Announcements

REMINDER:
No Class on Monday (Labor Day) ☹

- ***Office Hours:*** Tues 2:15 – 3:15
  Thur 10:00 – 11:00
  Fri 11:00 – 12:00
- ***Problem Session:*** ***Email VOTE!***
  - *Mon 3:20 – 4:20*
  - *Tues 4:15 – 5:15*
  - *Wed 4:30 – 5:30*

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More History

- Lavoisier
  -18th Century Frenchman
  -Wrote the 1st Chemistry text
  -Considered the "Father of Chemistry"

  Rigorously quantified masses **before and after** a chemical reaction (in a closed system):

  Law of Conservation of Mass

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Still more History

- Proust
  -also an 18th Century Frenchman

  Found that: *regardless of how prepared*, a compound will always have the same composition (same elements present in the same proportion)

  Law of Definite Proportions

BUT: still didn't know ***WHY*** these laws were followed

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along comes: John Dalton

- 19th Century British Schoolteacher
- He found: elements can combine to form *different* compounds when they combine in *different proportions:*

  Law of Multiple Proportions

- Based on these laws, he proposed an:

  Atomic Theory of Matter

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Dalton's Atomic Theory (1808)

- Matter is composed of **<u>Atoms</u>**
- Atoms are *indivisible particles*
- All atoms of an element are identical
- Different elements -> Different atoms
- Atoms retain their identities in chemical reactions
- Compounds are formed by *combining atoms* of different elements in simple whole-number ratios

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Quantitative Measurements

"If you can't measure it, you can't really understand it."

- Measured quantities have ***two parts*** :

  1) ***number***

  2) ***unit***

<u>Example:</u> **2.367** *quarts*

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Units

- ***SI*** Units (***S***ystème ***I***nternational) are the commonly used units for scientific measurements
- ***<u>Base</u>*** <u>SI Units:</u>

  Length: **meter, m**

  Mass: **kilogram, kg**

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Base SI Units

TABLE 1.4 SI Base Units

Physical Quantity	Name of Unit	Abbreviation
Mass	Kilogram	kg
Length	Meter	m
Time	Second	s[a]
Electric current	Ampere	A
Temperature	Kelvin	K
Luminous intensity	Candela	cd
Amount of substance	Mole	mol

[a] The abbreviation sec is frequently used.

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Prefixes

TABLE 1.5 Selected Prefixes Used in the Metric System

Prefix	Abbreviation	Meaning	Example
Giga-	G	10^9	1 gigameter (Gm) = 1×10^9 m
Mega-	M	10^6	1 megameter (Mm) = 1×10^6 m
Kilo-	k	10^3	1 kilometer (km) = 1×10^3 m
Deci-	d	10^{-1}	1 decimeter (dm) = 0.1 m
Centi-	c	10^{-2}	1 centimeter (cm) = 0.01 m
Milli-	m	10^{-3}	1 millimeter (mm) = 0.001 m
Micro-	m a	10^{-6}	1 micrometer (m m) = 1×10^{-6} m
Nano-	n	10^{-9}	1 nanometer (nm) = 1×10^{-9} m
Pico- m	p	10^{-12}	1 picometer (pm) = 1×10^{-12}
Femto- m	f	10^{-15}	1 femtometer (fm) = 1×10^{-15}

More Units

- *<u>Derived</u>* <u>SI Units:</u>

Volume: **m^3**

-more commonly: **cm^3** (cc or mL)

-even more commonly: **Liter, L**

(NOT an SI unit!)

Density: **g/cm^3**

-originally used to define mass

(1 gram = mass of water in 1 cm^3)

Energy Units

Not quite so obvious: $kg\text{-}m^2\text{-}s^{-2}$

-*<u>Gravitational Potential Energy</u>* =

mass x acceleration x length =

kg x m/s^2 x m = ***<u>Joules</u>***

-*<u>Kinetic Energy</u>* = mass x (velocity)^2

= kg x m^2/s^2 = ***<u>Joules</u>***

Dimensional Analysis

- Use *conversion factors* to change units:

1 inch = 2.54 cm

12 inches = 1 foot

1 m = 1000 mm

1 Å = 10^{-10} m

Dimensional Analysis Example

-How many *cm* *are there in* 1.7 miles?

We know: 2.54 cm = 1 inch
12 inches = 1 foot
1 mile = 5280 feet

miles -> feet -> inches -> cm

$1.7\ \cancel{\text{miles}} \times \frac{5280\ \cancel{\text{feet}}}{1\ \cancel{\text{mile}}} \times \frac{12\ \cancel{\text{inches}}}{1\ \cancel{\text{foot}}} \times \frac{2.54\ \text{cm}}{1\ \cancel{\text{inch}}} = \mathbf{273{,}588.48\ cm}$

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Significant Figures (digits)

- There is *measurement uncertainty* associated with **every** measured quantity:

1.7 miles – uncertainty is in last digit

273,588.48 cm – *where is the uncertainty?*

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Sig Figs: Rules

- Measurement uncertainty expressed in last digit
- In *addition and subtraction*: uncertainty in result is limited by value with the greatest ***absolute uncertainty***
- In *multiplication and division*: uncertainty in result is limited by value with the greatest ***relative uncertainty***

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Rounding and Zeros

Rounding

If <5, *round down*
If >5, *round up*
If =5, ***round to nearest EVEN number***

-Only round at the END of a calculation!

Zeros

All zeros are significant ***EXCEPT*** those that **only** locate a decimal point

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Example: Final Rounded Answer

$$1.7 \text{ miles} \times \frac{5280 \text{ feet}}{1 \text{ mile}} \times \frac{12 \text{ inches}}{1 \text{ foot}} \times \frac{2.54 \text{ cm}}{1 \text{ inch}} = \boldsymbol{273{,}588.48 \text{ cm}}$$

-limited to TWO sig figs in result

- ***273,588.48 cm rounds to:***

  270,000 cm

  or

  $\underline{2.7 \times 10^5 \text{ cm}}$ (best!)

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