

Math Diversion Problem 911

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Proofs are embedded in broader frameworks—moduli spaces,
categories, field theories—where the relationships
matter more than the isolated result.
— Copilot, being philosophical

Source: <https://www.chemteam.info/Mole/Determine-formula-of-hydrate-prob1-10.html>

Title: Hydrate of LiClO₄

Presenter: Patrick

1 Problem

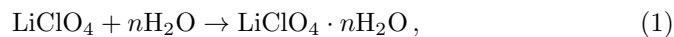
PROBLEM #1 from the website

Anhydrous lithium perchlorate (4.78 g) was dissolved in water and re-crystalized. Care was taken to isolate all the lithium perchlorate as its hydrate. The mass of the hydrated salt obtained was 7.21 g. What hydrate is it?

2 Solution

Step 1.

The chemical reaction is as follows:



where n is to be determined.

Step 2. Once again, a diagram.

Molar mass (g/mol):	106.39	+	18.01	→	
Substance:	LiClO ₄		H ₂ O		LiClO ₄ · nH ₂ O
Molestats:	1		n		1
Mass (g):	4.78		<u>2.43</u>		7.21
Moles: †	0.044929		†0.134925		

Figure 1. The mass of the water is determined by $7.21 - 4.78 = 2.43$.

Step 3.

We can calculate n by using a mole proportion on columns 1 and 2:

$$\frac{n}{1} = \frac{0.134925}{0.044929} \approx 3. \quad (2)$$

Thus, we choose $n = 3$, resulting in the formula to be $\text{LiClO}_4 \cdot 3\text{H}_2\text{O}$.

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 (†) 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 (►).