

SOLUTIONS-1

SOLUBILITY

Dr. Sapna Gupta

SOLUTIONS

- Solutions = solvent (higher quantity) + solute (smaller quantity)
- Two substances that are soluble will look homogeneous; two substances that don't mix are immiscible and will look like heterogeneous mixtures.
- Solute and solvent can be of any phases.

TABLE 13.1

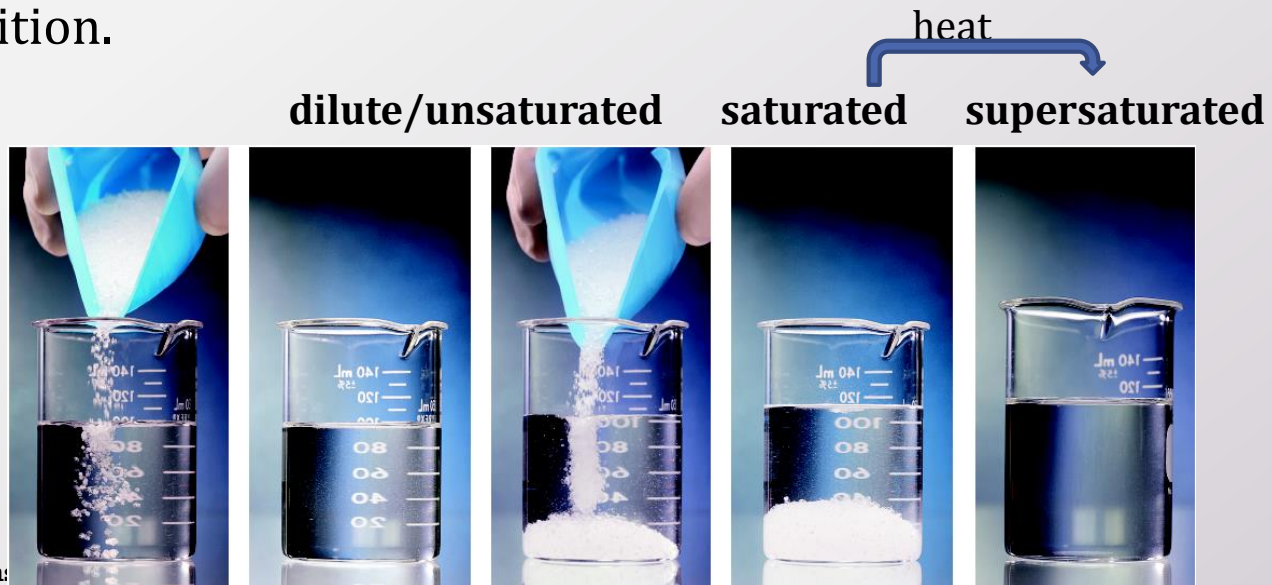
Types of Solutions

Solute	Solvent	State of Resulting Solution	Example
Gas	Gas	Gas*	Air
Gas	Liquid	Liquid	Carbonated water
Gas	Solid	Solid	H ₂ gas in palladium
Liquid	Liquid	Liquid	Ethanol in water
Liquid	Solid	Solid	Mercury in silver
Solid	Liquid	Liquid	Saltwater
Solid	Solid	Solid	Brass (Cu/Zn)

*Gaseous solutions can only contain gaseous solutes.

TYPES OF SOLUTIONS

- Dilute (unsaturated) – small amount of solute in solvent. Its possible to dissolve more solute.
- Concentrated – has more solute than dilute solution but not to the maximum solubility.
- Saturated – maximum amount of solute at a given temperature (This amount is termed the solubility of the solute.)
- Supersaturated – more solute than a saturated solution hence is an unstable condition.



IM FORCES IN SOLUTIONS

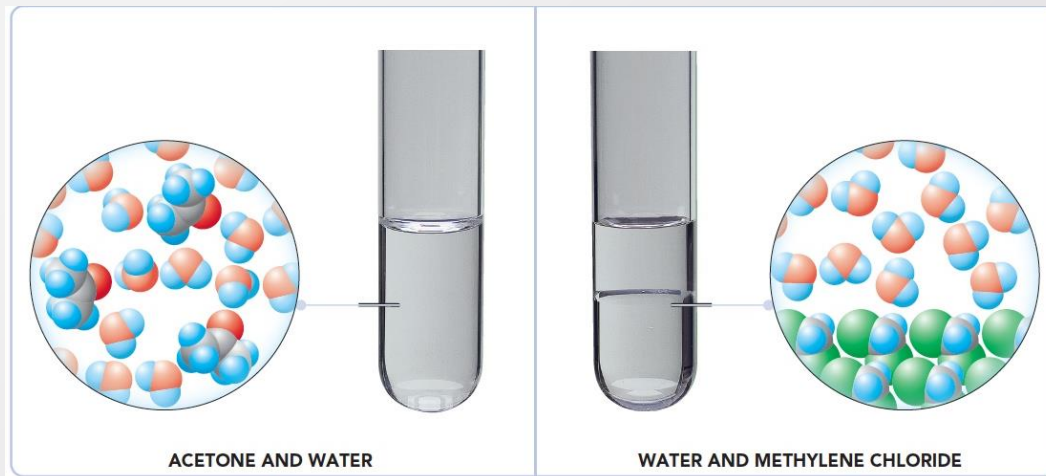
- When solutions are formed IM forces are key.
- “LIKE DISSOLVES LIKE”
- Polar substances dissolve in polar solvents
- Non polar substances will not dissolve in polar solvents

H_2O and CH_3COCH_3 (soluble)

Both have dipole-dipole interactions

H_2O and CH_2Cl_2 (insoluble)

dipole-dipole and dispersion forces



EXAMPLE: SOLUBILITY

Problem: Identify the solute(s) and solvent(s) in the following solutions and indicate if they will be soluble in each other.

- 80 g of Cr and 5 g of Mo
- 5 g of MgCl_2 dissolved in 1000 g of H_2O
- 39% N_2 , 41% Ar, and the rest O_2

Solution:

- The 5 g of Mo is the solute; the 80 g of Cr is the solvent.

Both are metals – they can be mixed – form an alloy.

- MgCl_2 is the solute; H_2O is the solvent.

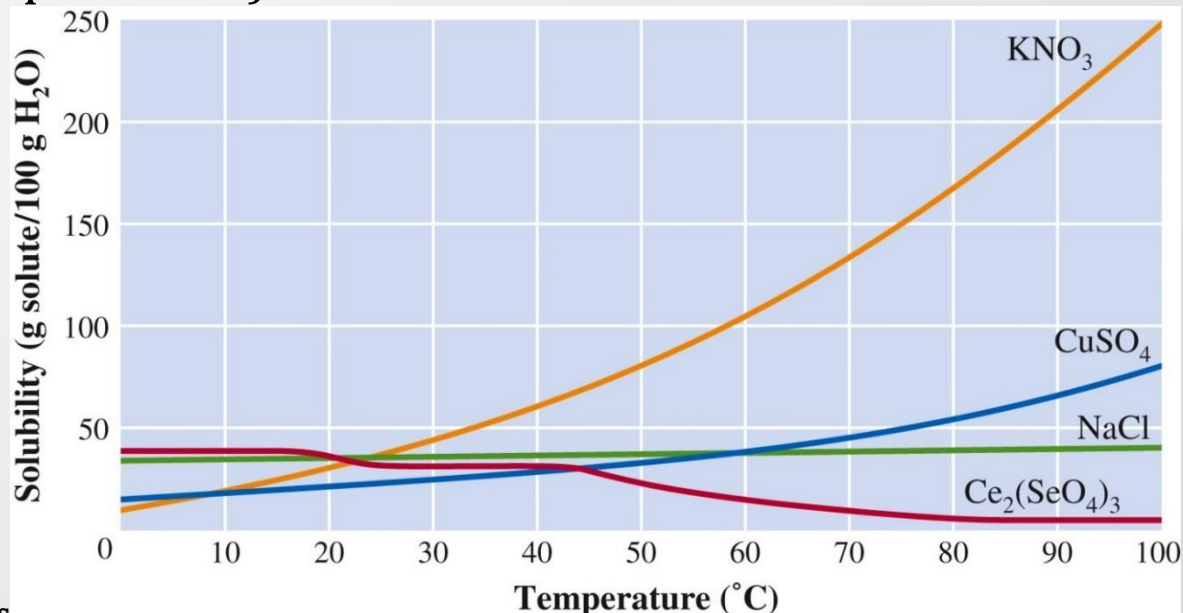
MgCl_2 is ionic and water is polar so both will dissolve.

- O_2 and N_2 are the solutes; Ar is the solvent.

All are non polar gases so they should form a mixture.

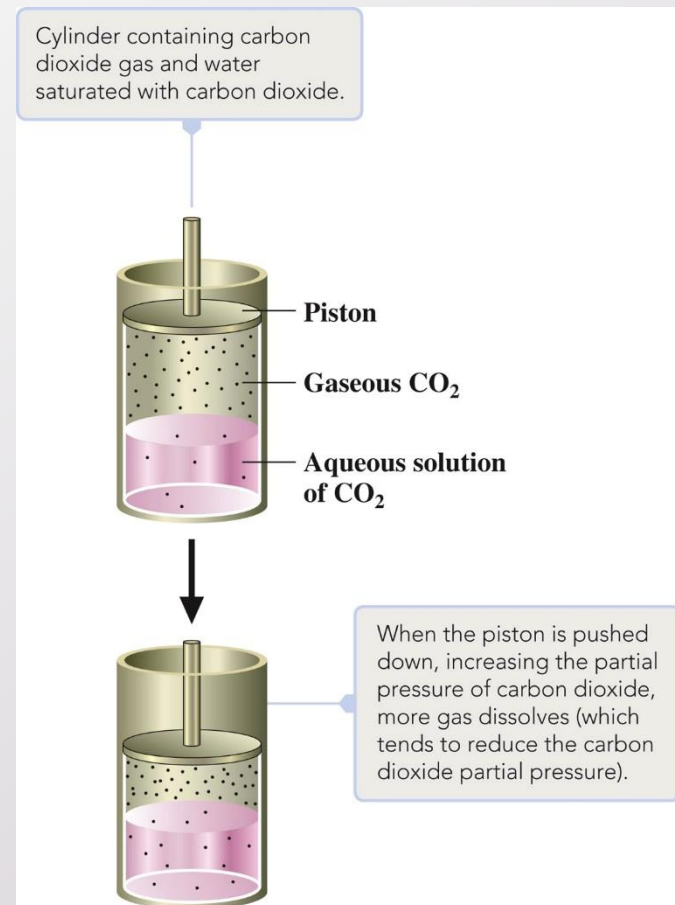
SOLUBILITY AND TEMPERATURE

- In general solubility of a substance will increase with temperature.
- In most cases dissolving is an endothermic process so temp. of solution decreases with solubility – so increasing temp. increases solubility. (Cold packs are endothermic processes.)
- In cases where dissolving is an exothermic process, the solution needs to be cooled in order to increase solubility (e.g. NaOH in water) (Hot packs are exothermic processes).



SOLUBILITY AND GASES

- Solubility depends on two conditions: pressure and temperature
- Henry's Law: solubility of gases increases with the partial pressure of the gas above the solution.
- The other aspect of gas solubility is:
Solubility decreases with temperature.



KEY CONCEPTS

- Predict solubility of substances in different solvents
- Predict solubility of substances with temp.