Monday June 21st – Week 2

Last week

Chapter 1.1 - 1.6 (still need to finish 1.6)

Two homework assignments - due tuesday June 22nd

Quiz due June 23rd

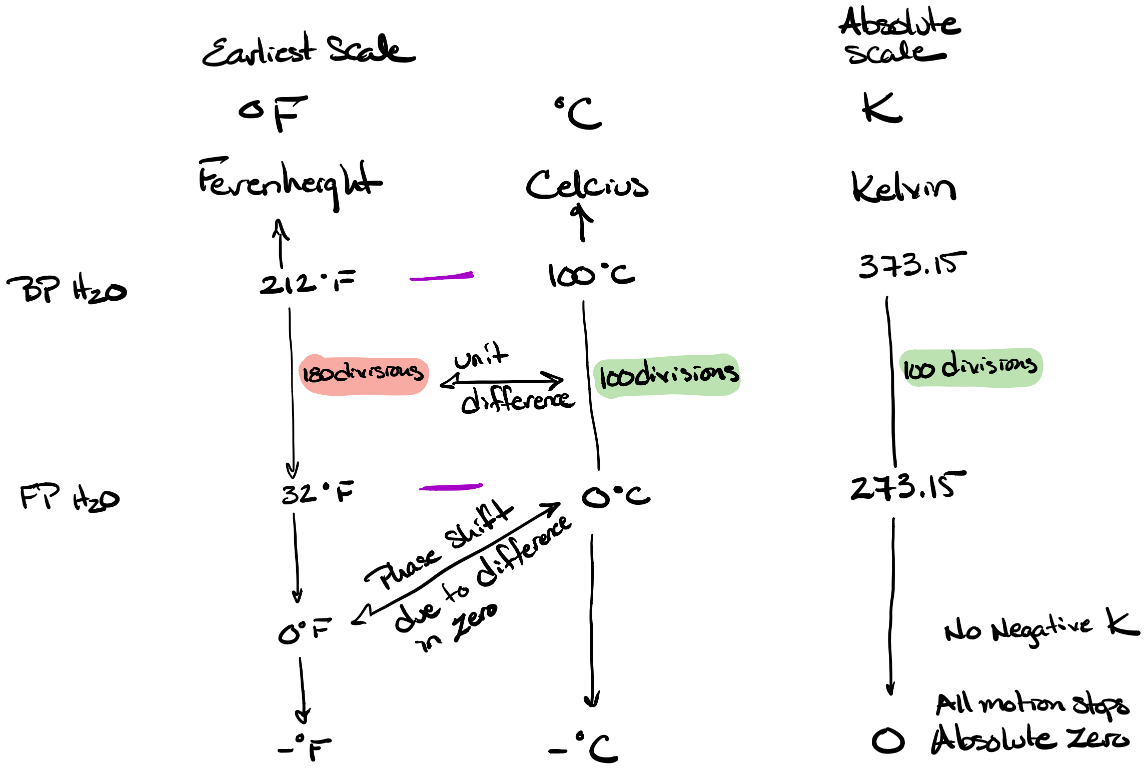
Lab due over the weekend – Density Lab

This week

Pickup end of Chapter 1.6

Start Chapter 2

End Chapter 1.6 Temperature Conversions



Easy First °C ⟷ K

Booth have 100 divisions between BP H_2O & FP of H_2O

$$°C + 273.15 = K$$

$$0°C \longrightarrow K$$

$$\boxed{0°C + 273.15 = 273.15\ K}$$

°C to K Add 273.15 to °C

K to °C Subtrack 273.15 from K to give °C

Example

what is the temp in K of 32.7°C?

$$K = °C + 273.15$$

$$K = 32.7 + 273.15 = 305.85\ K$$

$$\begin{array}{r} 32.7 \\ 273.15 \\ \hline 305.85 \end{array}$$

← Exact (definition)

Round even

$$= \boxed{305.8\ K}$$

What is the temp in °C of a sample that is 72.5 K?

$$°C + 273.15 = K$$

$$\Rightarrow °C = K - 273.15$$

$$\begin{array}{r} 72.\underline{5} \\ -\ 273.15 \\ \hline -\ 200.65 \end{array} \quad \text{exact}$$

$$= \boxed{-200.6\ °C}$$

To convert between °C & °F

$$\cancel{°C} \times \frac{180\ °F}{100\ \cancel{°C}} + 32 = °F$$

<u>Test</u> $0\ °C = 32\ °F$

$$\underbrace{0\ °C \times \frac{180\ °F}{100\ °C}}_{} + 32 =$$

$$0\ °C + 32 = 32\ °F \ ✓$$

Calculate the temp in °F that matches 27.2°C.

$$°C \times \frac{180°F}{100°C} + 32$$

$$\overset{3\ SF}{27.2\,°C} \times \overset{def}{\frac{180\,°F}{100\,°C}} + \overset{Counted}{32} = 80.96\,°F$$

$$\boxed{81.0\,°F}$$

What is the temperature in °C of 425 °F?

$$°C \times \frac{180°F}{100\,°C} + \cancel{32} = °F$$

$$-\cancel{32} \qquad -32$$

$$\cancel{\frac{100°C}{180°F}} \times °C \times \cancel{\frac{180°F}{100°C}} = \left(°F - 32\right) \times \frac{100\,°C}{180\,°F}$$

$$°C = \left(°F - 32\right) \times \frac{100°C}{180°F}$$

$$\left(\overset{3}{425} - \overset{exact}{32}\right)\cancel{°F} \times \overset{def}{\frac{100°C}{180°\cancel{F}}} = 218.33\overline{3}\ °C$$

$$= \boxed{218\ °C}$$

$$°C \times \frac{9}{5} + 32 = °F$$

$$(°F - 32) \times \frac{5}{9} = °C$$

$$\frac{10\cancel{0}}{18\cancel{0}} = \frac{5}{9} = \frac{10}{18} = \frac{5}{9}$$

$$\frac{180}{100} = \frac{9}{5}$$

What if you would like to Convert between °F & K?

$$(°F - 32) \times \frac{100}{180} = °C$$

$$°F \longrightarrow °C + 273.15 \longrightarrow K$$

$$K \xrightarrow{-273.15} °C \xrightarrow{°C \times \frac{180}{100} + 32 = °F} °F$$

How to use % as a Conversion factor

$$\% \text{ percent} = \frac{\text{part}}{\text{whole}} \times \underset{\text{base}}{100}$$

Wine label 12.7 % alcohol by $\underbrace{\text{volume}}_{\text{any units of volume}}$

$$\frac{12.7 \text{ mL alcohol}}{100 \text{ mL wine}} \quad \text{or} \quad \frac{12.7 \text{ gal alcohol}}{100 \text{ gal wine}}$$

A metal alloy is 87% Siver. by $\underbrace{\text{mass}}_{\text{any units of mass}}$.

$$\frac{87 \text{ g Silver}}{100 \text{ g alloy}} \quad \text{or} \quad \frac{87 \text{ lbs Silver}}{100 \text{ lbs alloy}}$$

Equality

87 g Silver = 100 g Alloy

pph % = $\frac{\text{Part}}{\text{whole}} \times 100$

ppt = $\frac{\text{Part}}{\text{whole}} \times 1000$

ppm = $\frac{\text{Part}}{\text{whole}} \times 1{,}000{,}000$

76 % by mass $\frac{\text{76 g Part}}{\text{100 g whole}}$

76 ppm by mass $\frac{\text{76 g part}}{\text{1,000,000 g whole}}$

76 ppb by mass $\frac{\text{76 g part}}{\text{1,000,000,000 g whole}}$

Current CO_2 Concentration

409.8 ppm by volume

$$\frac{409.8 \text{ mL } CO_2}{1{,}000{,}000 \text{ mL air}}$$

A room has a volume 1344 ft³.
How much CO_2 is in the room in ft³ if the concentration is 409.8 ppm by volume?

Road Map

$$\text{ft}^3\ \text{room} \xrightarrow{409.8\ \text{ft}^3\ CO_2 = 1{,}000{,}000\ \text{ft}^3\ \text{room}} \text{ft}^3\ CO_2$$

$$\overset{4}{1344}\ \text{ft}^3\ \cancel{\text{air}} \times \frac{\overset{4}{409.8}\ \text{ft}^3\ CO_2}{1{,}000{,}000\ \text{ft}^3\ \cancel{\text{air}}} = 0.5507712\ \text{ft}^3\ CO_2$$

$$\boxed{0.5508\ \text{ft}^3\ CO_2}$$

Chapter 2.1 - Atomic Theory

Dalton's Atomic Theory 1807

1) Matter is made up of atoms. Atoms are the smallest unit of an element that can participate in a chemical change.

2) Atoms of one type of element all have same mass & same properties

3) Atoms of 1 element unique to that element

4) Compounds are formed of 2 or more elements in <u>whole</u> number ratios.

⟹ The ratio always the same

water $\underline{H_2O}$ not H_3O or H_2O_2

5) Atoms are never created or destroyed in a Chemical Rxn ⟹ Conservation of Mass

Law of Multiple Proportions

When two elements react to form more than 1 compound $A + B = A_xB_y + A_n + B_m$, a fixed mass of one element will react with the other element in a ratio of small whole numbers.

Ex

$Cu + Cl$

Copper Chlorine

fixed mass of Element A

$1g\ Cu + 1.116g\ Cl \longrightarrow$ brown Solid

different

$1g\ Cu + 0.558g\ Cl \longrightarrow$ green Solid

$$\frac{\;\frac{1.116g\ Cl}{1\ g\ Cu}\;}{\;\frac{0.558\ g\ Cl}{1\ g\ Cu}\;} = \frac{1.116g\ Cl}{\cancel{1g\ Cu}} \times \frac{\cancel{1g\ Cu}}{0.558g\ Cl}$$

$$= \frac{1.116g\ Cl}{0.558g\ Cl} = 2$$

twice

this guy down here

1 Cu_mCl_n Green Solid $CuCl$ 1:1 Ratio

Ratio

2 $Cu_mCl_{\underline{\underline{2}}n}$ Brown Solid $CuCl_2$ 1:2 Ratio

fixed

H_2O water

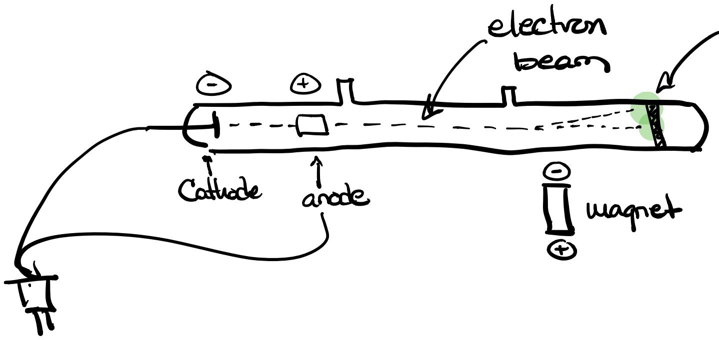
H_2O_2 not water hydrogenperoxide

~~$H_{3.6}O_{2.79}$~~

Always in whole # Ratios
& fixed for specific compounds

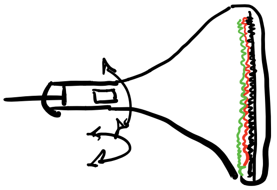
2.2 Evolution of Atomic Theory

1890 J.J Thompson Cathode Ray Tube



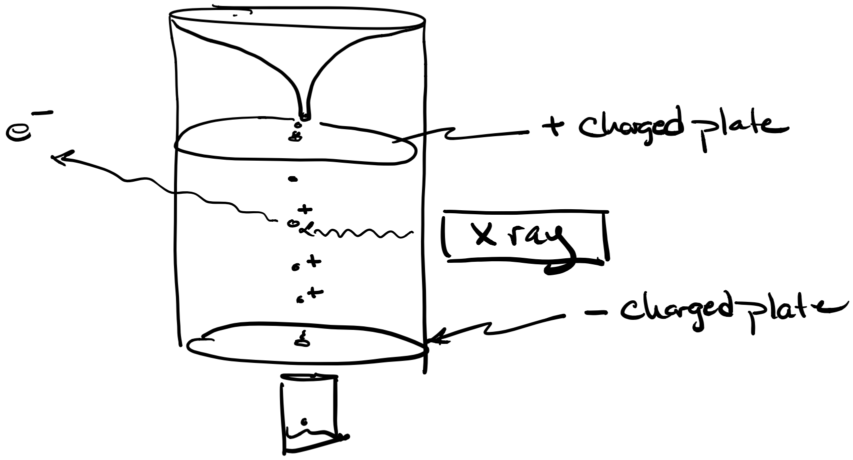
e^- charge

electron is a negatively charged particle



TV set CRT

1909 Robert Millikan "Oil drop"



Drop Changed Speed based on Charge on plates & # of + charges on the drop.

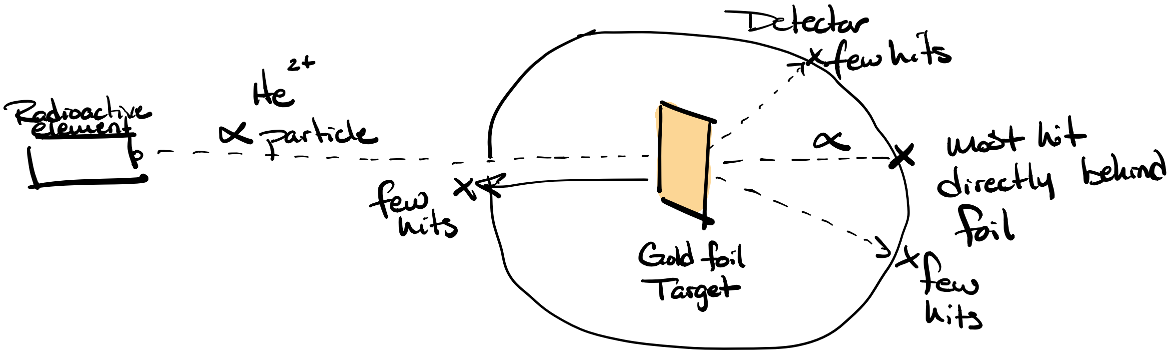
Rate of falling $\underline{1.6 \times 10^{-19}\ \text{Columb}} \times n$ ← whole # intiger value

= Charge on the electron

Charge on e^- $\propto$ mass of e^-

$$\boxed{\text{mass } e^- = 9.107 \times 10^{-31}\ \text{kg}}$$

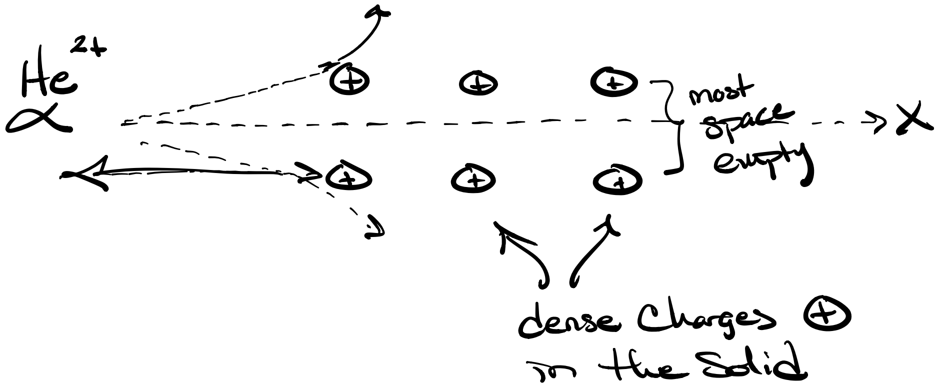
Early 1900's Rutherford



Outcomes

① volume of solid is mostly empty space

② Must be some small + charges in the solid for the He^{2+} to bounce off!



1921 Frederick Soddy ⇒ Nobel Prize

Some atoms of the same element have different masses ⇒ Isotopes

Hydrogen H

	$^{1}_{1}H$	$^{2}_{1}H$	$^{3}_{1}H$
mass	1 amu	2 amu	3 amu
Protons	1 proton	1 proton	1 proton
Neutrons	0 neutrons	1 neutron	2 neutrons

All hydrogen

⇐ potons determin element

3 Isotopes of hydrogen

1932 James Chadwick

Proposed that there were heavy neutral particles in the atoms and called them neutrons

Putting it all together

Experiments & law of definite proportions

$\Rightarrow$ atoms come in whole #'s & fixed proportions

Oil drop

Charge & mass of e^-

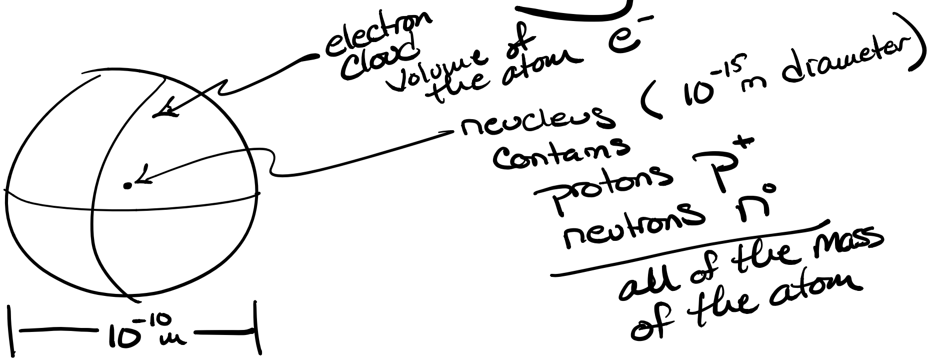
Rutherford

Idea of proton ⊕

Chadwick

neutron ≈ proton but is neutral

2.3 Modern Atomic Theory



$p^+ = 1 \text{ amu} = 1.0073 \text{ amu}$

$n^\circ = 1 \text{ amu} = 1.0087 \text{ amu}$

$e^- = 1/2000 \text{ amu} = 0.00055 \text{ amu}$

$2000\, e^- = \text{mass } \underline{1}\ p^+$