this:

   **Calculate the mass of sodium hydroxide that must be dissolved in water to make 200 cm$^3$ of solution of concentration 60 g.dm$^{-3}$.**

   a) Ask ‘What are we looking for?’ and ‘What will its units be?’ Highlight or circle it.
   b) Ask ‘What do we know?’ (and think ‘what do the units tell us?’ In this case the units cm$^3$ tell us that we have a volume of 200 cm$^3$). Highlight or circle them.
   c) Ask ‘Write down the formula that relates these quantities.’ (Hint: ‘what do the units tell us?’)
   d) Ask ‘Do the prefixes match?’ In this case we have cm$^3$ and dm$^3$ so convert 200 cm$^3$ to dm$^3$.
   e) Substitute in the numbers with their units into the formula then rearrange as required.
      (Alternatively rearrange the formula first). Ensure that the units cancel out appropriately.
Model answer:

**Calculate the mass of sodium hydroxide that must be dissolved in water to make 200 cm$^3$ of solution of concentration 60 g.dm$^{-3}$.**

a) We are trying to calculate the mass – units should be g.

b) We know the volume is 200 cm$^3$ (cm$^3$ is a unit for volume).

We know the concentration is 60 g.dm$^{-3}$

c) \[ \text{concentration (g dm}^{-3}) = \frac{\text{mass (g)}}{\text{volume (dm}^3\text{)}} \]

d) 200 cm$^3$ is 0.2 dm$^3$

e) \[ \text{mass} = \text{concentration} \times \text{volume} = 60 \text{ g dm}^{-3} \times 0.2 \text{ dm}^3 = 12 \text{ g} \]