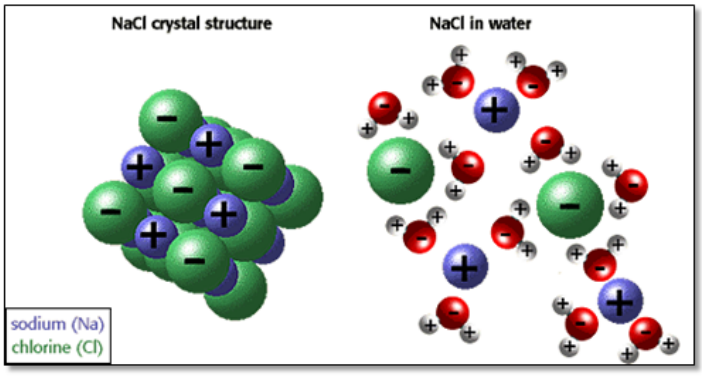
E3.3 explain the effects of changes in temperature and pressure on the solubility of solids, liquids, and gases (e.g., explain how a change in temperature or atmospheric pressure affects the solubility of oxygen in lake water)

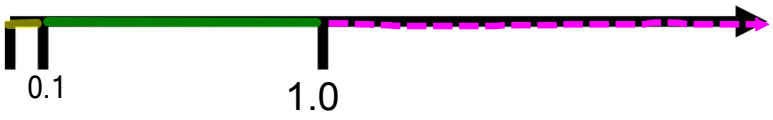
E3.4 identify, using a solubility table, the formation of precipitates in aqueous solutions (e.g., the use of iron or aluminum compounds to precipitate and remove phosphorus from wastewater)

SOLUBILITY

- Measures **mass** of a **solute** that can **dissolve** in a specific solvent at a certain temperature.



All substances can dissolve to a certain degree (even oil in water), however some dissolve much more than others. Think of different degrees of solubility as laying along a continuum.



Insoluble -less than 0.1 g of solute dissolves in 100 mL of solvent

Sparingly soluble: 0.1 to 1.0 g of solute dissolves in 100 mL of solvent

Soluble- more than 1.0 g of solute dissolves in 100 mL of solvent

Factors that Affect Solubility

1-Molecule Size and Solubility

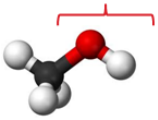
- Molecules with **small non-polar** sections can be **soluble** in **polar solvents**

Increasing size of non-polar portion of molecule

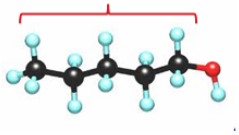
Name of Compound	Methanol	Ethanol	Propanol	Butanol	Pentanol
Chemical Formula	CH_3OH	CH_3CH_2OH	$CH_3CH_2CH_2OH$	$CH_3(CH_2)_3OH$	$CH_3(CH_2)_4OH$
Solubility at 25°C and 100 kPa	miscible	miscible	miscible	9 g/100 mL	3 g/100 mL

Decreasing solubility

Effect of **polar** OH predominates



Effect of **non-polar** portion predominates



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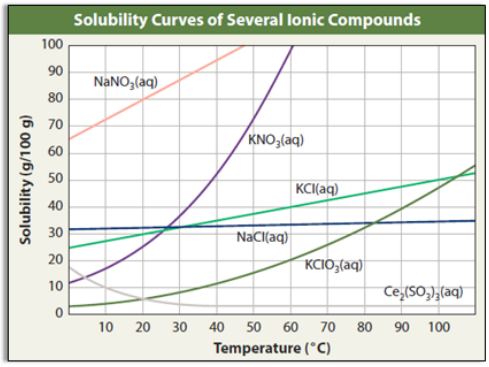
2-Temperature and Solubility

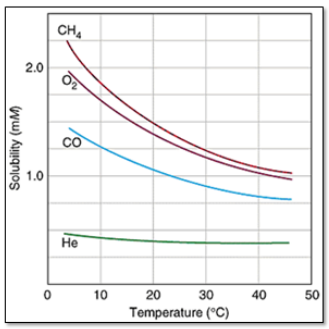
- Solubility of a ***solid*** solute in a liquid solvent usually ***increases with temperature***



This is because energy is needed to break the strong bonds between the particles in a solid. At higher temperatures, more energy is present.

- Solubility of most *liquids* is not greatly affected by temperature. This is because the bonds between particles in a liquid are not as strong as the bonds between particles in a solid.

- Solubility of most ***gases*** in most liquid solvents ***decreases*** with an increase in temperature

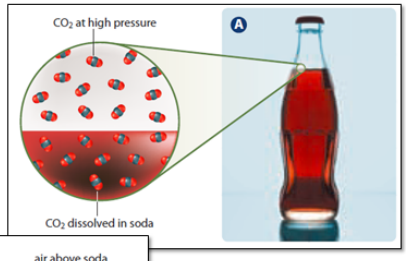


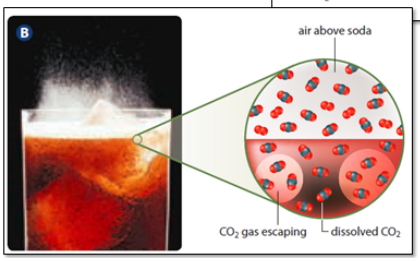
This is because gas particles move quickly and have a great deal of kinetic energy. When a gas dissolves into a liquid, it loses some of this energy. At higher temperatures, dissolved gas gains energy and comes out of solution.

3-Pressure and Solubility

Changes in pressure have hardly any effect on the solubility of solids in liquids or on the solubility of liquids in liquids, but the solubility of a gas in a liquid solvent is directly proportional to the pressure of the gas above the liquid.

- ***Increased*** pressure of a gas above a liquid solvent ***increases*** the ***solubility*** of ***that particular gas***





Ex. The solubility of the carbon dioxide in your Coke decreases when you open the can and the pressure is reduced.

Factors that Affect Rate of Dissolving

Factor	What Happens?	Why?
Temperature	for most solid solutes, the rate of dissolving is faster at higher temperatures.	Solid particles have more kinetic energy (movement) at higher temperatures and thus collide more often with the solvent particles.
Surface Area	the greater the SA the faster the rate of dissolving	More solid particles are colliding with the solvent particles when surface area is high. (eg. granular sugar dissolves faster than large crystal sugar).
Agitation	stirring or shaking increases the rate of dissolving.	Solid particles collide more often with the solvent particles.

Homework

Solubility Graphing Assignment