Math Diversion Problem 684: Stoichiometry

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> Chop your own wood and it will warm you twice.
> — Henry Ford

The problem is found at:

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Source: Chemistry: The Molecular Nature of Matter and Change
Title: Grams-to-Liters
 Presenter:  M. S. Silberberg.
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1 Problem 4: Iron Content in Ore Sample

This fourth problem is taken from *Chemical Principles: The Quest for Insight* ([1], p. F85).

PROBLEM: (paraphrase)

A sample of iron ore of mass 0.202 g is first dissolved in acid and then titrated with potassium permanganate in the following reaction:

$$5Fe^{2+}(aq) + MnO_4{}^-(aq) + 8H^+(aq) \longrightarrow 5Fe^{3+}(aq) + Mn^{2+}(aq) + 4H_2O(l) \quad (1)$$

If it takes 16.7 mL of 0.0108 M $KMnO_4(aq)$ to reach the stoichiometric point (the point at which all the Fe^{2+} is consumed), what is the mass and percentage of iron in the sample?

SOLUTION:

We can calculate the percentage of iron in the sample after we have calculated the grams of iron that reacted with the permanganate. Now, we produce a diagram of the equation:

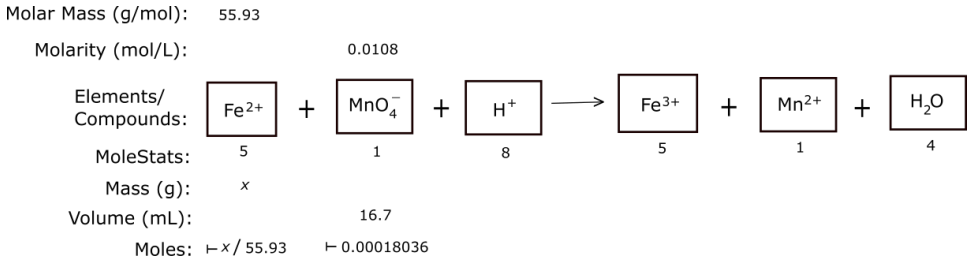

Figure 14. This graphic displays only enough numeric information to solve for x grams of Fe^{2+}.

Next, we write down our mole proportion between columns 1 and 2:

$$\frac{5}{1} = \frac{\text{moles } Fe^{2+}}{\text{moles } MnO_4^-} = \frac{x/55.93}{0.00018036}\,. \tag{2}$$

On solving for x, we get

$$x = 0.0504\,\text{g}\,. \tag{3}$$

Therefore, the percentage of iron in the ore sample is

$$\%\ \text{Fe} = \frac{0.0504\,\text{g}}{0.202\ \text{g}} \times 100\% = 25.0\%\,. \tag{4}$$

References

[1] P. Atkins and L. Jones. *Chemical Principles: The Quest for Insight*, 3rd Ed. Freeman (2005).

[2] R. Blitzer. *Intermediate Algebra for College Students*, 3rd Ed. Prentice-Hall (2002).

[3] M. Hein and S. Arena *Foundations of College Chemistry*, alternate 12th ed, John Wiley & Sons (2007), 421–422.

[4] H. Rolf. *Finite Mathematics*, 5th Ed. Brooks/Cole (2002), p. 57.

[5] M. S. Silberberg. *Chemistry: The Molecular Nature of Matter and Change* 4th Ed. McGraw-Hill (2006).