Is Matter Around us Pure?

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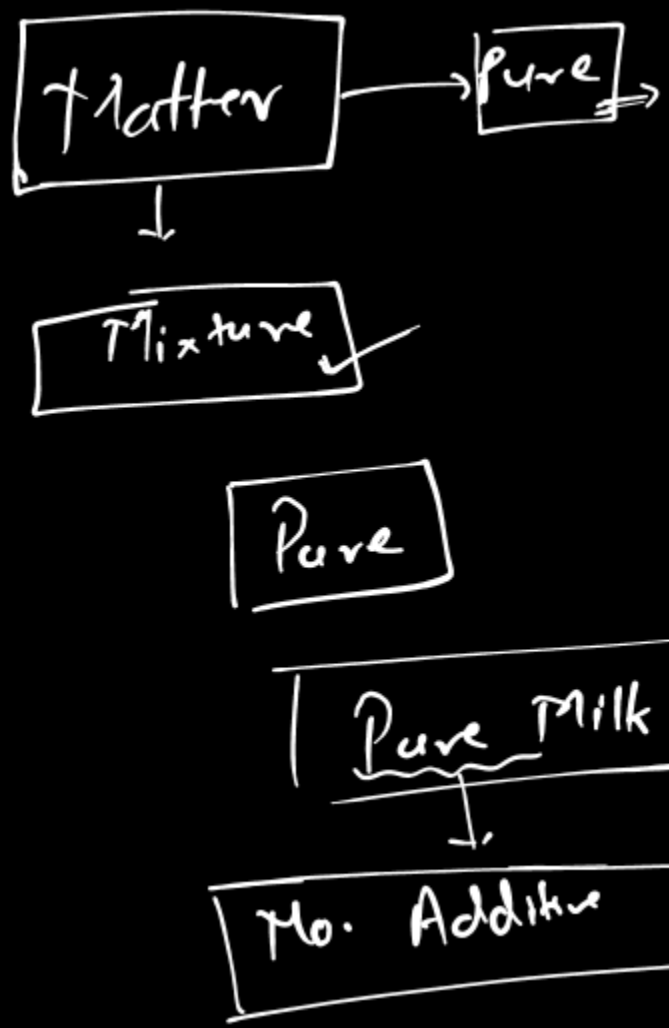

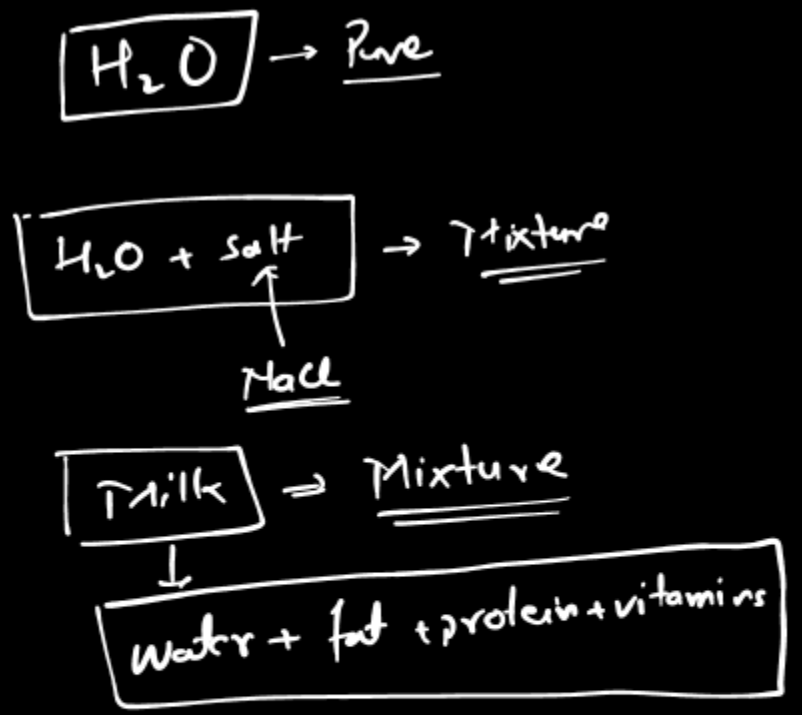

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Matter

Chemical classification

- Pure Substance
  - Elements
    - Same atom
    - eg: Iron
      - Atomic iron
  - Compound
    - Combination of two or more atoms in a fixed ratio
    - Water: H_2O
    - Sugar: $C_{12}H_{22}O_{11}$, $C_6H_{12}O_6$
    - H_4O_2
      - H_3O ×
      - HO_2 ×
      - H_2O_2 ×
    - eg: NaCl → common salt
- Mixture
  - Homogeneous mixture (uniform distribution)
    - Solution
  - Heterogeneous mixture (non-uniform)
    - Colloid
    - Suspension

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Pure Substance

→ Substance that consists of only one type of particle (atoms/molecules)

Eg Gold, Iron, Oxygen, Baking soda., Water, Acid, Diamond,

24k 99.99% pure

(Distilled water)

⇒ Elements and Compounds are pure substance.

(Some type of atom)

(Some type of molecules)

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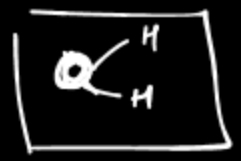
Mixture

$CO_2 + CO + H_2O + C$
$SO_2 + NO_2$



O-H

O=O

O_2

→ when two or more substance are combined in any ratio.

eg: Lemonade, Soft drink, brine (salt water), sugar+water, sea water, blood, air, wood, alloys, soil, vinegar.

100 ml + 1g salt
100 ml + 2g salt
100 ml + 10g salt
} mixture

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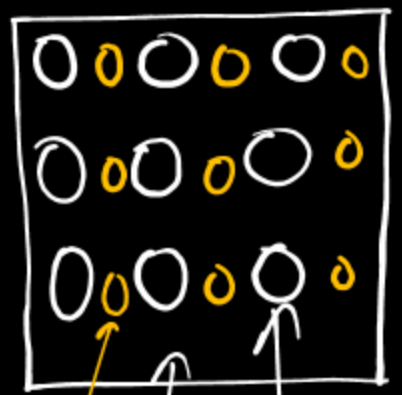
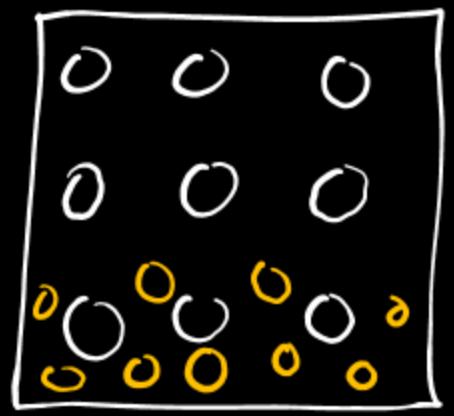
Types of Mixture

- Homogeneous
  - eg: Salt + water solution.
- Heterogeneous
  - Muddy water, sand + water



Particle 1 Particle 2

Uniform distribution of particles



Non-uniform distribution of particles.

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Homogeneous mix.

- Uniform composition throughout
- Components can not be seen through unaided eye
- They can be separated using physical means.

  eg. Salt can be seperated from salt solution thereby evaporation process.

Heterogeneous mix.

- Non-uniform composition throughout the mix.
- Components can be seen through unaided eye.
- The can also be seperated using physical means.

  eg. Sand can be seperated from sand water mixture by Sedimentation & decantation.

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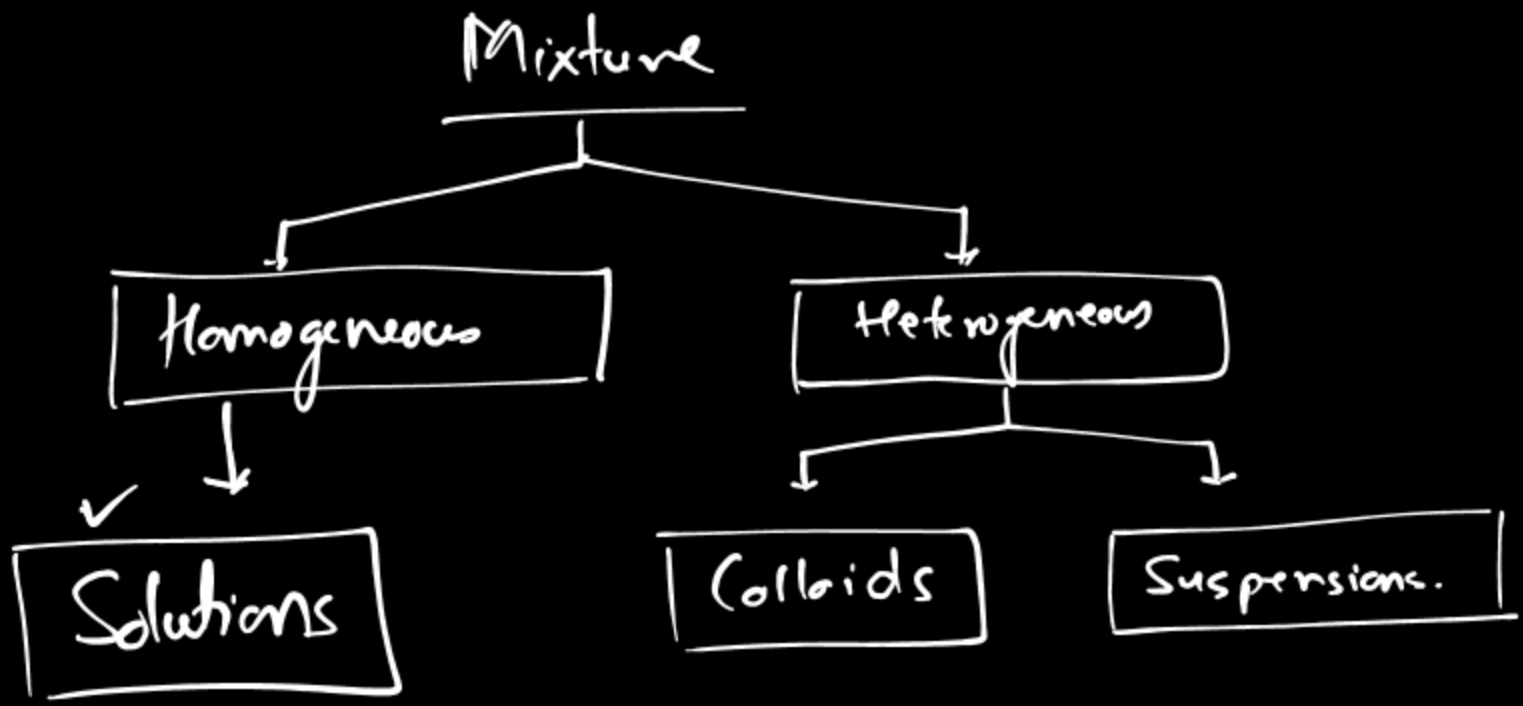
Solutions



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Solutions :

⇒ A solution is a uniform mixture of two or more substances.

⇒ Solutions are homogeneous mixture.

Solutions Types

- Liquid into liquid solution (Honey in water)
- Solid into liquid (salt in water)
- Solid into solid (alloy) eg. → (Metal + another metal/non-metal)
  - ⇒ Brass : Copper + 30% to 50% Zinc (Zn)
  - ⇒ Bronze : Copper (Cu) + 12% tin (Sn)
  - Steel → 99% Iron + Cr + Ni + C

- Gas into Gas (oxygen + Hitrogen)
- Gas into Solid (Hydrogen + metals)

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- Gas into liquid (CO_2 into & water)
  - cold drink

Components of Solution

- Solute + Solvent = Solution
  - Solute: Component which is in lesser amount.
  - Solvent: Component which is more in amount.

Water is universal solvent

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Brass ⇒ Copper + Zinc

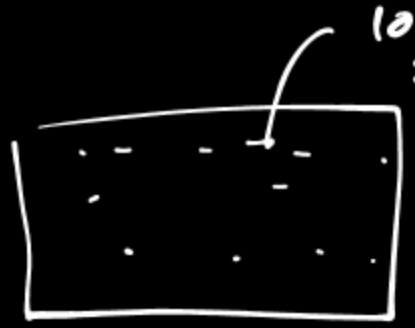
Copper: solvent

Zinc: (Solute)

Salt + water ⇒ Water | Salt

Water: solvent

Salt: Solute



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Why Water is considered universal Solvent?

- (i) Most of the minerals are soluble in water.
- (ii) Water is present in plenty and available on earth.

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Examples of Solution :

→ Sugar in water

→ "iodine in alcohol"

[tincture of iodine]

- antibacterial / antifungal property.

O_2 21%

(O_2 (0.03% → by mass

100kg Air

71.Kg H_2

Protein

→ Aerated drinks [CO_2 in water] ⇒ Carbonated water

Soda water

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→ Air mixture of different gases. (N_2, O_2, (CO_2 0.03%, Ar, Ne, He, H_2) 1%.)

↓

Solution

(Homogeneous mixture)

MEN

78% nitrogen gas

21% Oxygen gas.

(Carbon dioxide [O])

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Properties of solutions :

- → Homogeneous.
- → Particle size is very small (less than 1 nm nanometer)

  invisible to ~~the~~ naked eye.

$$1\ nm = 10^{-9}\ m$$

- → They donot scatter beam of light.

$$1\ nm = 0.000000001\ m$$

$$1\ \mathring{A} = 10^{-10}\ m$$

- → Solute cannot be separated using filteration method.

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Concentration of Solution

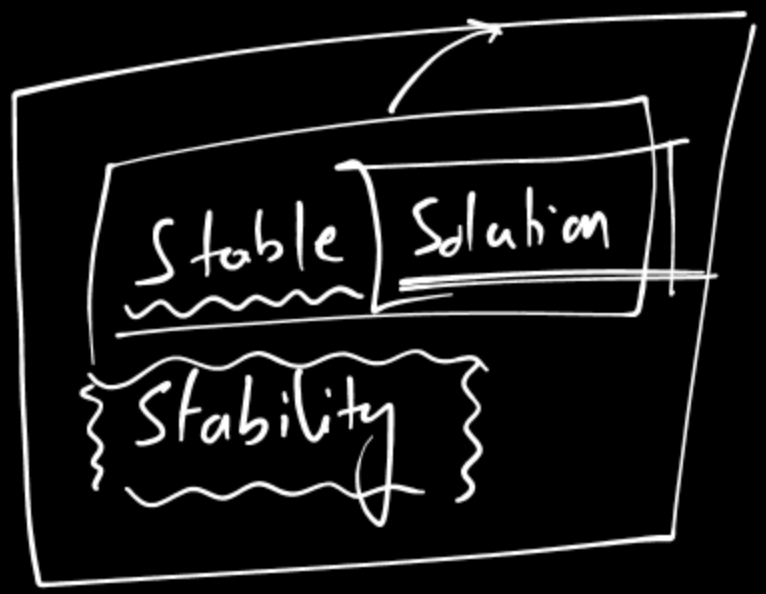
⇒ Dilute solution ✓

⇒ Concentrated solution ✓

⇒ Unsaturated solution ✓

⇒ Saturated solution. ✓

⇒ Solubility



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Dilute Solution :

Solute ↓↓↓ + Solvent ↑↑↑

"The solution in which the amount of solute is much less than the solvent."

eg. 1000 ml water + 1g salt

Concentrated Solution :

"A solution with large amount of solute in the solvent"

eg: 1000 ml water + 20 g salt conc. solution

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Concentration

A — 1 l H_2O + 20 g salt

B — 1 l H_2O + 22 g salt]

C — 1 l H_2O + 23 g salt

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Unsaturated Solution

→ A solution which more solute can be dissolved is called _____.

→ Dil. Solution
→ Conc. solutions

} unsaturated

Saturated Solution ⇒ A solution in which no more solute can be dissolved.

Supersaturated solution ⇒

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Solubility :/→

$\boxed{50g \text{ salt} + 1\,l\,H_2O}$] $\boxed{\text{room temp}}$

50.1g salt + 1 l H_2O

$\boxed{.1g}$ ×

The amount of solute present in the saturated solution at a given temperature is called its solubility..

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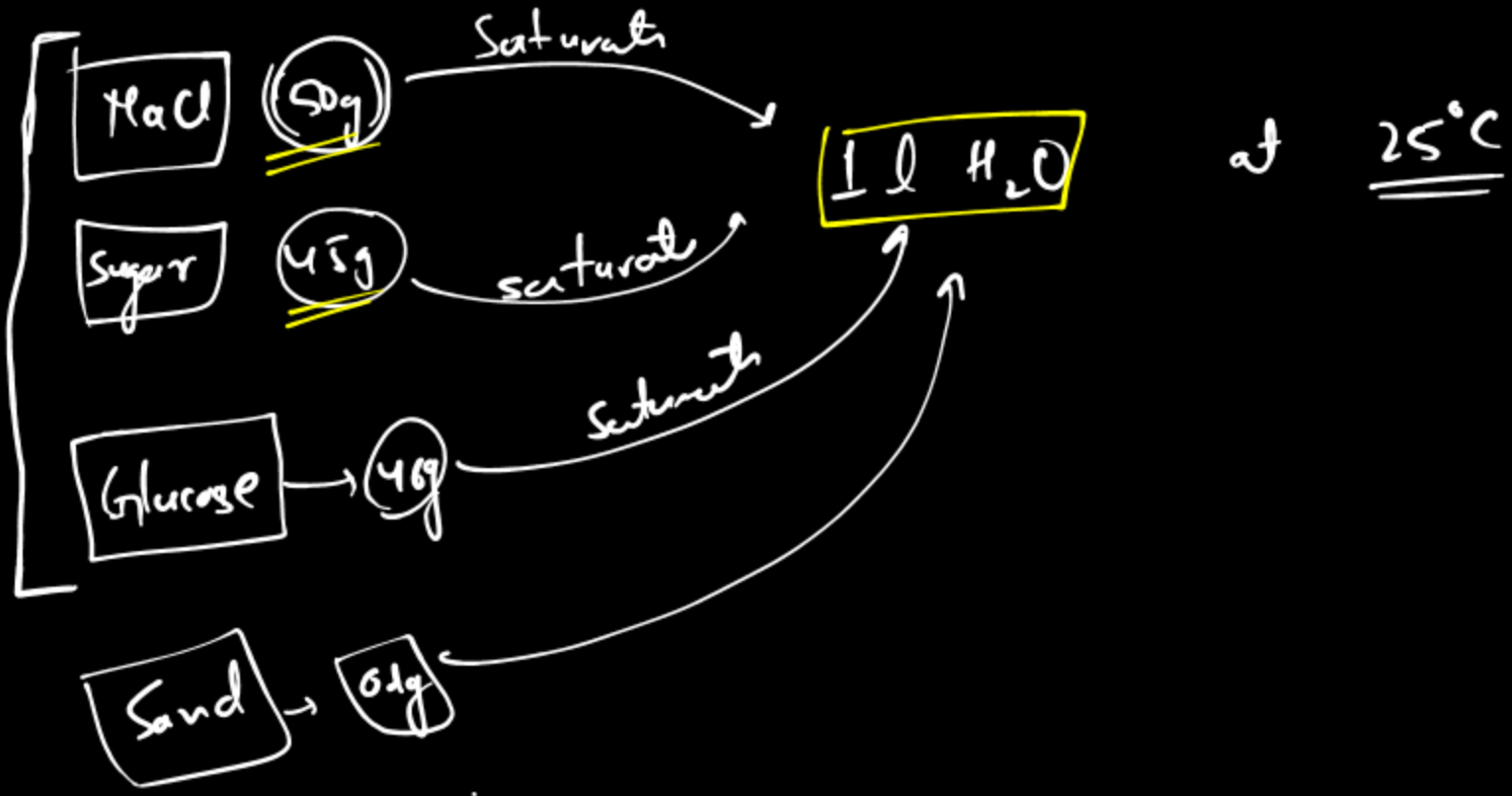

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Concentration of solution [Expression].

Concentration of solution = $\frac{\text{Amount of solute (mass/volume)}}{\text{Amount of solution (mass/volume)}}$

2g

Conc. of solution is 2g/litre.

2g solute per liter of solution

mass/volume

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"The concentration of a solution is the amount of solute (mass/volume) dissolved/present in a given amount of solution (mass/volume)"

$$\text{Concentration of solution} = \frac{\text{Amount of solute (m/v)}}{\text{Amount of solution (m/v)}}$$

2 g/l → 2g solute / litre

$$\Rightarrow \text{Percentage concentration of solution} = \left(\frac{\text{Amt. of solute (m/v)}}{\text{Amt. of solution (m/v)}} \times 100\right)\%$$

m/m

m/m
w/w
v/v
m/v
w/v

$$\left(\frac{2\text{ g}}{100\text{ ml}} \times 100\right)\%$$

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Method 1:→ Mass by Mass percentage conc. of solution = $\left(\frac{\text{Mass of solute}}{\text{mass of solution}} \times 100\right)\%$

Weight

2: Mass by volume percentage conc. of solution = $\left(\frac{\text{Mass of solute}}{\text{Volume of solution}} \times 100\right)\%$

3: Vol. by Vol. percentage conc. of solution = $\left(\frac{\text{Vol. of solute}}{\text{Vol. of solution}} \times 100\right)\%$

V/V

W/W

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Other methods: Molarity, molality, Normality, formality, ppm, etc

Q. A solution contains 40 g of common salt in 320 g of water. Calculate the concentration in terms of mass by mass percentage (w/w) (m/m) of solution.

mass of solute = 40 g.

mass of solvent = 320 g.

mass of solution = 320 + 40 = 360 g.

m by m percentage = $\frac{40\text{ g}}{360\text{ g}} \times 100$ %

= 11.1%

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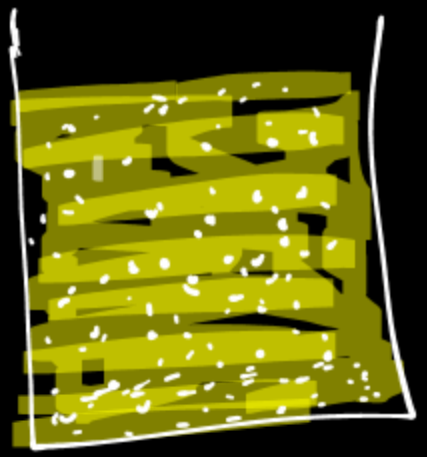
Suspension

⇒ It is a heterogeneous mixture in which solute particles do not dissolve, but remain suspended throughout the bulk of the medium / solvent.

eg: Sand in water,
Chalk in water
Dust in air
Smoke in air



1 mole = 6.022×10^{23} entities

1 dozen = 12 entities

1 gross = 144 entities

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Properties of Suspension :→

→ Heterogeneous mixture.

→ Particles of solute in suspension can be seen through unaided eye.

→ The particles of suspension (if particle size is small. Smoke particle / dust particles) they scatter a beam of light and makes its path visible through the suspension. (Tyndall effect)

→ Suspension is unstable : i.e. when left undisturbed, particles settles down. [precipitation]

↳ Also, they don't show Tyndall Effect. "Opaque"

→ Solute particles of suspension can be filtered out. (& separated by filtration method)

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Colloidal Solution (Colloid)

→ Colloid is a heterogeneous mix. of two or more substances in which size of particle/solute lie inbetween solution and suspension.

eg: milk, cream, fog, mist,

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Properties:

→ Hetero.

→ Particles cannot be seen through unaided eye.

→ They show Tyndall effect..

→ Colloids are stable: Particles do not settles down, when left undisturbed.

→ We cannot separate particles using filtration (?)

To filter colloid particles we use "centrifugation method"

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Solution

Colloid

Suspension

Components of colloid

- **Dispersed Phase** (≡ Solute): The dispersed particle or solute like component
  - may exist in solid / liquid / gas.
- **Dispersing medium** (≡ Solvent): The medium in which the solute like particles are spread / dispersed.
  - may exist in solid / liq. / gas.

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Types of Colloid

Based on physical states of dispersing medium & dispersed phase.

Type	medium	phase	eg:
Aerosol	Gas	Liquid / Solid	mist, perfume, Smoke
Foam	Gas	Liquid	Shaving foam, whipped cream.
Emulsion	Liquid	Liquid	⇒ Milk, mayonnaise, face cream
Sol	Liquid	Solid	mud, paint, milk of magnesia [$Mg(OH)_2$]

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Type	Phase	medium	eg:
Solid foam	Gas	Solid	Styrofoam, sponge, pumice, rubber.
Gel	Liquid	Solid	Jelly, Gelatin, butter, cheese.
Solid sol	Solid	solid	Sparkeling gemstones

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Physical and Chemical Change (Re

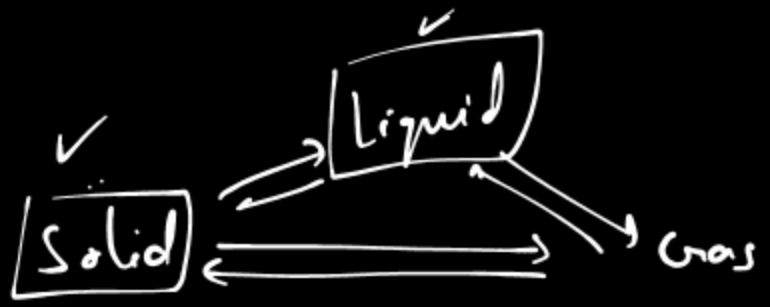
Physical Change

- Colour
- melting point
- fluidity
- density
- state

} Physical property

Eg: Interconversion of states

H_2O



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Chemical change (Irreversible process)

$H_2O(l) \xrightarrow{\text{heat}} H_2O(g)$ [Physical change]

$H_2O(l) \xrightarrow[\text{(electricity)}]{\text{[burn]}} H_2 \uparrow + O_2 \uparrow$ [chemical change]

Solid Wax $\xrightarrow{\text{heat}}$ Liquid wax [Physical change]

$\xleftarrow{\text{cool}}$

Solid Wax $\xrightarrow{\text{burn}}$ $CO_2 + H_2O +$ energy [chemical change]

$\xleftarrow[\text{X}]{\text{cool}}$

Chemical change = Chemical reaction

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Melting ≡ fusion

Molten

m/v $\frac{m}{V}$

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Pure Substance

Element:

→ basic form of matter.

→ 118 elements

→ 92 Naturally occuring

Remaining → artificial element

→ "They are made up of same type of atoms"

"It can not be broken down into simpler substance by chemical process."

Eg: H, He, Li, C, O, Fe, Si, Cr, Mn, Cu, Co, Ag, Au.

∅ → F, P, N

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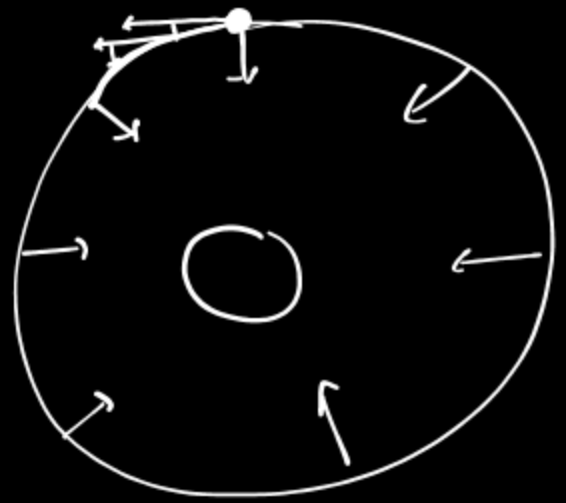

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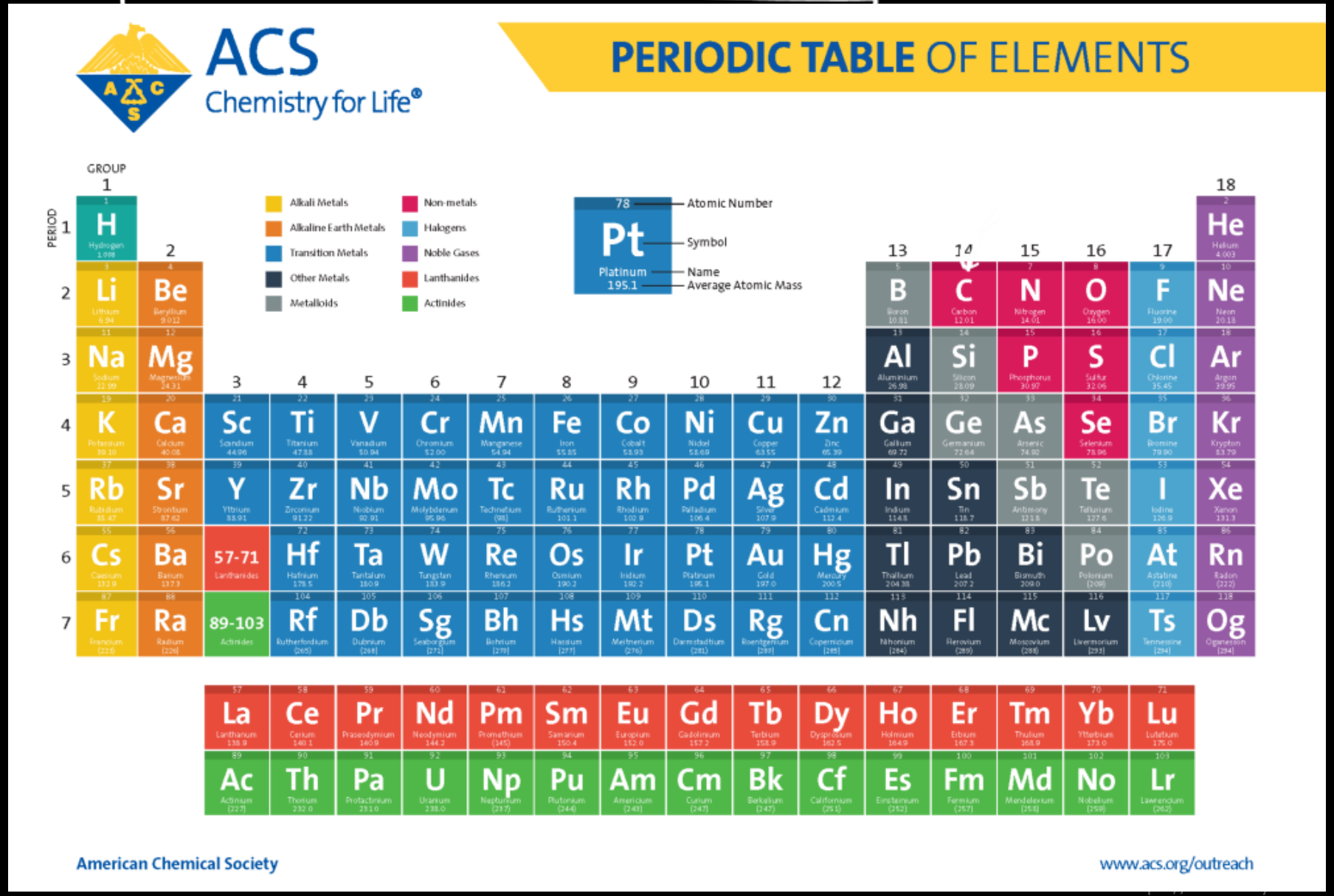
Elements

- 7 Metals
- 91 - metals



Elements

Metals

91 - metals

⇒ Sonorous

⇒ Malleable ✓

⇒ Ductile ✓

⇒ Solid (except Hg) (R.T.)

⇒ Shiny (grey/silverish) ✓

→ Good conductor (Heat & Electricity)

Metalloid

7 - metalloid

→ Properties lies in between metals and non-metals

↓

Semi-conductors

Non-metal

20 non-metals

⇒ Solid and Gas state (except Br liq. at RT)

→ Not shiny except Iodine.

→ Bad conductor of Heat and electricity (exception graphite)

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Compounds :

"Two more elements combined in a fixed ratio."

Pure substance

CO_2 , H_2O , **NaCl** , $C_{12}H_{22}O_{11}$

Molecule → Smallest particle of a compound, which has all the properties of the compound.

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