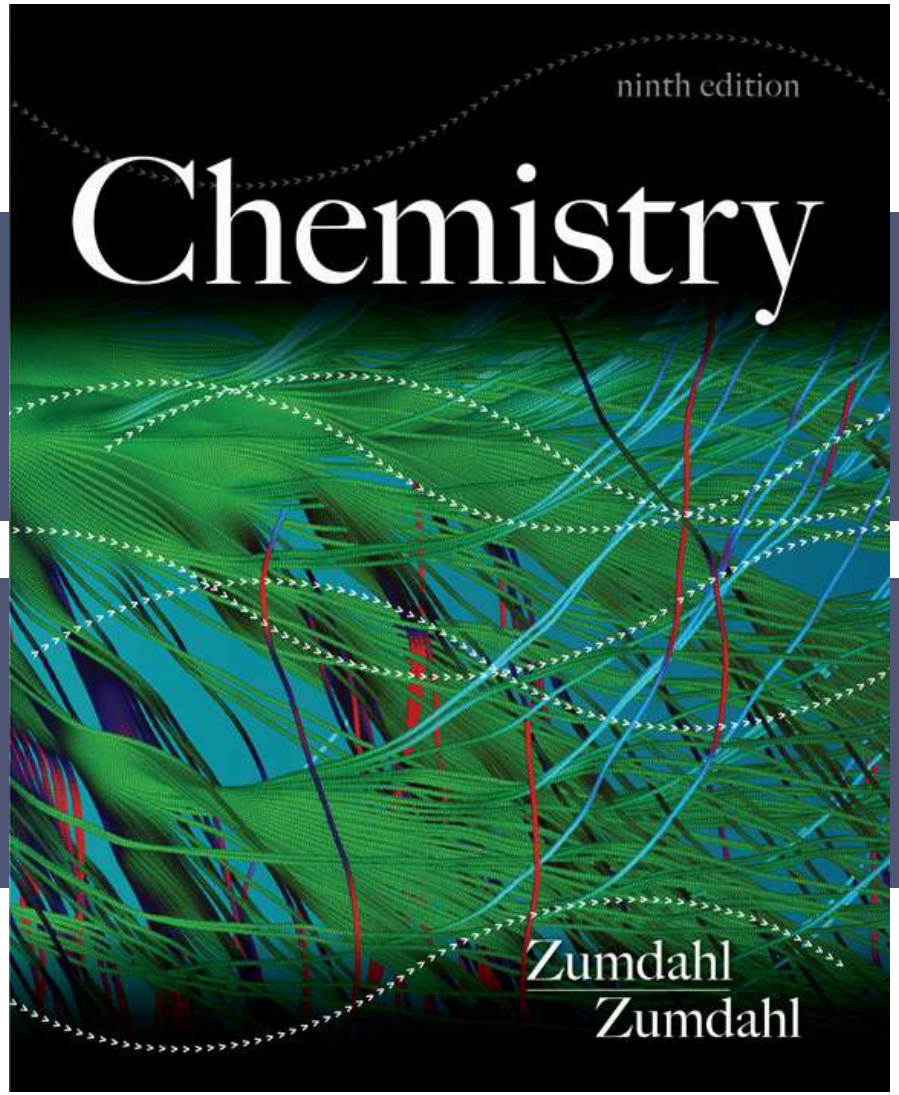


Chapter 1

Chemical Foundations

The Fundamental SI Units

Physical Quantity	*Name of Unit*	*Abbreviation*
Mass	kilogram	kg
Length	meter	m
Time	second	s
Temperature	kelvin	K
Electric current	ampere	A
Amount of substance	mole	mol.
Luminous intensity	candela	cd

Prefixes Used in the SI System

- Prefixes are used to change the size of the unit.

Table 1.2 | Prefixes Used in the SI System (The most commonly encountered are shown in blue.)

Prefix	Symbol	Meaning	Exponential Notation*
exa	E	1,000,000,000,000,000,000	10^{18}
peta	P	1,000,000,000,000,000	10^{15}
tera	T	1,000,000,000,000	10^{12}
giga	G	1,000,000,000	10^{9}
mega	M	1,000,000	10^{6}
kilo	k	1,000	10^{3}
hecto	h	100	10^{2}
deka	da	10	10^{1}
—	—	1	10^{0}

Prefixes Used in the SI System

Table 1.2 | Prefixes Used in the SI System (The most commonly encountered are shown in blue.)

Prefix	Symbol	Meaning	Exponential Notation*
deci	d	0.1	10^{-1}
centi	c	0.01	10^{-2}
milli	m	0.001	10^{-3}
micro	μ	0.000001	10^{-6}
nano	n	0.000000001	10^{-9}
pico	p	0.000000000001	10^{-12}
femto	f	0.000000000000001	10^{-15}
atto	a	0.000000000000000001	10^{-18}

*See Appendix 1.1 if you need a review of exponential notation.

Section 1.3
Units of Measurement

Scientific Notation:

Exponential Notation (scientific notation)

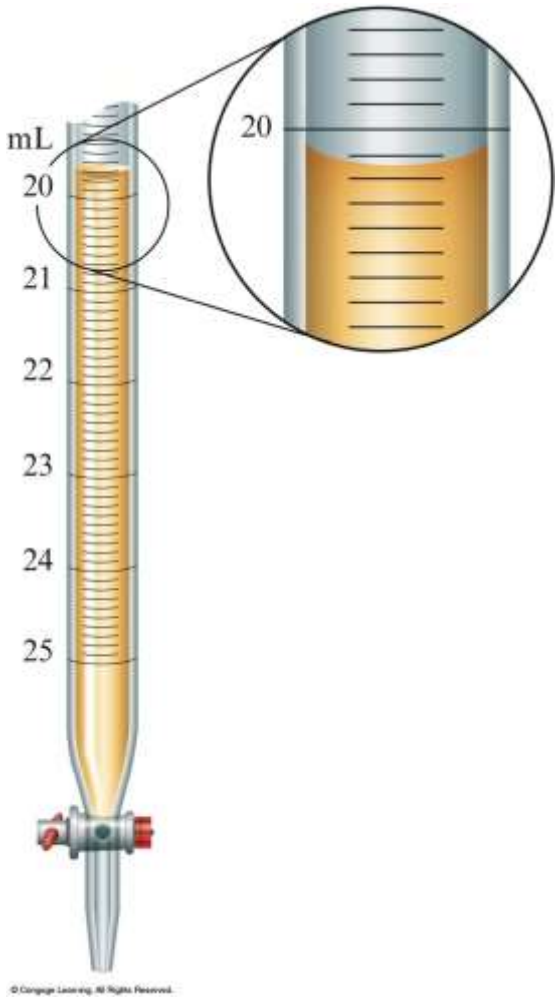
- Example 5000. : 5.000×10^3 4 S.F
- 5000 : 5×10^3
- $38100000000000000 = 3.81 \times 10^{17}$
- $0.000000000914 = 9.14 \times 10^{-10}$
- $5.00X10^3$ 3 S.F
  - 300. written as 3.00×10^2
  - Contains three significant figures.
- Two Advantages
  - Number of significant figures can be easily indicated.

Exponential Notation and Significant Figures:

- 90000 — 1 S.F
- 90000. — 5 S.F
- 9.0000×10^4 — 5 S.F
- 9.0×10^4 — 2 S.F
- $9.00 X 10^4$ — 3 S.F
- 6510000000000000 — 6.51×10^{15} — 3 S.F
- 0.00000000000002710 — 2.710×10^{-17} — 4 S.F
- ( ) x 10^x

Measurement of Volume Using a Buret

- The volume is read at the bottom of the liquid curve (meniscus).
- Meniscus of the liquid occurs at about 20.15 mL.
  - Certain digits: 20.15
  - Uncertain digit: 20.15



Rules for Counting Significant Figures

1. Nonzero integers always count as significant figures.
   - 3456 has 4 sig figs (significant figures).

300000

Rules for Counting Significant Figures

2. There are three classes of zeros.

a. Leading zeros are zeros that precede all the nonzero digits. These do not count as significant figures.

- 0.0000048 has 2 sig figs.

Rules for Counting Significant Figures

b. Captive zeros are zeros between nonzero digits. These always count as significant figures.

- 16.07 has 4 sig figs.
- 0.00807 3 s. f.

- 2.00002001 9 s. f.

Rules for Counting Significant Figures

c. Trailing zeros are zeros at the right end of the number. They are significant only if the number contains a decimal point.

- 9.300 has 4 sig figs.
- 150 has 2 sig figs.
- 23100000 3 s.f.
- ----------
- 410070000 5 s.f.
- 4.10070000 9 s.f.
- 5.00 3 s.f.

Precision and Accuracy

Accuracy

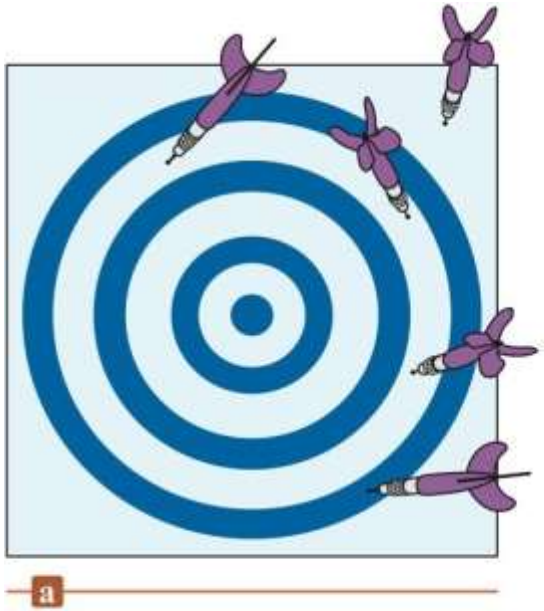
- Nearness of the measurements to the true value.

Precision

- Nearness of the measurements to each other.

Section 1.4
Uncertainty in Measurement

Precision versus Accuracy

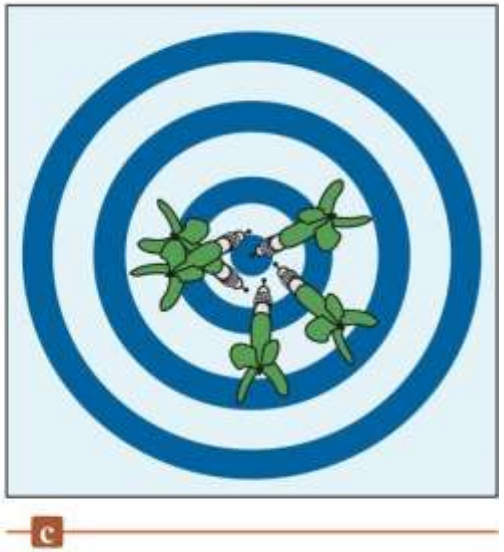


a

Neither accurate nor precise.

b

Precise but not accurate.



c

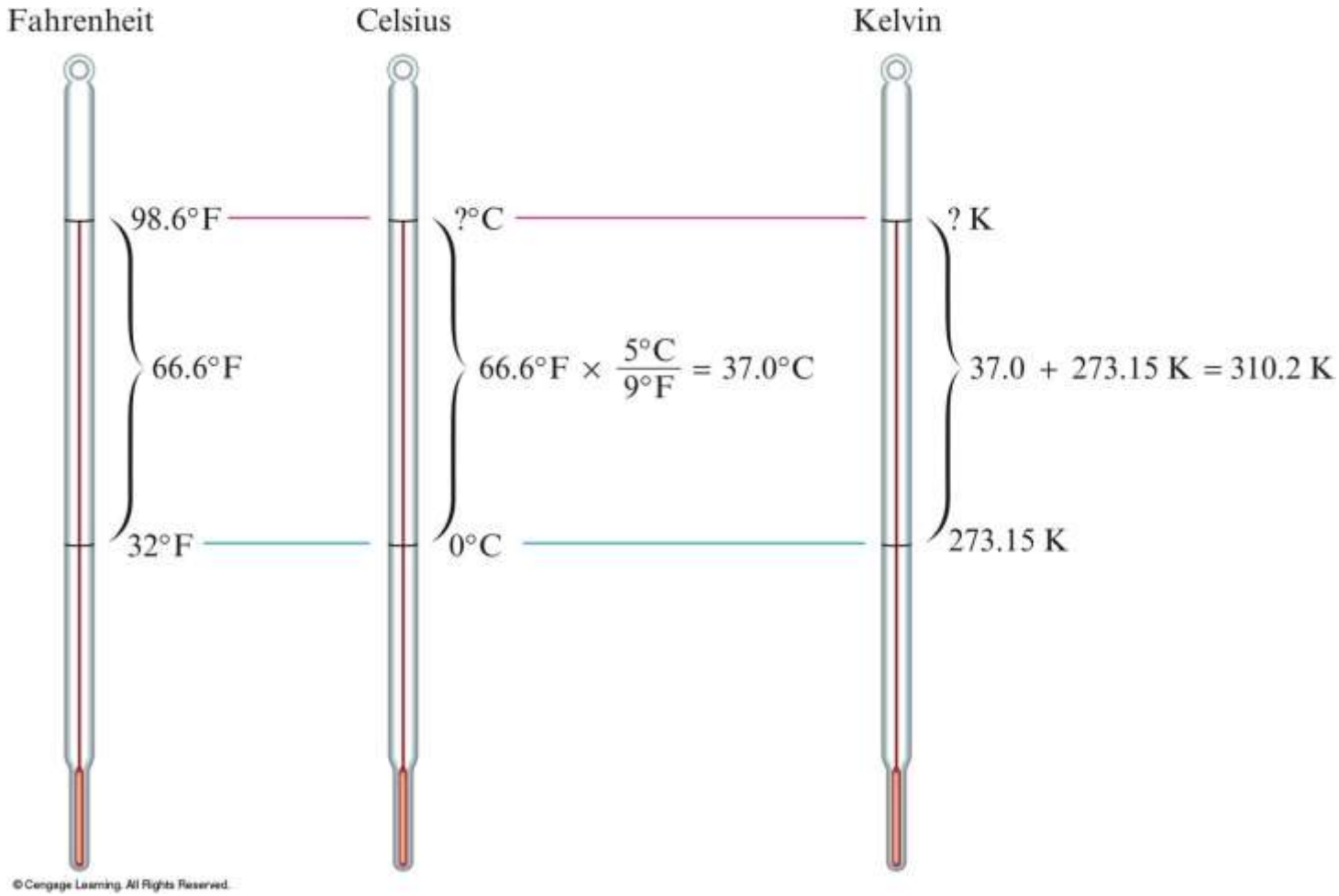
Accurate and precise.

Three Systems for Measuring Temperature

- Fahrenheit
- Celsius
- Kelvin

Section 1.8
Temperature

The Three Major Temperature Scales



Converting Between Scales

$$T_K = T_C + 273.15 \qquad T_C = T_K - 273.15$$

$$T_C = \left(T_F - 32^\circ\text{F}\right)\frac{5^\circ\text{C}}{9^\circ\text{F}} \qquad T_F = T_C \times \frac{9^\circ\text{F}}{5^\circ\text{C}} + 32^\circ\text{F}$$

Example

- What is the F equivalent of 35 ^{o}C?

  35 ^{o}C x 9/5 + 32 = 95 ^{o}F

- What is the equivalent of 151 ^{o}F in K?

  First convert into ^{o}C then to K.

  ^{o}C: (151 – 32) x 5/9 = 66.1 ^{o}C

  K: 66.1 + 273.15 = 339.3 K

Section 1.8
Temperature

EXERCISE!

At what temperature does $^{o}C = {}^{o}F$?

EXERCISE!

- Since ° C equals ° F, they both should be the same value (designated as variable *x*).
- Use one of the conversion equations such as:

$$T_C = \left(T_F - 32^\circ\text{F}\right)\frac{5^\circ\text{C}}{9^\circ\text{F}}$$

- Substitute in the value of *x* for both T_C and T_F. Solve for *x*.

EXERCISE!

$$T_C = \left(T_F - 32^\circ\text{F}\right)\frac{5^\circ\text{C}}{9^\circ\text{F}}$$

$$x = \left(x - 32^\circ\text{F}\right)\frac{5^\circ\text{C}}{9^\circ\text{F}}$$

$$x = -40$$

So $-40^\circ\text{C} = -40^\circ\text{F}$