



AFTER ANTOINE LAVOISIER DISCOVERED OXYGEN, HIS WHOLE FAMILY WOULD BREATHE IT REGULARLY AS A SHOW OF SUPPORT

cartoonist:
Sidney
Harris

General Chemistry I: BC2001x



Power Point Slides can be found on-line at course web page:

<http://bc.barnard.columbia.edu/~schapman/bc2001/index.htm>

Lab Lectures at 1:10 PM given by

Prof. Sally Chapman Monday and Friday

schapman@barnard.edu

Dr. Jacob Alexander Tuesday, Wednesday, Thursday

jalexand@barnard.edu

We use the same slides and cover the same material every day.

Help with lab available M-F 12-1:45 in 806 Altschul

Dr. Alexander's office hours: 11-1, M-F

First Laboratory Lecture



- **Today:**
Significant Figures
Exponential (or scientific) notation
Rounding
- **Next week:**
Arithmetic with Significant Figures
Experimental Uncertainty or error
Absolute and relative uncertainty
- **If these are unfamiliar topics,
study them carefully on your own!**

Reading assignments in your laboratory manual



- Next week's experiment (pp 1-20)
- Start working through the study guides:
Significant Figures (pp 21 - 30)
Experimental Uncertainties (pp 31 - 37)

Chemistry experiments



- Some are **quantitative**
 - result includes **numbers** (measured directly or calculated from measured values)
 - six weeks of this course
- Others are **qualitative**
 - results not numerical: **observations**
 - five weeks of this course

Significant Figures



- **Quantitative** results are expressed with correct number of significant figures
- The simplest way scientists communicate **how well their data is known**
- Very important in assessing and using data
- **The rightmost digit is the one that is uncertain** (those before it are certain)
- example: 5.647
4 significant figures, the 7 is uncertain

Historical Question



- Are atoms made of **integral numbers of a basic unit**?
- Consider atomic weights of several common elements measured to the nearest tenth of an amu (atomic mass unit) →
- This would have been quite accurate, 200 years ago
- **Are these integers?**
- These data are **consistent** with such an interpretation

H	1.0
He	4.0
C	12.0
N	14.0
F	19.0
Na	23.0
Ca	40.1

Atomic weights are not integers



- Modern values with **correct number of significant figures**
- Many have values quite close to integers, but many do not!
- The structure of the atom (electrons, protons, and neutrons) and the meaning of atomic weight (average isotopic distribution) account for the differences.

F	18.999483
C	12.011
N	14.0067
B	10.811
Cl	35.453
Ti	48.867
Ni	58.694

How do you determine the number of significant figures?



- When **you** are making a measurement **deciding this is an important part of the job!**
- Depends on the piece of equipment you are using, how well it is working, and on your ability to use it.

Deciding the correct number of significant figures



Example: weighing on a **Digital top loading balance**

Digital display reads
100.86 g

If reading is steady,
how many significant figures?



answer: five

Deciding the correct number of significant figures



- If someone else has made the measurement, you may assume that the value is reported correctly, with correct significant figures.
- The rightmost digit written is always **the first uncertain figure** and **the last significant figure**

Review of Exponential Notation



- $1.2 \times 10^3 = 1.2 \times 10 \times 10 \times 10 = 1200$
- $3.7 \times 10^{-2} = 3.7 \times 10^{-1} \times 10^{-1} = 0.037$
- **REMEMBER THAT** $10^1 = 10$ and $10^0 = 1$
- Exponential Notation also called **Scientific Notation**
- There is nothing unscientific about writing 1200 or 0.037! Be sensible: use exponential notation when it is warranted:
 - for large/small numbers
 - when needed to express significant figures

How many significant figures?



- 170 cm Dr. Alexander's height
- 299,792,458 m/s speed of light
- 0.0045
- 301,000,000 people US population

Now, write these in **exponential form**

Exponential Notation



- 170 cm = 1.70×10^2 cm
- 299,792,458 m/s = 2.99792458×10^8 m/s
- 0.0045 = 4.5×10^{-3}
- 301,000,000 people = 3.01×10^8 people
- Leading zeroes (0.0045) are never significant; trailing place-holding zeroes (301,000,000) might be.
- Some use a decimal point (350. vs 350) to convey significance. This is not a universal convention.
- Exponential notation **removes this ambiguity**

Do all numbers used in science have experimental uncertainty?



NO: some quantities are **exact!**
(number of significant figures is infinite!)

Examples:

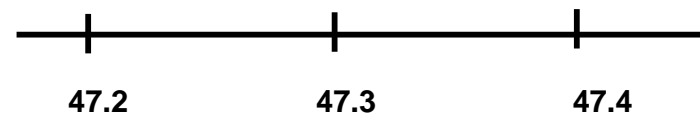
- 1000 mL = 1 L
- water has 2 H atoms per molecule
- ratio of circumference to diameter of circle $\pi = 3.141592654\dots$

ROUNDING



47.219361

- Round to 3 significant figures



- Think of its position on a number line:
which 3 significant figure value is closest?

ROUNDING

47.25

- round to 3 significant figures.
- **Exactly** halfway between 47.2 and 47.3
- Round up/down with equal probability
- Various algorithms effect this...!
- Happens infrequently, **not important**.



Final notes for today

IF YOU ARE DEFINITELY TAKING THIS COURSE,
PUT YOUR NAME ON YOUR LAB MANUAL NOW.

(IF NOT...RETURN IT!)

If you will be observing any religious holidays this semester which conflict with your lab day, you must schedule a makeup with Dr. Alexander **SOON**.
The week of the conflict is TOO LATE for planning.



Next ...

- Introduction to Lab in 813
- Lab safety introduction
- Lab coat fitting
- Quantitative skills assessment

