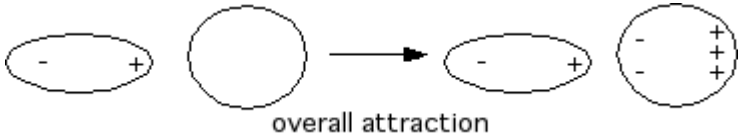
Summary of Intermolecular Interactions

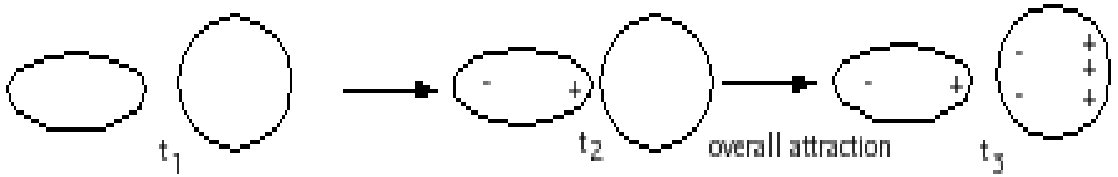
- attractive interactions among molecules:
  - ion-dipole

  - dipole-dipole

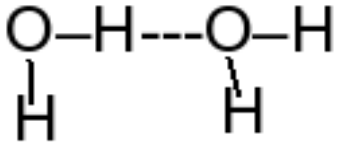
  - dipole - induced dipole



  - Dispersion



  - Hydrogen bonding (directional partial bond, an H bonded to N, O or F). H–F---H–F---H–F and



Review

- Solute Types
  - Electrolytes dissolve in water to produce electrically conducting solutions.
    - Usually salts (ionic compounds)
    - + and – ions are separately solvated

    Chang Fig 4.2
  - Non-electrolytes dissolve in water to produce non-conductive solutions.
    - Molecular compounds
    - Dissolve poorly if not polar.
- Liquids that mix are called miscible, those that don't immiscible.

Review

- % by mass or % w/w
  - =(100%)(mass solute)/(mass of sol'n)
- ppm = parts per million
  - $=(10^6 ppm)$(mass solute)/(mass of sol'n)
  - Equivalent to (mg solute)/(kg sol'n)
- ppb = parts per billion
  - $=(10^9 ppb)$(mass of solute)/(mass of sol'n)
- ppt = parts per trillion
  - $=(10^{12}$ ppt)(mass of solute)/(mass of sol'n)
- M = molarity
  - mol solute/L sol'n

Review

- Molarity = moles solute/L of solution
- Conversion between M and w/w units
  - moles solute → g solute using molar mass
  - Convert L sol'n → g sol'n using density of sol'n
- Solubility vocabulary (soluble, insoluble, saturated, unsaturated, supersaturated, miscible, immiscible).
- Alkane nomenclature (special names 1-4 C, Greek prefixes for > 5 C. end in -ane).

Naming “Normal” Alkanes (1-4)

# C	# H	Formula	Name
1	4	CH_4	Methane
2	6	H_3CCH_3 (C_2H_6)	Ethane
3	8	$H_3CCH_2CH_3$	Propane
4	10	$H_3CCH_2CH_2CH_3$	Butane

Naming “Normal” Alkanes (>4)

Named systematically using Greek prefixes:

Greek Prefix for # of C + -ane

# C	Prefix
5	Penta-
6	Hexa-
7	Hepta-
8	Octa-
9	Nona-
10	Deca-

Example: $H_3CCH_2CH_2CH_2CH_2CH_2CH_3$ = heptane

Alkane Subunits & General Formula

- Subunits:
  - -CH_2- : methylene group
  - -CH_3 : methyl group

- General Formula: C_nH_{2n+2}

Review

- Energy = capacity to do work
  - Standard units = J = $kg \bullet m^2 s^{-2}$
  - Energy is conserved.
  - Forms (potential, kinetic, electromagnetic)
- Thermochemistry = study of energy in chemical reactions.
  - System = what we are care about (at minimum all reactants and products).
  - If energy comes out (is produced) the process is exothermic and $q < 0$.
  - If energy goes in (is used) the process is endothermic ($q > 0$).

Review

- Pressure volume work: $w = -P\Delta V$. Take care with sign (work done on surroundings or by system is negative, work done on system is positive.)
- Internal Energy $\Delta E = q + w$ (energy is conserved).
- Enthalpy (ΔH) is easier to keep track of because under constant P conditions $\Delta H = q$ (or sometimes q_p, to indicate constant pressure).
- $q = C_p\Delta T$, C_p = constant pressure heat capacity of sample ($C_p = nc_p$, c_p = molar heat capacity or $C_p = ms$, m = mass, s = specific heat).
- Constant pressure/solution Calorimetry
  - Key relationship: $0 = \Delta H_{RXN} + C\Delta T \Rightarrow \Delta H_{RXN} = -C\Delta T$

Review

- Bond energies to calculate ΔH_{RXN}
  - Breaking bonds requires putting energy in (+) (Don't forget to multiply # bonds in molecule by stoichiometric coefficients)
  - Making bonds releases energy (-) (Remember stoichiometric coefficients)
  - $\Delta H_{RXN} = \Delta H_{break} + \Delta H_{make}$
- ΔH^o_f to calculate ΔH_{RXN}
  - Key relationship: $\Delta H^o_{RXN} = \sum \Delta H^o_f(prod) - \sum \Delta H^o_f(react)$
- Fuel Values: kJ/g, kJ/mL and CO_2 intensity (mol/kJ)
- Hess's Law: $\Delta H(A \rightarrow C) = \Delta H(A \rightarrow B) + \Delta H(B \rightarrow C)$