General and Organic Chemistry

C1: Chemical Foundations

Lecture 1

19/oct-/2024

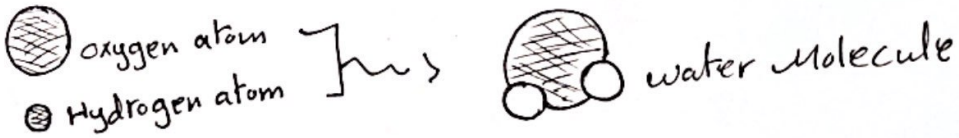
★ General and Organic Chemistry
Ch1

★ Chemistry is used to understand the connection between the macroworld and the microworld of atoms and molecules

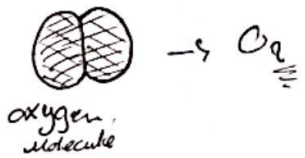
- Matter is composed of tiny Particles called **Atoms**

  The smallest part of an element that exists [or still the same element]

- when two or more atoms join and act as a unit its called a **Molecule**

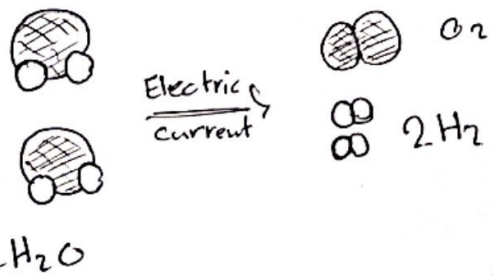


- we use subscripts when more than one atom is in the molecule



- A chemical reaction is :
  - ★A substance changing to another by recognizing the way atoms attach

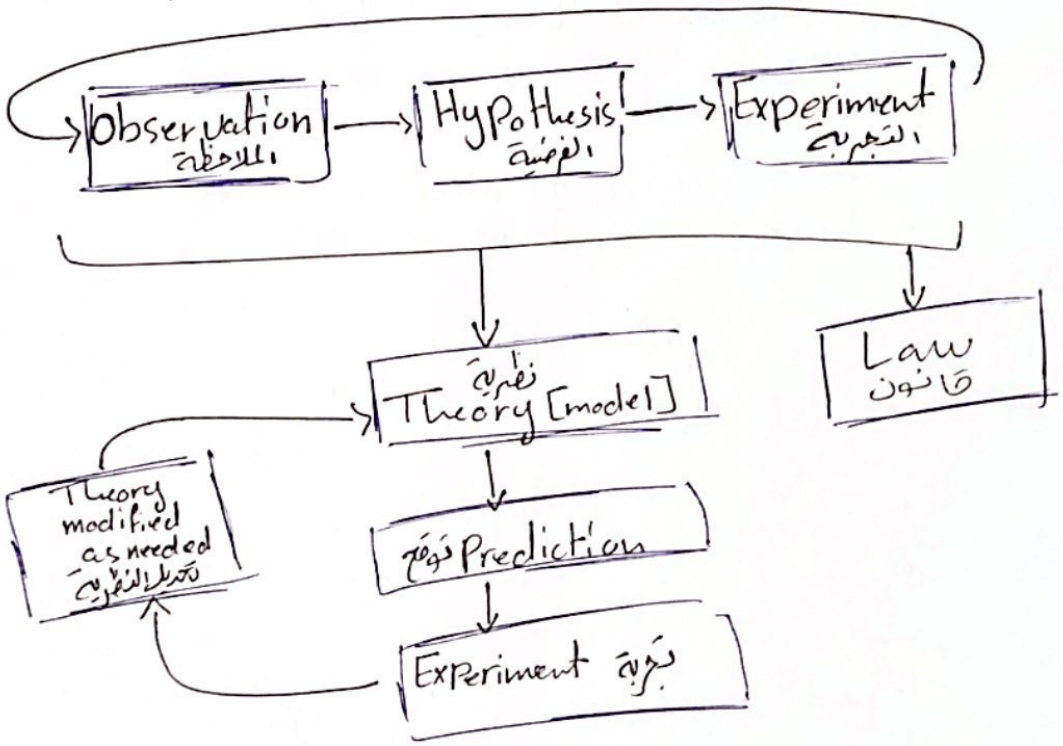
ex:



* Science is a Frame to gain + organize knowledge and we use experimenting along with questions to gain that knowledge

– That requires using "The Scientific Method"

* Steps of the Scientific Method :



* The scientific Models :

① Hypothesis : A Possible explanation for an observation

② Theory (model) : A set of tested hypotheses that gives an over all explanation of some natural Phenomenon

③ Law : A summary of repeatable observed (measurable) behavior

* A quantitive observation consists of:
  - A Number ex: 20 grams
  - A unit

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* Prefixes used to chang the size of the unit:

giga	10^9 G
Mega	10^6 M
Kilo	10^3 k
hecto	10^2 h
dekka	10^1 da
1	
deci	10^{-1} d
centi	10^{-2} c
milli	10^{-3} m
micro	10^{-6} μ
nano	10^{-9} n

Mass ≠ weight

Mass	Weight
↓	↓
resistance to change in state of motion	Force exerted by gravity
[does not change]	[varies]

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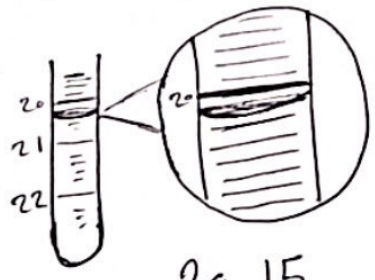
* uncertainty:
  - A digit that must be estimated in a measurement is called uncertain
  - A measurement always has some degree of uncertainty based on the tool
  - we record the certain digits and only the first uncertain one

* Measuring liquid, we read the value at the bottom of the liquid curve [meniscus]

ex:



20.15

Certain ↵ ↳ uncertain ±1

So 20.16 or 20.14

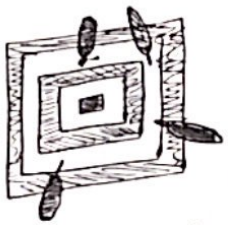
* Percision and Accuracy
دقة صحة

* Accuracy : Agreement of a particular value with the True value

* Percision : Agreement of several measurements of the same quantity to some Degree

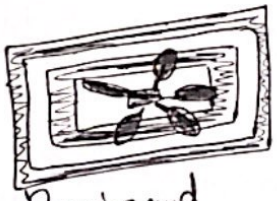
- So you can be Percise but not accurate

ex :



neither Percise nor Accurate

Percise but not Accurate



Percise and Accurate

* Significant figures & Calculations:

- Rules for Counting Significant figures:

(1) Nonzero integers [whole numbers] always count as sigfig

ex: 3456 → has 4 sigfigs

(2) Classes of Zeros:

(a) Leading Zeroes [come before nonzero digits] do NOT count as sig figs

ex: 0.948 → 3 sigfigs ⟹ Just 2 sigfigs

Not sig figs

(b) Captive Zeros [between nonzero digits] They are Always sig figs

ex: 16.07 → 4 sigfigs [All]

(c) Trailing Zeros [at the right end of the number] They ONLY count as a sigfig if there was a decimal Point (if not they don't count)

ex: 9.300 → 4 sig figs [All]

but 15000 → NOT sig figs

2 sigfigs

③ Exact numbers have an Infinite numbere of sigfigs

exc: 1 inch = 2.54 cm, Exactly
↳ ∞ sigfigs
[That means the uncertainty = 0]

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* Using the exponential notation:

Ex: 300. could be written as 3.00×10^2
↳ 3 sigfigs — 3 sigfigs

The advantages:
- Number of sigfigs can be easily indicated
- Fewer Zeroes are needed to write a large or small number

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* Sigfigs in mathematical operations:

- in multiplication and division: The number of sigfigs in the resultant should be the same as the sigfigs number of the Least Persice measurement used in calculation

least Persice means the one with biggest uncertainty ← Persice

exc: 1.342 × 5.5 = 7.381 ≈ 7.4

1.342: uncertainty = ±0.001
5.5: least Persice, uncertainty = ±0.1

- For addition and subtraction:
  (+, −)

The result should have the same number of **decimal** places of the least Precise measurement used in the calculation

ex: 23.445
+ 7.83 → least Precise, has 2 decimal places
= 31.275 ≈ 31.28

★ Converting between units:

① using the equivalence statement that relates the two units

ex: how many inches are in 6.8 ft

if (1 ft = 12 in) → equivalence statement

6.8 ft → in → either $\frac{1\text{ ft}}{12\text{ in}}$ or $\frac{12\text{ in}}{1\text{ ft}}$

we multiply the value we want to convert with the value we want to convert to fro the derived relation so:

$$6.8\text{ ft} \times \frac{12\text{ in}}{1\text{ ft}} = 82\text{ in}$$

So they canced out

★ using sigfig rules is important

Ex2: how many grams are in 4.50 lbs

if (1 kg = 2.20461 lbs, 1 kg = 1000 g) → $\frac{1\text{ kg}}{2.20461\text{ lb}}$, $\frac{2.20461\text{ lb}}{1\text{ kg}}$

$$4.50\text{ lbs} \cdot \frac{1\text{ kg}}{2.20461\text{ lbs}}$$

we use this be we want to convert to kg

$= 2.04\text{ kg}$ → then convert kg to g

we use the sigfig rules

$$2.04\text{ kg} \cdot \frac{1000\text{ g}}{1\text{ kg}} = 2.04 \times 10^3\text{ g}$$

* Temperature :

- There are Three systems for measuring Temperature

- Fahrenheit	32°	the Zero
- Celsius	0°	
- Kelvin → the SI unit	273.15	

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* Converting between Scales :

① $T_K = T_C + 273.15$ → [C → K]

② $T_C = (T_F - 32F^\circ) \cdot \frac{5C^\circ}{9F^\circ}$ → [F → C]

* Note : we use sigfig rules too

* Solve excersises

Ex: when does °C = °F

$$T_C = T_F$$

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

$$\Rightarrow T_F = (T_F - 32F^\circ) \cdot \frac{5}{9}$$

$$\frac{9 \cdot T_F}{5} = (T_F - 32)$$

$$\frac{9 T_F}{5} - T_F = -32$$

$$\frac{4 T_F}{5} = -32$$

$$T_F = -40$$

* Density: The Mass of a Substance Per unit of Volume of The same Substance

* Density = $\frac{\text{mass}}{\text{volume}}$

Common units: $\frac{g}{cm^3}$, $\frac{g}{mL}$

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* Matter: Anything that is:
  - Occupying Space
  - Has a Mass

- There are ~~three~~ Three states of matter:

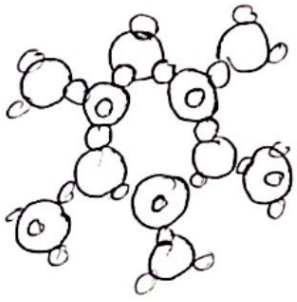
Solid
- * Rigid
- * Has fixed Volume and Shape

Liquid
- * Has definite Volume but no specific shape
- * Assumes the shape of Container

Gas
- * No fixed Volume or Shape
- * Takes the shape and Volume of its Container

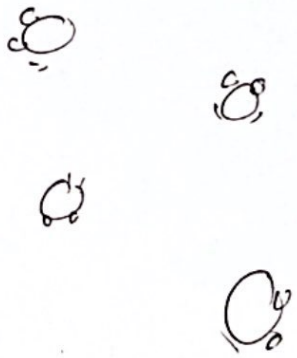
* For water:

as Ice: Molecules are locked into rigid Positions and close together



as Liquid: Molecules Close together but can move to some extent

as Gas: Molecules are far apart and move randomly



* Mixtures: A blend of two or more substances
  - They have varying Compositions

Mixtures

Homogeneous Mixture
↓
Can't distinguish its Parts visibly like a solution
Ex: Coffee
/ Gasoline

Heterogeneous Mixture
↓
Can see and distinguish its Parts visibly
Ex: Rocks in a glass of water
/ oil in water

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* Changing of Matter:

Changing of Matter

* To make it easier to recognize signs of chemical change include:
- release of Bubbles / colors
- release of heat / light
- Combustion
- Rotting

Physical Change
↓
A change in the form of a substance and NOT in its Chemical composition
Ex: Boiling or Freezing water
↓
- can be used to seperate a mixture into pure compounds but won't break compounds into Elements, using:
- Distillation
- Filtration
- Chromatography
etc...

Chemical Change
↓
A Given substance becomes anew one/or more different substances with different Properties and Composition

Ex: Bunsen Burner [Methane CH_4 reacts with oxygen O_2 to form carbon dioxide CO_2 and water

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$