Deacon's Challenge No. 42 Answer

A mobile phase for an HPLC method is prepared by mixing 100 mL of methanol with 900 mL of buffer. If only 360 mL of buffer is available, how much methanol must be added to obtain the maximum volume of mobile phase?

There are two ways of approaching this problem. The first is a more systematic approach:

Let x equal the amount of methanol used. The final volume of mobile phase will be the volume of buffer (360 mL) plus the volume of methanol (x mL) i.e. (360 + x) mL. The concentration of methanol in the x mL added is 100%, whereas the concentration of methanol in the final mobile phase must be 10% (as stated in the question). The total AMOUNT of methanol in the final mobile phase must be the same as the amount added. The total AMOUNT of methanol is given by the volume of solution multiplied by its concentration:

Initial amount of methanol = Amount of methanol in final mobile phase

$$100\ (\%)\ \times\ x\ (\text{mL}) \quad = \quad 10\ (\%)\ \times\ (360 + x)\ (\text{mL})$$

Expand the expression on the right hand side of this equation:

$$100\ (\%)\ \times\ x = \quad (10\% \times 360) + (10\% \times x)$$

Rearrange then solve for *x*:

$$[100\ (\%)\ \times\ x] - [10\% \times x] \quad = \quad 36$$

$$90\% \times x \quad = \quad 36$$

Since 90% is the same as 90/100:

$$\frac{90 \times x}{100} \quad = \quad 36, \qquad x \quad = \quad \frac{36 \times 100}{90} \quad = \quad \textbf{40 mL}$$

This approach will always work, and may be the best method to use if the numerical values for concentrations and volumes are awkward.

A simpler and more intuitive approach is :

The volume of buffer in the mobile phase must be 90% of the final volume.

$$\text{i.e.} \quad 360 \quad = \quad \frac{90 \times \text{Final volume}}{100}$$

Rearranging:

$$\text{Final volume} \quad = \quad \frac{360 \times 100}{90} \quad = \quad 400\ \text{mL}$$

Therefore volume methanol = 400 - 360 = **40 mL**

Alternatively, since the buffer is being diluted by 9/10, the volume of methanol added must be 1/9 of this volume i.e. 360 x 1/9 = **40 mL**. ■

Question 43

In 1976 Cockroft and Gault studied the relationship between creatinine excretion, age and body weight. They plotted the 24 h urinary creatinine excretion (mmol/24 h) divided by body weight (in Kg) on the *y* axis against age on the *x* axis. The intercept on the *y* axis (i.e. *y* value when $x = 0$) was 0.248, whereas the slope was -0.0018. Derive an equation which can be used to calculate creatinine clearance (in mL/min) from plasma creatinine (µmol/L), body weight (in Kg) and age (in years).