# Math Diversion Problem 913

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You may be *a* doctor, but I am *the* Doctor
— the definite article, you might say.
— Doctor Who (Tom Baker)

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Source:  https://www.chemteam.info/Mole/Determine-formula-of
              -hydrate-prob1-10.html
 Title:  Hydrate of Na_2C_3, PROBLEM 5a
  Presenter: Patrick
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## 1 Problem

A solution was made by dissolving 52.0 g of hydrated sodium carbonate in water and making it up to 5.00 $dm^3$ of solution. The concentration of the solution was determined to be 0.0366 M. Determine the formula of hydrated sodium carbonate.

## 2 Solution

Step 1.

Note: 1 $dm^3$ = 1 liter.

The chemical reaction is as follows:

$$Na_2CO_3 \cdot nH_2O \rightarrow Na_2CO_3 + nH_2O\,, \tag{1}$$

where $n$ is to be determined.

Step 2. Once again, a diagram.

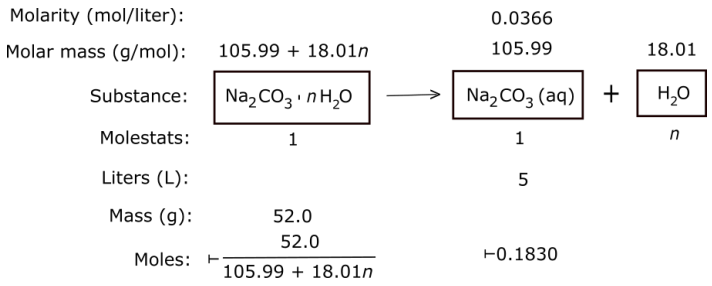


Figure 1. In this problem there are two ways to arrive at moles.

Step 3. We can calculate $n$ by using a mole proportion on columns 1 and 2:

$$\frac{1}{1} = \frac{52.0/(105.99 + 18.01n)}{0.1830}\,. \tag{2}$$

On solving this for $n$, we get, after rounding to the nearest integer, $n = 10$, resulting in the formula $NaCO_3 \cdot 10H_2O$.

# 3 Appendix: How to interpret the Stoich diagrams

There are four main types of data in the stoich diagrams I make. The most common are data from given information, from the coefficients of the balanced equation, and from data tables, such as a periodic table of elements for molar mass information. This kind of data I do not mark up. The second kind of data in stoich diagrams comes from computations based on data in the same column, for which I use the turnstile ($\vdash$) to indicate. The third kind of data is a result in one column that required data from at least one other column to calculate it, and I indicate that kind of value or result by use of the underlining. The fourth kind of data in the figures is the result of combining given information to derive a secondary value. I indicate this kind of data with a right arrowhead ($\blacktriangleright$).