Math Diversion Problem 929

P. Reany

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Thanksgiving isn't Thanksgiving until
you've said thanks.
— Pastor Price

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Source: Chemical Principles: Quest for Insight, 3rd Ed
Title: Problem  6: p. F55 Ex. G.4
  Presenter: Atkins and Jones
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1 Problem

We need to prepare 250 mL of 1.50×10^{-3} M NaOH (aq), using 0.0380 M NaOH (aq) stock solution. How much stock solution do we need?

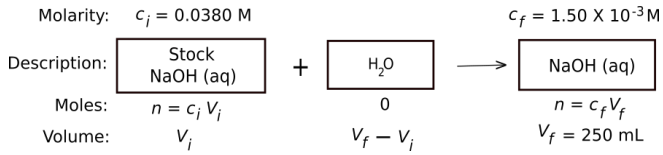

Figure 1. The moles line counts the moles of NaOH in each group. (In any chemical process, the number of moles of a given chemical specie is fixed.)

Initial State: c_i = 0.0380 M NaOH (aq).

Final State: 250 mL of c_f =1.50×10^{-3} M NaOH (aq).

What we must do is to add a certain amount of pure water to the stock solution to end up with the desired volume of NaOH (aq). However, in the process of adding pure water, the number of moles n of NaOH will not change. Hence,

$$n = c_i V_i = c_f V_f \, . \tag{1}$$

Therefore,

$$
\begin{aligned}
V_i &= \frac{c_f V_f}{c_i} \\
&= \frac{(1.50 \times 10^{-3}\,\mathrm{M})(250\,\mathrm{mL})}{(0.0380\ \mathrm{M})} \\
&= 9.87 \times 10^{-3}\,\mathrm{L}\,. \qquad (2)
\end{aligned}
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