Today, Jan 10 - sections 12.1 - 12.3
Friday, Jan 12 - sections 12.4 - 12.6

Tutoring will be ~~available~~ Sundays and Tuesdays from 7:00 - 8:30 in Epply 107!

Chapter 12

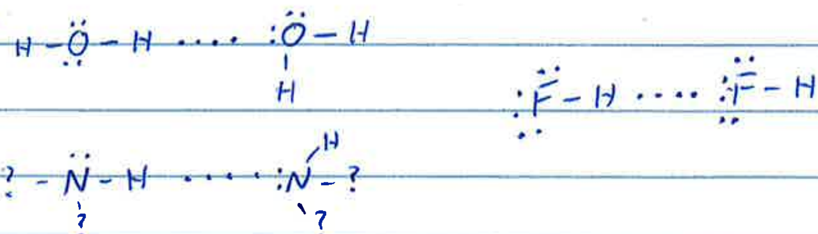
solutions

- like dissolves like
  - ↳ things with similar intermolecular forces will ~~so~~ dissolve in each other

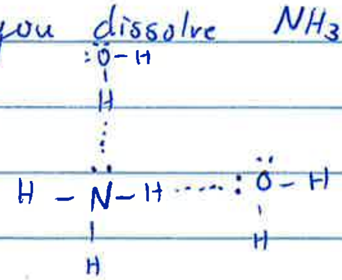
- solute(smaller) solvent (bigger amount of moles)

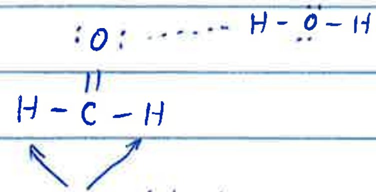
- intermolecular forces
  - Dipole - Dipole 3 - 4 kJ/mol
  - Hydrogen bonding 10 - 40 kJ/mol
    - occurs when there is an O-H, N-H, or F-H

example:



- when you dissolve NH_3 ~~and~~ in H_2O





cannot hydrogen bond by itself since the H is on Carbons

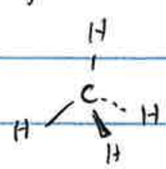
- London - Dispersion 1-10 kJ/mol
  - proportional to molar mass

		at room temp
non-polar	F_2	gas
	Cl_2	gas
	Br_2	liquid
	I_2	solid

↓ increasing London-dispersion

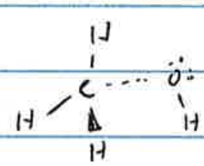
*At room temperature (RT) all substances with MM more than 200g/mol are solids

examples:



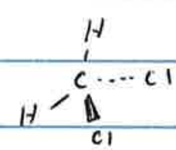
methane

non-polar



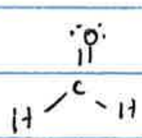
methanol

H-bonding



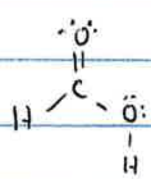
dichloromethane

Polar



methanal

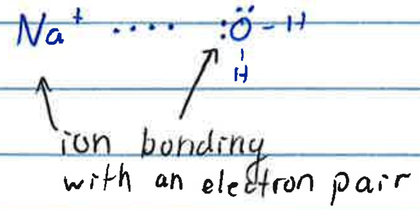
polar



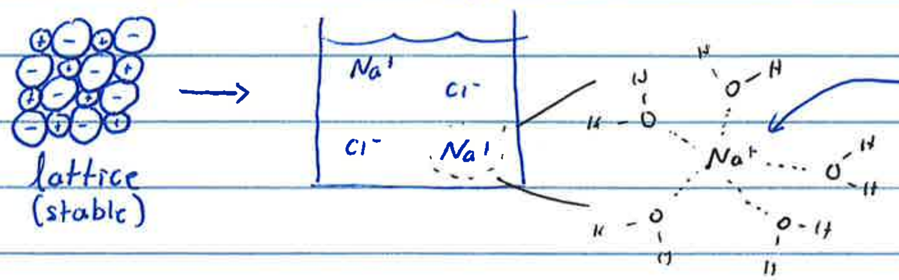
methanoic acid

H-bonding

- Ion-dipole forces



$NaCl_{(s)} \longrightarrow NaCl_{(aq)}$ $\Delta H = +3.9\ kJ/mol$ (not favorable) $\Delta S = +43.4\ kJ/mol \cdot K$ (favorable)



The Na^+ makes lots of ion-dipole forces in solution and it increases entropy (amount of "randomness")

$KOH_{(s)} \longrightarrow KOH_{(aq)}$ $\Delta H = -57.6\ kJ/mol$ (favorable) $\Delta S = +12.9\ J/mol \cdot K$ (favorable)

measuring concentrations of solutions

solubility:

- Sea water contains 3.5g NaCl (solute) per 100g H_2O (solvent)

- mole fraction = $\frac{\text{moles } (n) \text{ of solute}}{\text{total moles}} = \frac{n_{solute}}{n_{solute} + n_{solvent}}$
  (does not have units)

$$n_{NaCl} = 3.5g\ NaCl \times \frac{1\ mol\ NaCl}{58.5g\ NaCl} = 0.060\ mol\ NaCl$$

$$n_{H_2O} = 100g\ H_2O \times \frac{1\ mol\ H_2O}{18.0g\ H_2O} = 5.56\ mol\ H_2O$$

$$\text{mole fraction} = \frac{0.060\ mol}{0.060\ mol + 5.56\ mol} = \boxed{0.0107}$$

- mass % = $100\% \times \frac{m_{NaCl}}{m_{NaCl} + m_{H_2O}} = \frac{3.5g}{3.5g + 100g} \times 100\% = \boxed{3.38\%}$

$$\text{molality} = \frac{\text{moles of solute}}{\text{mass of solvent (kg)}} = \frac{n_{solute}}{m_{solvent}(kg)}$$

$$\frac{0.060\,mol\ NaCl}{0.100\,kg\ H_2O} = \boxed{0.60\ molal\ NaCl}$$

means $\frac{mol\ NaCl}{kg\ H_2O}$

<u>converting from one to another</u>

- convert 0.52 molal NH_4Br into X_{NH_4Br} and mass % NH_4Br

	MM	m	n
NH_4Br	$97.9\,g\,mol^{-1}$	50.9 g	0.52 mol
H_2O	$18.0\,g\,mol^{-1}$	1000 g	55.6 mol

$$n_{H_2O} = \frac{1000g}{} \Big| \frac{mol}{18g} = 55.6\,mol$$

$$m_{NH_4Br} = \frac{0.52\,mol}{} \Big| \frac{97.9\,g}{mol} = 50.9\,g$$

$$X_{NH_4Br} = \frac{n_{NH_4Br}}{n_{NH_4Br} + n_{H_2O}} = \frac{0.52}{0.52 + 55.6} =$$

$$\text{mass \%} = 100\% \frac{m_{NH_4Br}}{m_{NH_4Br} + m_{H_2O}} = 100\% \times \frac{50.9\,g}{50.9\,g + 1000\,g} = \boxed{4.85\%}$$