

Math Diversion Problem 917

P. Reany

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Anything worth doing is worth doing well.

— An old saying

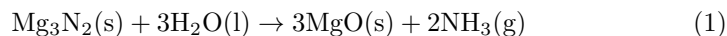
Source: <https://answers.yahoo.com/question/index?qid=20100413231838AAI14qf>

Title: Making Ammonia Gas

Presenter: Patrick

1 Problem

If water is added to magnesium nitride, ammonia gas is produced when the mixture is heated.



If 13.7 g of magnesium nitride is treated with water, what volume of ammonia gas would be collected at 28°C and 737 mm Hg?

2 Solution

Step 1.

First, we treat the ammonia evolved as an ideal gas and expect to employ the ideal gas law:

$$PV = nRT, \quad (2)$$

where n is the number of moles of the gas. Now, since the Ideal Gas Constant R can be given in various unit systems, let's make that choice right now.

$$R = 8.2057 \times 10^{-2} \frac{\text{atm}\cdot\text{L}}{\text{mol}\cdot\text{K}}. \quad (3)$$

Thus,

$$P = (737 \text{ mm Hg}) \frac{1 \text{ atm}}{760 \text{ mm Hg}} = 0.9697 \text{ atm}, \quad (4)$$

and, of course, $T = (273 + 28)\text{K} = 301\text{K}$.

Step 2. Now, a diagram.

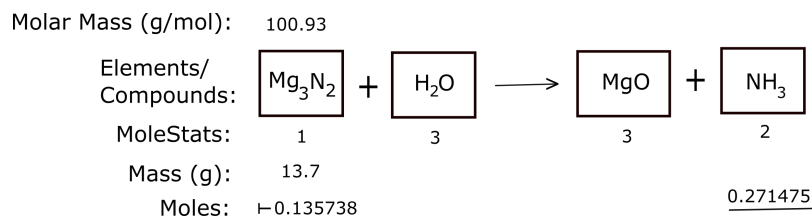


Figure 1. In column 4, the moles of NH₃ is calculated by one-to-two mole proportion between columns 1 and 4.

Step 3.

Lastly, we solve (2) for V , using $n = 0.271475$ mol from the diagram above, and write

$$V = \frac{nRT}{P} = \frac{(0.271475 \text{ mol})(8.2057 \times 10^{-2} \frac{\text{atm}\cdot\text{L}}{\text{mol}\cdot\text{K}})(301 \text{ K})}{0.9697 \text{ atm}} = 6.92 \text{ L}. \quad (5)$$

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 (▶).