Chapter 1: Sharpening the Math Toolbox

August 22, 2022

Chemistry Department, Cypress College

Outline

Introduction: Who am I?

Review: Syllabus

Math Review for Chemist

Introduction: Who am I?

- Last June, graduated from University of California, Irvine, receiving my PhD in Computational and Theoretical Chemistry
- May refer me as Dr. Prof. Brian D. Nguyen
- Exercising, driving, hiking, learning new languages, and gaming

Introduction: Your Turn

With your notecard:

- Take 2-3 mins and write down your name on one side
- On the other side, write down something that I can remember you by

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Math Review for Chemist

Chemistry is necessarily an experimental science: its conclusions are drawn from data, and its principles supported by evidence from facts. - Michael Faraday

Scientific Notation

The scientific notation is expressed

$$N = C \times 10^m \tag{1}$$

where N is a large number, C is the coefficient (a number between $1 - 9$) and m is the exponent (a positive or negative integer)

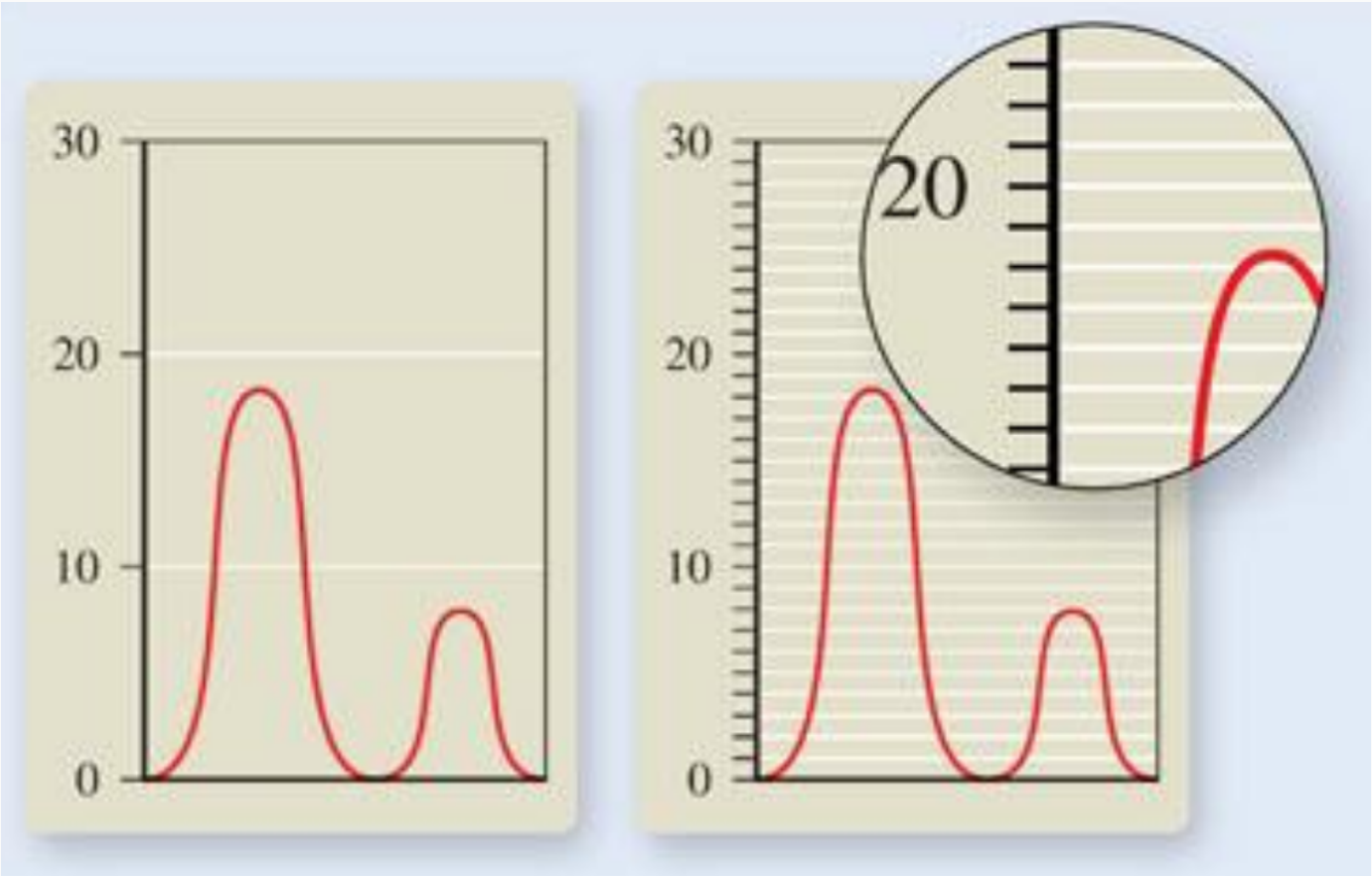
Example: $0.00363246 = 3.63246 \times 10^{-3}$

Significant Figures

- The meaningful digits in a measured or calculated quantity
- Example: $0.00363246 \simeq 3.63 \times 10^{-3}$ to three sig figures
- Implies relative accuracy of 10^{-m}, e.g. 0.1% for $m = 3$

- For practice, what is the measured volume for the liquid above?

Significant Figures - More Practice!



Which is relatively more accurate? What is the approximate measurement for each graph? What is missing?

Counting Significant Figures

All **non-zero** numbers in a measured number are significant

Practice: What is the number of significant figures?

- 36.1 ft
- 1 dozen eggs
- 155.6 lbs

Leading, Sandwiched and Trailing Zeroes

Leading zeroes: Precede non-zero digits in a decimal number are **not** significant

Sandwiched zeroes: Occur between nonzero numbers are significant

Trailing zeroes: Following non-zero numbers are significant in numbers with a decimal point

Leading, Sandwiched and Trailing Zeroes

Practice: What is the number of significant figures?

- 0.0702 lb
- 48600 L
- 100.000 g
- 1.020 atm
- 9.01×10^5 m

Calculated Answers

- Answers must have the same number of significant figures as the least precise measured number(s)
- Calculator answers must often be **rounded off**
- **Rounding rules** are used to obtain the correct number of significant figures

TIPS: Avoid Rounding Errors

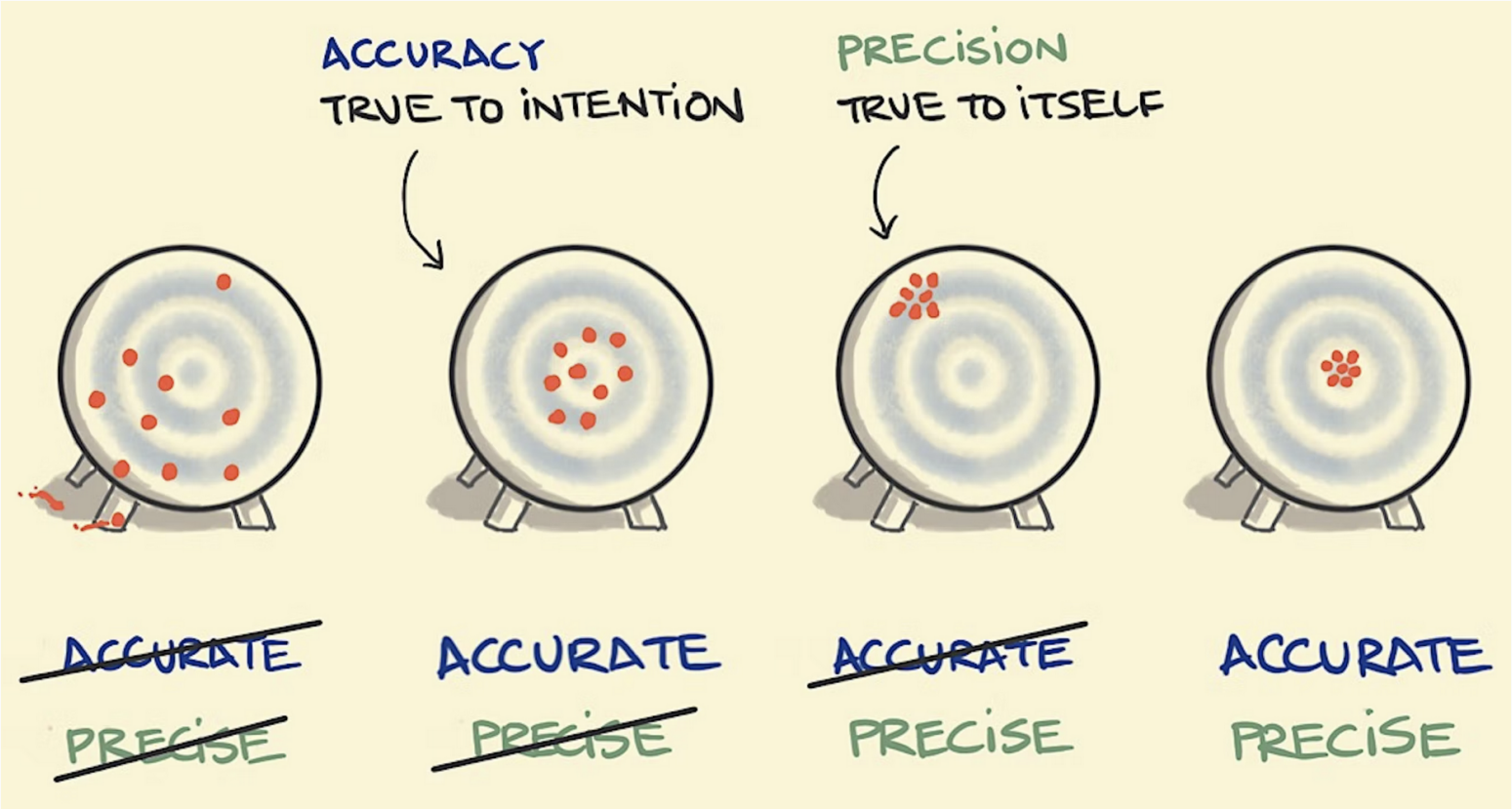
- Carry at least 2 extra significant figures in intermediate results!
- You will need to report your results *exactly* to a given precision
- Round at the very end

Practice: Round to four significant figures.

- 824.75143 cm
- 0.112544 g

Accuracy vs. Precision

What is the difference between accuracy and precision?



Accuracy vs. Precision

Accuracy

- How close you are to the actual value
- Calculated by the forumula

$$\%\text{Error} = \frac{\text{measured} - \text{actual}}{\text{actual}} \tag{2}$$

Precision

- How finely tuned your measurements are or how close they can be to each other
- Depends on the measuring tool
- Implied by the number of significant figures