



Introduction to Solutions



Recall:

MATTER

PURE SUBSTANCES

Elements (gold)

Compounds (NaCl)

- both are uniform in appearance

MIXTURES

Heterogeneous (granola)

- components are visible

Homogeneous (tea)

- uniform in appearance



- What is a solution?
- A mixture in which only one phase is visible.



Solutions

Characteristics of a solution:

- homogenous mixture
- transparent (clear)
- may be coloured
- Dissolved particles are very small
- Can be SOLID, LIQUID OR gas
- Ex. Salt water

Components of a solution

- **Solute** – the substance that is being dissolved in a solvent
e.g. sugar
- **Solvent** – the medium in which a solute is dissolved (often a liquid)
*in aqueous solutions, water is the solvent. Recall: 'aq' as a subscript in word equations



Solutions

- When water is used as a solvent, the solutions are called aqueous solutions

e.g. $\text{NaCl}_{(aq)}$ - solid in a liquid

$\text{C}_2\text{H}_5\text{OH}_{(aq)}$ - liquid in a liquid

- More solutions terminology

- ✓ When a solid dissolves in a liquid solvent we say that it is SOLUBLE in that solvent
- ✓ If the solute does not substantially dissolve in a given liquid we say that it is INSOLUBLE
- ✓ When two liquids dissolve in each other they are said to be MISCIBLE (usually the liquid present in the smaller quantity is regarded as the solute)
- ✓ IMMISCIBLE liquids will not dissolve in each other

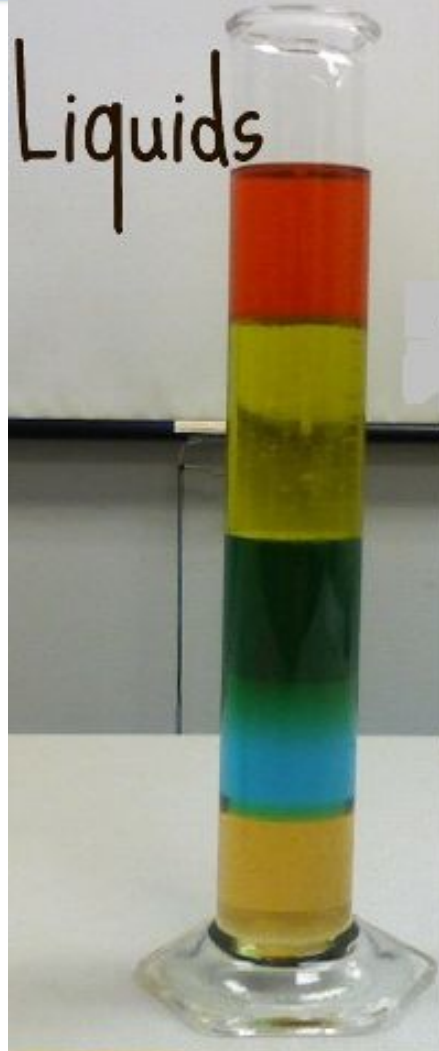


MISCIBLE





IMMISCIBLE



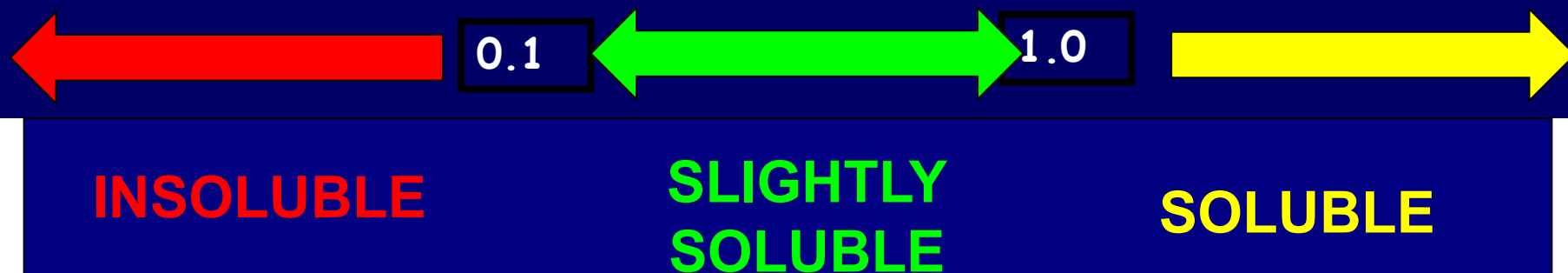


Solutions can come in many states of matter

Solute	Solvent	Solid	Liquid	Gas
Solid		Carbon in Iron (steel)	Sugar in Water (juice)	Particulate matter in air (e.g. dust in air)
Liquid		Hg in Silver (dental filling)	Acetic Acid in Water (vinegar)	Water vapour in air (humidity)
Gas		H ₂ dissolved in metals	CO ₂ in water (carbonated water)	Oxygen in nitrogen (the atmosphere)

SOLUBILITY

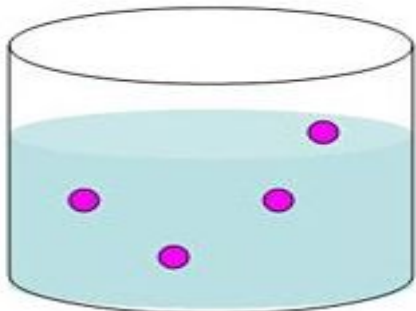
- Solubility = how much a solute dissolves
- Measured in g/100mL
- If Soluble, solubility $> 1\text{g}/100\text{mL}$
- If Insoluble, solubility $< 0.1\text{ g}/100\text{mL}$
- If Slightly soluble, solubility is between $0.1\text{ g}/100\text{mL}$ and $1\text{g}/100\text{mL}$



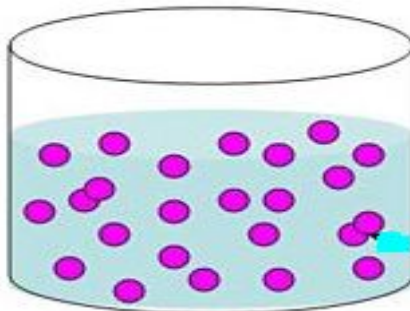


SOLUBILITY AND SATURATION

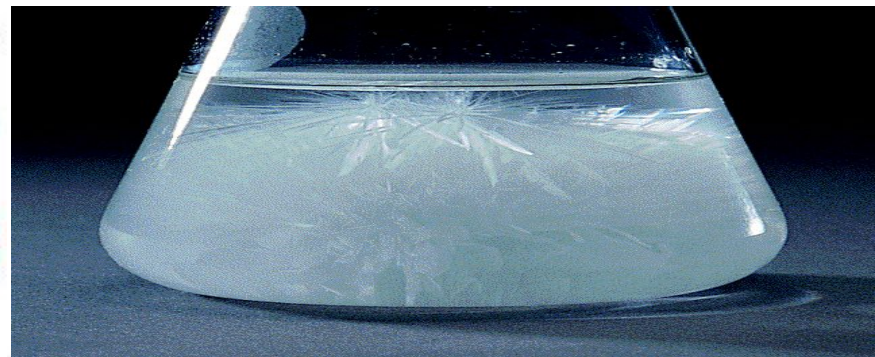
- **Unsaturated solution:**
 - MORE solute can dissolve
- **Saturated solution:**
 - NO MORE solute can dissolve (maximum)
- **Supersaturated solution:**
 - - MORE than the MAXMIUM solute



Unsaturated solution



Saturated solution

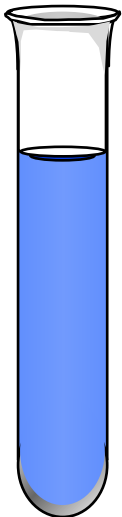




Solubility

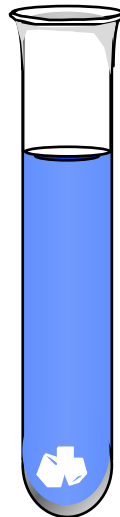
UNSATURATED SOLUTION

more solute
dissolves



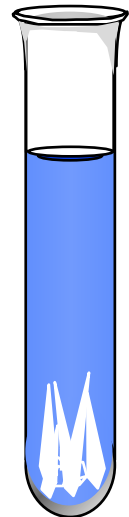
SATURATED SOLUTION

no more solute
dissolves



SUPERSATURATED SOLUTION

becomes unstable,
crystals form



concentration



Alloys – solid solutions

- ❑ Alloys are solutions formed by dissolving one solid in another. Steel is an alloy containing iron, carbon and other elements such as Mn, Ni and Cr to help improve strength and durability
 - ✓ Chrome-moly is a steel alloy usually used for bicycle frames
 - ✓ Dental fillings are a mix of metals such as mercury, silver, copper and tin.
- ❑ Other properties of solutions
 - ❑ Electrolytes – solutions that conduct electricity because they contain ions
 - ❑ Non-electrolytes – do not conduct electricity
 - ❑ Acidic – $\text{pH} < 7$, contain H^+ ions, litmus paper ☐ red
phenolphthalein ☐ stays clear, bromthymol blue ☐ yellow
 - ❑ Basic – $\text{pH} > 7$, contain OH^{-1} ions, litmus paper ☐ blue
phenolphthalein ☐ pink, bromthymol blue ☐ stays blue
 - ❑ Neutral – $\text{pH} = 7.0$, bromthymol blue ☐ green