

General and Organic Chemistry

C1: Chemical
Foundations

Lecture 1

19/oct-2024

* General and Organic Chemistry

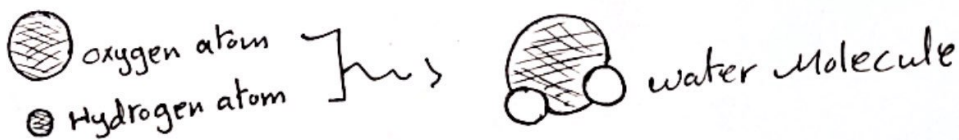
Ch 1

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

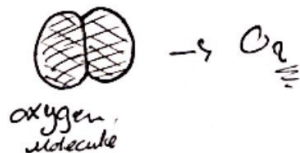
- Matter is composed of tiny particles called **Atoms**

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**

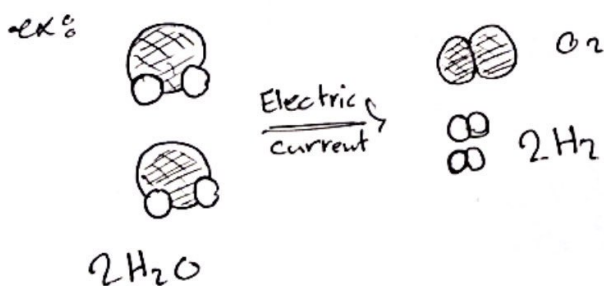


- we use subscripts when more than one atom is in the molecule



- A chemical reaction is :

* A substance changing to another by recognizing the way atoms attach

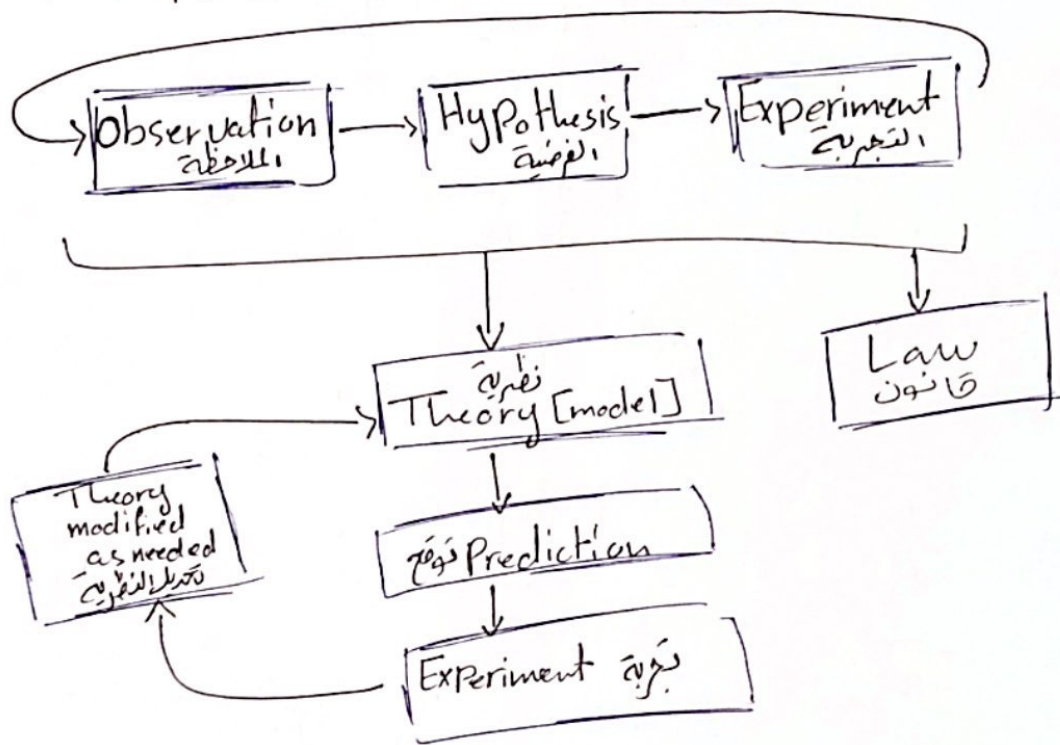


(1)

* 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 quantitative observation consists of :

- A Number ex: 20 grams
- A Unit

* Prefixes used to change the size of the unit :

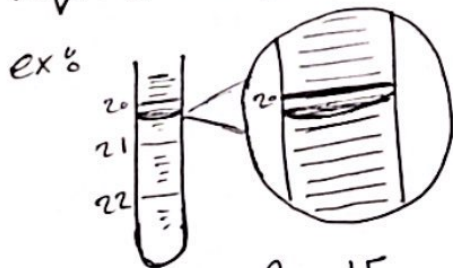
giga	10^9	G
Mega	10^6	M
Kilo	10^3	k
hecto	10^2	h
deka	10^1	da
1		
deci	10^{-1}	d
centi	10^{-2}	c
milli	10^{-3}	m
micro	10^{-6}	μ
nano	10^{-9}	n

Mass \neq weight
↓
resistance to change in state of motion
[does <u>not</u> change]
↓
Force exerted by gravity
[varies]

* 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]



20.15

Certain uncertain

± 1 So 20.16 or 20.14

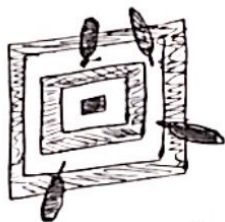
* Precision and Accuracy

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

* Precision: Agreement of several measurements of the same quantity to some degree

- So you can be precise but not accurate

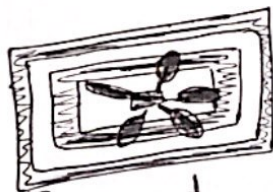
ex:



neither precise nor accurate



precise but not accurate



precise and accurate

* Significant Figures & Calculations :

- Rules for Counting Significant Figures :

① NonZero integers [whole numbers] always count as sig fig

ex: 3456 \rightarrow has 4 sig figs

② Classes of Zeros :

① Leading Zeros [come before nonZero digits]
do NOT count as sig figs

ex: 0.948
Not sig figs \rightarrow sig figs \Rightarrow Just 2 sig figs

② Captive Zeros [between nonZero digits]
they are Always sig figs

ex: 16.07
 \rightarrow 4 sig figs [All]

③ Trailing Zeros [at the right end of the number]
They ONLY count as a sig fig if there was a
decimal point (if not they don't count)

ex: 9.300
 \rightarrow 4 sig figs [All]

but
2 sig figs \leftarrow 15000
 \rightarrow NOT sig figs

⑤

③ Exact numbers have an Infinite number of sig figs

ex: $1 \text{ inch} = 2.54 \text{ cm}$, Exactly
↳ ∞ sig figs

[That means the uncertainty = 0]

~~2.54~~

* Using the exponential notation:

Ex: $300.$ could be written as 3.00×10^2
↳ 3 sig figs 3 sig figs

The advantages:

- Number of sig figs can be easily indicated
- Fewer zeroes are needed to write a large or small number

* Sig figs in mathematical operations:

- in multiplication and division: The number of sig figs in the resultant should be the same as the sig figs number of the least

← least precise means the one with biggest uncertainty

← least precise measurement used in calculation

ex: $1.342 \times 5.5 = 7.381 \Rightarrow 7.4$

uncertainty = ± 0.001

least precise, uncertainty = ± 0.1

⑥

- 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
 $+ 7.83 \rightarrow$ least precise, has 2 decimal places
 $\approx 31.275 \rightarrow 31.28 \checkmark$

*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) \rightarrow equivalence statement
 6.8 ft \rightarrow in \rightarrow 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 from the derived relation so:

So they cancel out

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

*Using sig fig rules is important

Ex: how many grams are in 4.50 lbs

if (1 kg = 2.2046 lbs, 1 kg = 1000 g) $\rightarrow \frac{1 \text{ kg}}{2.2046 \text{ lb}}, \frac{2.2046 \text{ lb}}{1 \text{ kg}}$

$4.50 \text{ lbs} \cdot \frac{1 \text{ kg}}{2.2046 \text{ lbs}}$

we use this \leftarrow because we want to convert to kg

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

we use the sig fig rules \leftarrow

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

(7)

* Temperature °

- There are Three systems For measuring Temperature

- Fahrenheit

- Celsius

- Kelvin → the SI unit

32°

0°

273.15

} the Zero

* Converting between Scales °

$$\textcircled{1} \boxed{T_K = T_C + 273.15} \rightarrow [C \rightarrow K]$$

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

* Note: we use sigfig rules too

* Solve exercises

Ex: when does °C = °F

$$T_C = T_F$$

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

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

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

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

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

$$T_F = -40$$

⑧

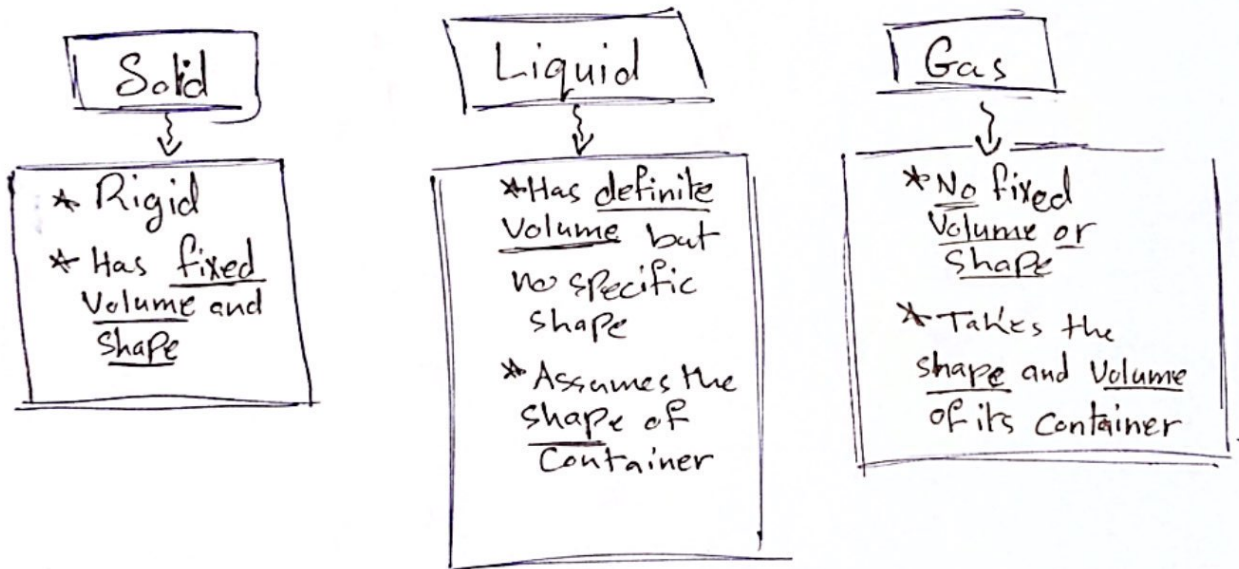
* Density: the Mass of a substance Per unit of Volume of the same substance

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

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

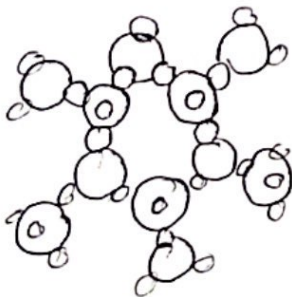
* Matter: Anything that is:
- Occupying Space
- Has a Mass

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



* For water:

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

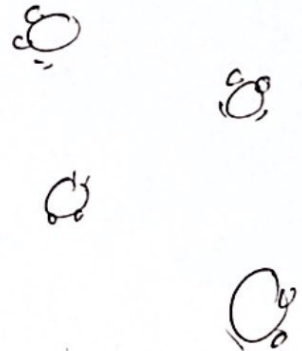


as Liquid: Molecules are close together but can move to some extent

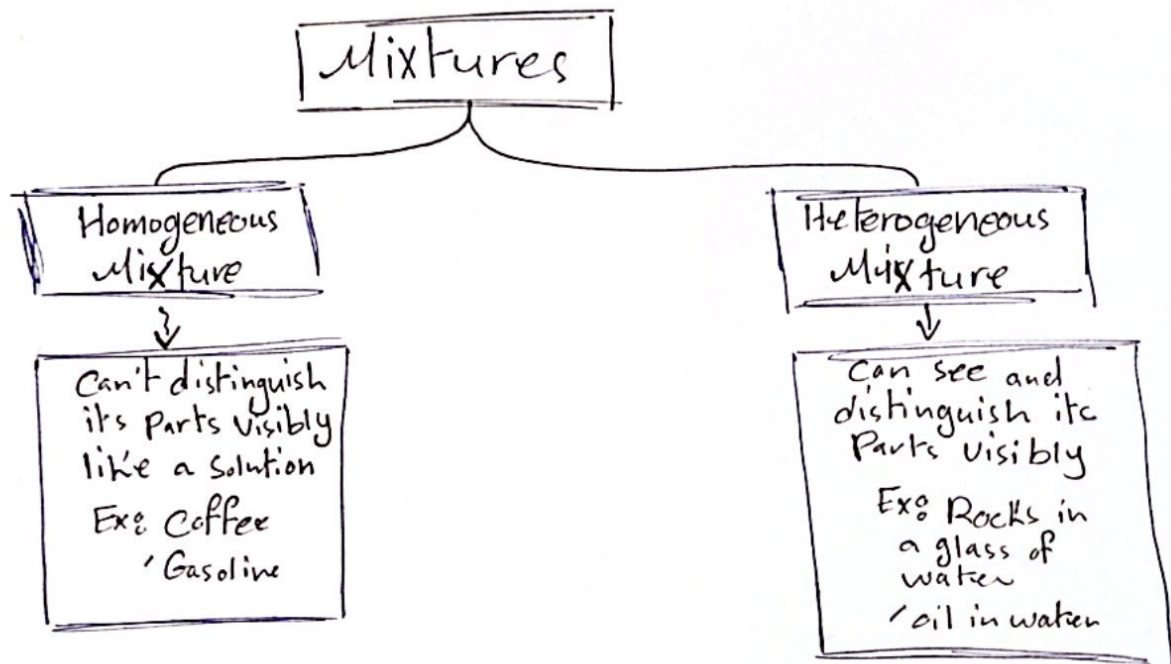


(a)

as Gas: Molecules are far apart and move randomly



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



* Changing of Matter:

