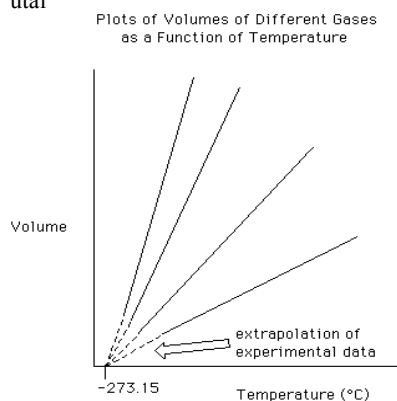


A gáztörvényekhez:

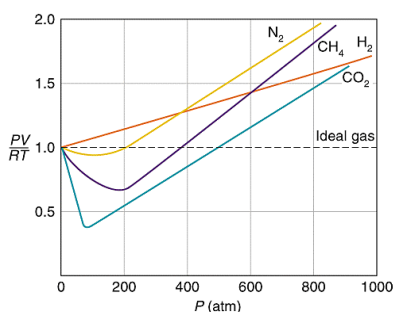
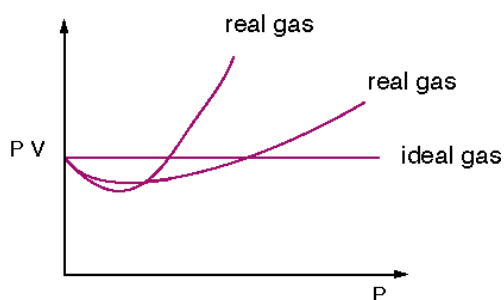
$$pV = nRT$$

$$V = \text{const.}T; \text{const.} = (n/p)R$$

Az alábbi ábra szövege félrevezető: a 'different gases' nem a kémiai különbségre, hanem a minta mennyiségére, ill. a nyomásra utal



Eltérés az ideálistól: reális gázok



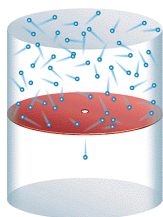
A gázok kinetikus elmélete

A hőmérséklet az átlagos kin. en. mértéke:

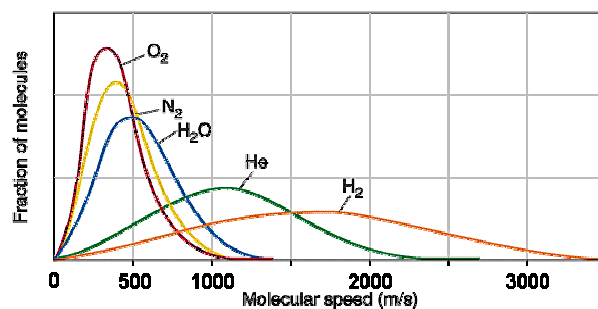
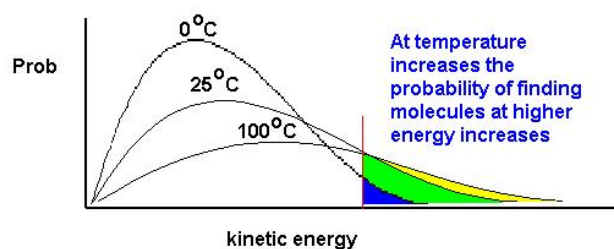
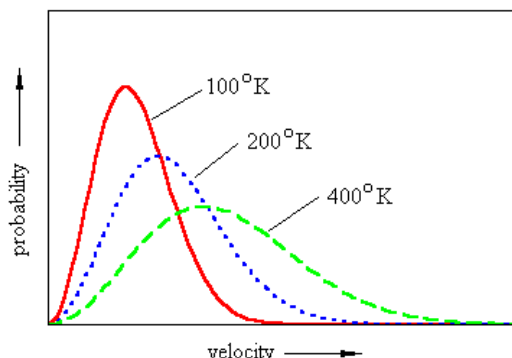
$$E_{\text{kin}} = 3/2 k_B T$$

Egy szabadsági fokra (ekvipartíció elve szerint) jutó energia: $1/2 k_B T$

Diffúzió (effúzió) :



A Maxwell-Boltzmann eloszlás:



Reális gázok

A van der Waals egyenlet:

$$(P + a n^2/V^2)(V - bn) = nRT$$

Gas	Formula	a [(L ² · atm)/mole ²]	b [L/mole]
Helium	He	0.03412	0.02370
Hydrogen	H ₂	0.2444	0.02661
Nitrogen	N ₂	1.390	0.03913
Oxygen	O ₂	1.360	0.03183
Carbon dioxide	CO ₂	3.592	0.04267
Acetylene	C ₂ H ₂	4.390	0.05136
Chlorine	Cl ₂	6.493	0.05622
n - Butane	C ₄ H ₁₀	14.47	0.1226
n - Octane	C ₈ H ₁₈	37.32	0.2368

--	--	--	--

A kristályszerkezet meghatározása:
Röntgen-diffraktométer (X-ray diffr.)

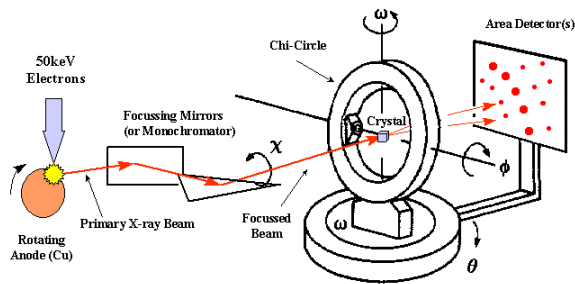
Mégegyszer, részletesebben:

/www.seas.upenn.edu/~chem101/sschem/solidstatechem.html

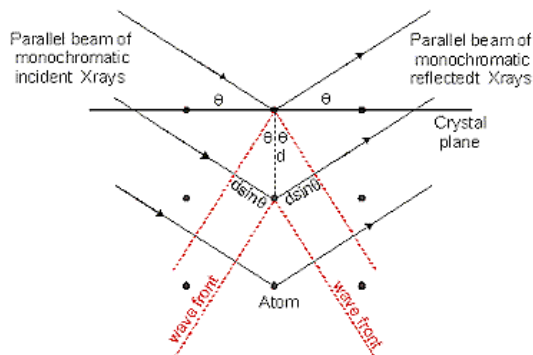
7 Kristályrendszer - 7 elemi cella.

Figyeljük a cellák alakját.

Rendszerezés az élhosszak és a szögek szerint:



4-Circle Goniometer (Eulerian or Kappa Geometry)



Path difference between the reflected rays is a function of the angle of incidence

A Bragg-törvény

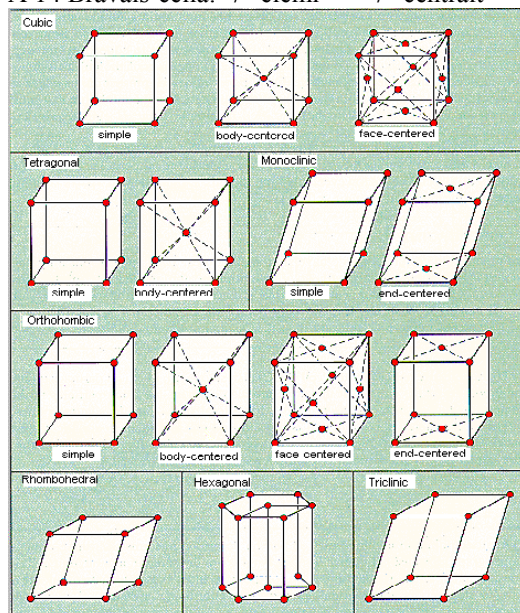
θ irányban erősítés van, ha:

$$2 d \sin \theta = n \lambda$$

Rendszerezés

Kristályrendszerek:

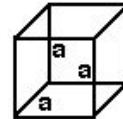
A 14 Bravais-cella: 7 "elemi" + 7 "centrált"



Cubic

$$a = b = c$$

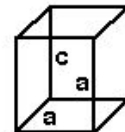
$$\alpha = \beta = \gamma = 90^\circ$$



Tetragonal

$$a = b \neq c$$

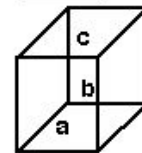
$$\alpha = \beta = \gamma = 90^\circ$$



Orthorhombic

$$a \neq b \neq c$$

$$\alpha = \beta = \gamma = 90^\circ$$



Rhombohedral

$$a = b = c$$

$$\alpha = \beta = \gamma \neq 90^\circ$$

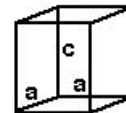


Hexagonal

$$a = b \neq c$$

$$\alpha = \beta = 90^\circ$$

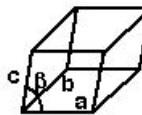
$$\gamma = 120^\circ$$



Monoclinic

$$a \neq b \neq c$$

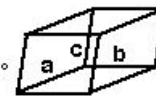
$$\alpha = \gamma = 90^\circ \neq \beta$$



Triclinic

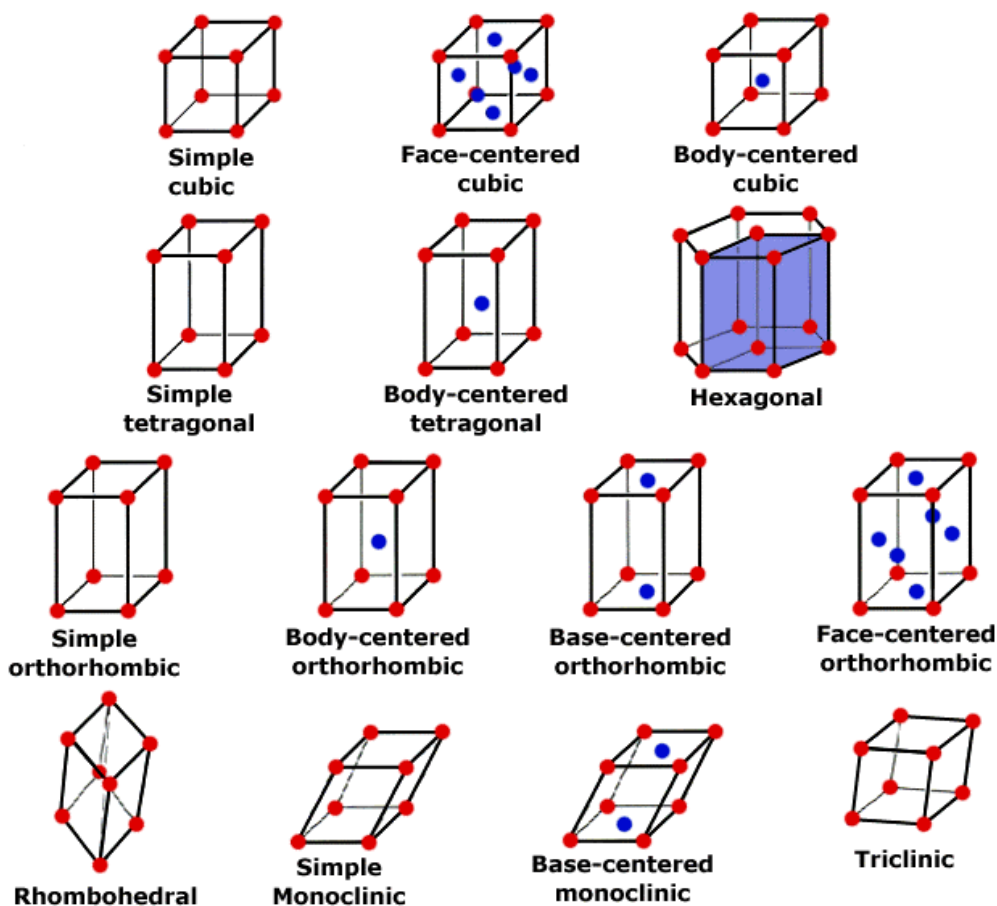
$$a \neq b \neq c$$

$$\alpha \neq \beta \neq \gamma \neq 90^\circ$$



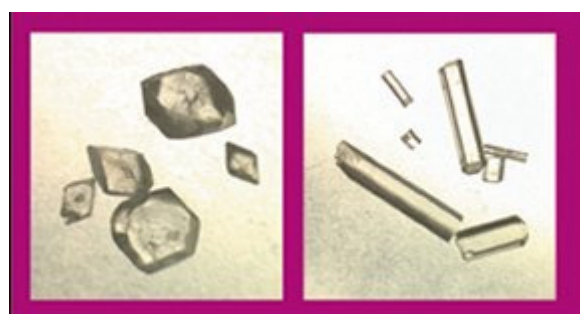
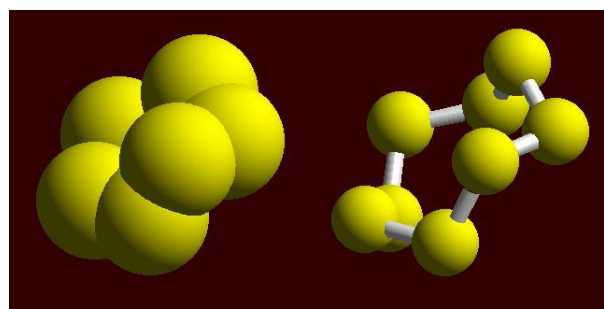
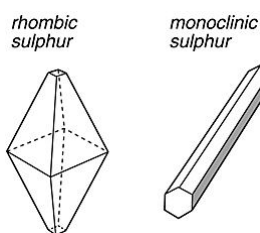
Folyt. 2005/18b

Fent 7 formát látunk, azonban maga a kristályrács 14-féle lehet (*Bravais-cellák*)



Pl. Kén: rombos (*orthorhombic*)

Cell parameters: a /pm b /pm c /pm α /° β /° γ /°
 1043.7 1284.5 2436.9 90.000 90.000 90.000



Polimorfia: u.azon kémiai anyag, különböző kr. szerkezet; elemek esetében: *allotróp* módosulatok
 In [materials science](#) polymorphism is the ability of a solid material to exist in more than one form or crystal structure. Diamond, graphite and the Buckyball are examples of polymorphs of carbon. α -ferrite, austenite, and δ -ferrite are polymorphs of iron. When found in elemental solids the condition is also called [allotropy](#)

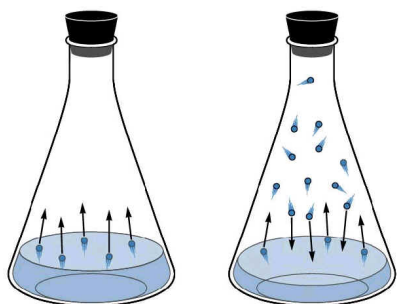
POLYMER RELIEF. Growing crystals of the pain-relieving drug acetaminophen on different polymer surfaces will yield different crystal structures. One polymer gives rise to tiny prisms (left); another, miniature monoliths (right).

Fázisátalakulások:

Párolgás, forráspont, kritikus állapot

Egyensúlyi gőznyomás (tenzió):

www.unit5.org/christjs/Vapor_Pressure_Boiling_Point.htm



In container A, the liquid is evaporating. Some of the molecules have enough kinetic energy to escape (turn to a gas) by pushing against the pressure of the atmosphere. Container B shows the flask is saturated. When new molecules of liquid are vaporized, the gas cannot hold additional molecules, therefore some of the molecules condense back to liquid.

Néhány anyag tenziója 25°C-on:

www.psigate.ac.uk/newsite/reference/plambeck/chem2/p01045

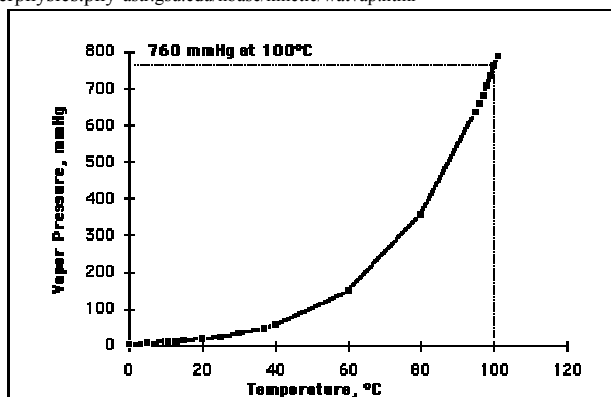
Substance	Vapor Pressure (kPa)	Density (kg/m ³)
H ₂ O (l)	3.1691	0.99702
CH ₃ OH (l)	16.8511	0.791
C ₂ H ₅ OH (l)	7.8279	0.785
C ₆ H ₆ (l)	12.6893	0.899
Hg (l)	0.2460	13.5340
I ₂ (s)	0.1889	4.93

A víz tenziója a hőmérséklet függvényében:

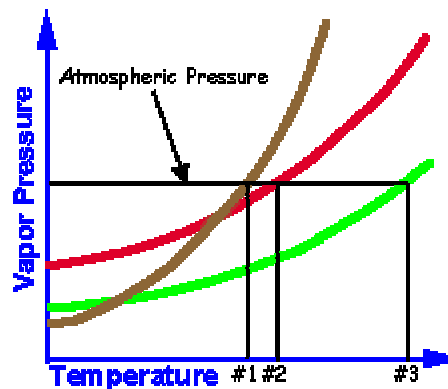
T (°C)	P (kPa)	T (°C)	P (kPa)	T (°C)	P (kPa)
0	0.61	21	2.49	40	7.38
5	0.87	22	2.64	50	12.34
10	1.23	23	2.81	60	19.93
15	1.71	24	2.98	70	31.18
16	1.82	25	3.17	80	47.37
17	1.94	26	3.36	90	70.12
18	2.06	27	3.57	95	84.53
18.5	2.13	28	3.78	100	101.32
19	2.19	29	4.01		
19.5	2.27	30	4.25		
20	2.344	35	5.63		

Forráspont: tenzió eléri a külső nyomást

hyperphysics.phy-astr.gsu.edu/hbase/kinetic/watvap.html

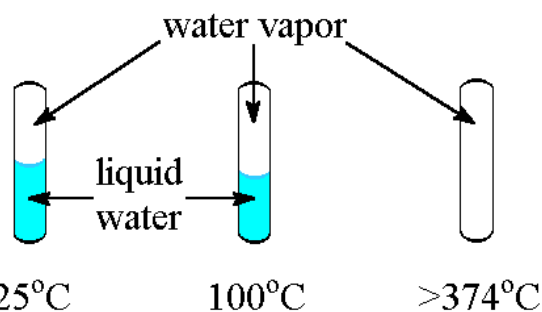


Különböző anyagok forráspontja:



Boiling Points and Heat of Vaporization

Substance	Boiling point K	Boiling point °C	Heat of vaporization (10 ³ J/kg)
Helium	4.216	-268.93	20.9
Hydrogen	20.26	-252.89	452
Nitrogen	77.34	-195.81	201
Oxygen	90.18	-182.97	213
Ethyl alcohol	351	78	854
Mercury	630	357	272
Water	373.15	100.00	2256
Sulfur	717.75	444.60	326
Lead	2023	1750	871

A kritikus állapot kialakulása:

Kritikus hőmérséklet és nyomás

substance	temperature (°C)	critical pressure (atm)
NH ₃	132	111.5
O ₂	-119	49.7
CO ₂	31.2	73.0
H ₂ O	374	217.7

SUPERCritical CARBON DIOXIDE REACTOR



These include a 20 ml reaction vessel with borosilicate glass view windows, enabling visual monitoring of the reaction. Pressurised carbon dioxide is charged and exhausted via valves situated at the top. The reactor is either heated in an oven or directly on a hotplate with the temperature regulated by a thermocouple inserted into the body of the vessel.

CIC Case Study

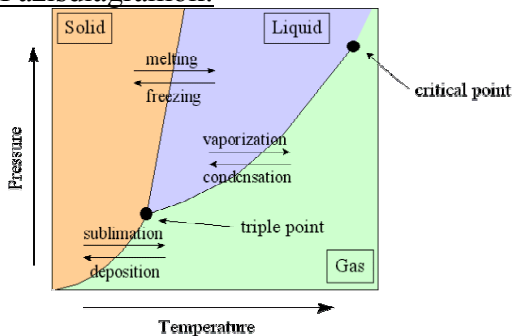
Supercritical carbon dioxide is currently being intensely investigated as an alternative solvent for synthetic chemistry. The unique tuneable properties of supercritical fluids allow much greater control over reactions than is possible with conventional solvents, and enables excellent pathway selectivity. CIC members have developed novel reactions, which in conventional solvents give mixtures of products, but under supercritical conditions yielded just a single product, which eliminates additional purification steps and minimises waste.

Olvasás

Melting Points and Heat of Fusion

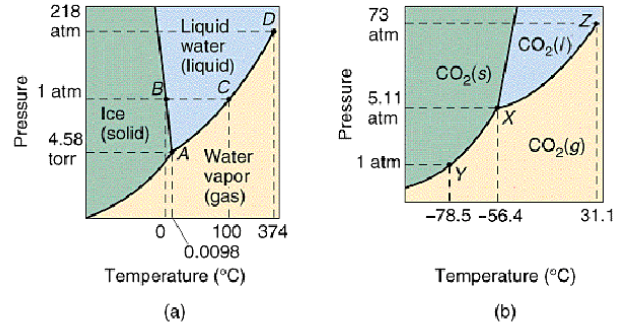
Substance	Melting point K	Melting point °C	Heat of fusion (10 ³ J/kg)
Helium	3.5	-269.65	5.23
Hydrogen	13.84	-259.31	58.6
Nitrogen	63.18	-209.97	25.5
Oxygen	54.36	-218.79	13.8
Ethyl alcohol	159	-114	104.2
Mercury	234	-39	11.8
Water	273.15	0.00	334
Sulfur	392	119	38.1
Lead	600.5	327.3	24.5
Silver	1233.95	960.80	88.3
Gold	1336.15	1063.00	64.5
Copper	1356	1083	134

Fázisdiagramok:



Két példa:

Phase diagram for water and carbon dioxide

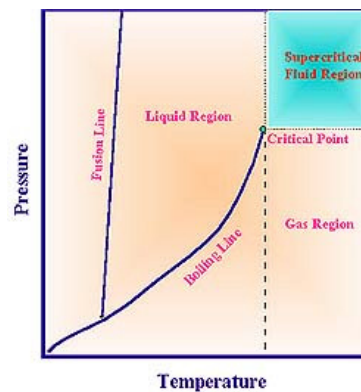


Néhány anyag hármaspontja:

Substance	Temperature K	Pressure 10 ⁵ Pa
Hydrogen	13.84	0.0704
Deuterium	18.63	0.171
Neon	24.57	0.432
Oxygen	54.36	0.00152
Nitrogen	63.18	0.125
Ammonia	195.40	0.0607
Sulfur dioxide	197.68	0.00167
Carbon dioxide	216.55	5.17
Water	273.16	0.00610

Fázisdiagram, a szuperkritikus állapotot is feltüntetve

<http://www.ceic.unsw.edu.au/centers/SCF/images/fig1.jpg>



Néhány oldhatósági adat

Solubilities in Water at 293 K (g per 100 g water)

NH ₄ Cl	37.2	NH ₄ NO ₃	192
BaCl ₂ ·2H ₂ O	35.8	Ba(NO ₃) ₂	9.0
CaCl ₂ ·6H ₂ O	74.5	Ca(NO ₃) ₂ ·4H ₂ O	129
CuCl ₂	73.0	Cu(NO ₃) ₂	125
PbCl ₂	1.00	Pb(NO ₃) ₂	54.3
LiCl	83.5	LiNO ₃	70.1
MgCl ₂	54.6	AgNO ₃	216
KCl	34.2	KNO ₃	31.6
NaCl	35.9	NaNO ₃	87.6

Gázok oldhatósága:

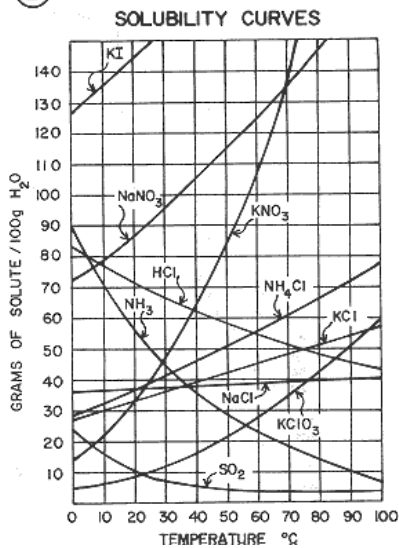
Solubilities of Gases in Water at 293 K

Gas	Solubility ^a
Ammonia	52.9
Bromine	14.9
Carbon dioxide	0.169
Carbon monoxide	0.0028
Chlorine	0.729
Hydrogen	0.00016
Hydrogen sulfide	0.385
Methane	0.0023
Nitrogen	0.0019
Oxygen	0.0043
Sulfur dioxide	11.28

^aGrams of gas dissolved in 100 g of water when the total pressure above the solution is 1 atm.

Az oldhatóság hőmérséklet-függése

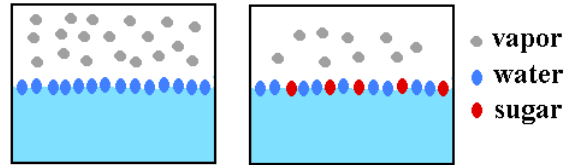
D



Oldatok gőznyomása (Raoult-törvény)

Szemléletes kép:

moon.fccj.org/~ethall/2046/ch11/vp.htm



1. Ha csak az egyik anyag (oldószer) illékony ..

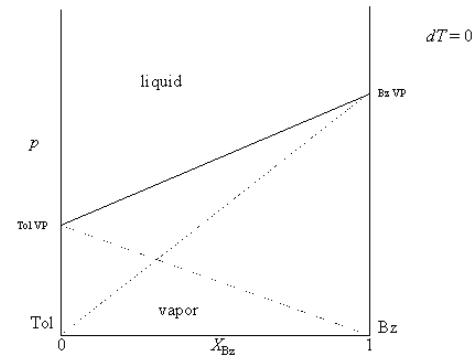
$$p = x p^0$$

2. Ha több illékony komponens van:

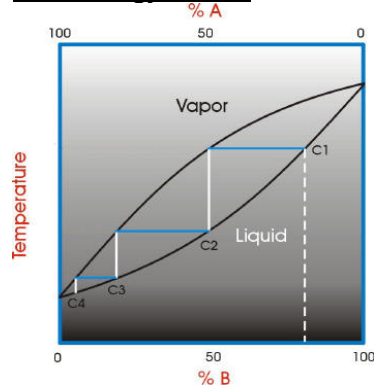
$$p_A = x_A p_A^0$$

$$p_B = x_B p_B^0$$

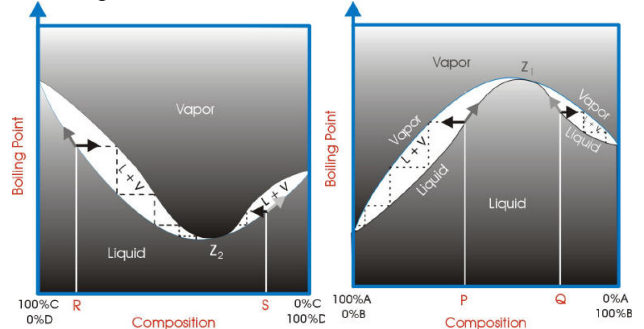
pl. benzol-toluol elegy



Ideális elegy forrása



Azeotróp



a) dipól-dipól;

energia $\sim 1/r^3$, szabad forgás esetén $1/r^6$

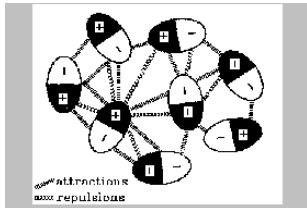


Figure 59 Attractions between polar molecules occur because the molecules tend to align themselves so that opposite charges are near each other.

b) London-féle diszperziós ; gyenge, de mindig jelen van, az elektronfelhő pillanatnyi fluktuációi polarizálják a szomszéd atomot.

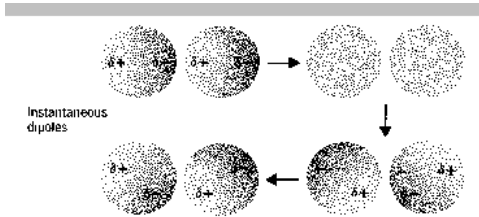


Figure 61 Instantaneous or "frozen" views of the electron density in two neighbouring atoms.

Nagyságára általános szempont: nagyobb molekulák, kiterjedt elektronfelhő: könnyebben polarizálható.

V.ö. Cl₂ és Br₂ olv.pont és forrp.

A részecskék közti távolsággal rohamosan csökken:

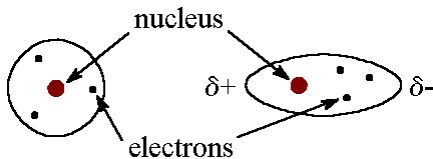
függés $\sim 1/r^6$

<http://www.chem.purdue.edu/gchelp/liquids/disperse.html#Disperse>

The London dispersion force is the weakest intermolecular force. The London dispersion force is a temporary attractive force that results when the electrons in two adjacent atoms occupy positions that make the atoms form temporary dipoles. This force is sometimes called an induced dipole-induced dipole attraction. London forces are the attractive forces that cause nonpolar substances to condense to liquids and to freeze into solids when the temperature is lowered sufficiently.

Because of the constant motion of the electrons, an atom or molecule can develop a temporary (instantaneous) dipole when its electrons are distributed unsymmetrically about the nucleus.

sematikusan:



symmetrical distribution

unsymmetrical distribution

A second atom or molecule, in turn, can be distorted by the appearance of the dipole in the first atom or molecule (because electrons repel one another) which leads to an electrostatic attraction between the two atoms or molecules.



Larger and heavier atoms and molecules exhibit stronger dispersion forces than smaller and lighter ones.

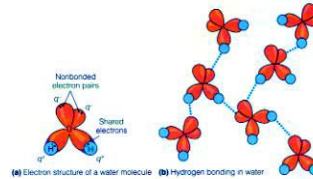
In a larger atom or molecule, the valence electrons are, on average, farther from the nuclei than in a smaller atom or molecule. They are less tightly held and can more easily form temporary dipoles.

The ease with which the electron distribution around an atom or molecule can be distorted is called the **polarizability**.

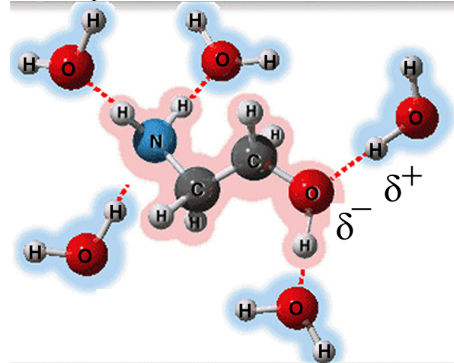
c) H-híd: energia 3-6 kcal/mol;

távolság pillératomok között: 2.5 - 3 Å

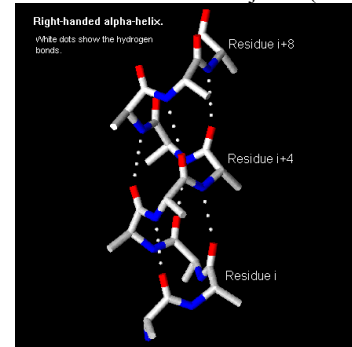
pl. vízmolekulák között:



Amino- és OH-csoport vízzel:

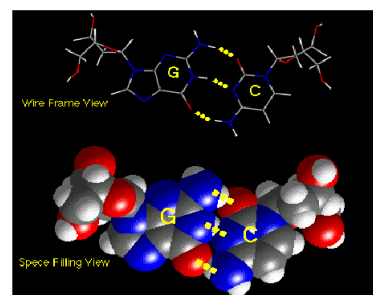


H-hidak a peptidek α -hélix konformációjában (Pauling!)



H-hidak tartják össze a DNS kettősspirált (Watson és Crick) A-T, ill. G-C bázispárok, pl. Guanin-citozin:

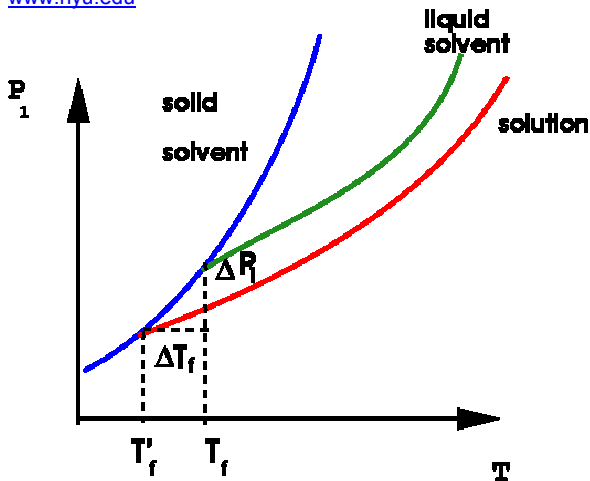
Example of dG-dC base pair as found within DNA double helix



Kolligatív tulajdonságok

Fagyáspontcsökkenés- forráspontemelkedés alapja:
Az oldat tenziója csökken.

www.nyu.edu



Mértéke jellemző az oldószerre, és arányos az 1000 g oldószerre jutó oldott mólok számával:

$$\Delta T_f = M_R K_f$$

ahol M_R - Raoult-konc., K_f - az oldószerre jellemző adat, *molális* fagy.p.csökk.

Hasonlóan, a forráspontemelkedés: K_b

Jelentőség: molekulásúly meghatározása ...

Néhány adat:

<http://hyperphysics.phy-astr.gsu.edu/hbase/tables/bpelev.html>

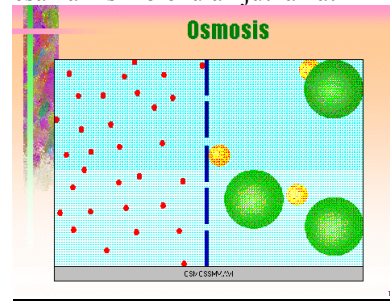
Solvent	Formula	Melting Point (°C)	Boiling Point (°C)	K_f (°C/m)	K_b (°C/m)
Water	H ₂ O	0.000	100.000	1.858	0.521
Acetic acid	HC ₂ H ₃ O ₂	16.60	118.5	3.59	3.08
Benzene	C ₆ H ₆	5.455	80.2	5.065	2.61
Camphor	C ₁₀ H ₁₆ O	179.5	...	40	...
Carbon disulfide	CS ₂	...	46.3	...	2.40
Cyclohexane	C ₆ H ₁₂	6.55	80.74	20.0	2.79
Ethanol	C ₂ H ₅ OH	...	78.3	...	1.07

Data source: Landolt-Bornstein, 6th Ed., Zahlenwerte und Funktionen aus Physik, Chemie, Astronomie, Geophysik, und Technik, Vol II, part IIa, Springer-Verlag, 1960. Pp 844-849 and 918-919.

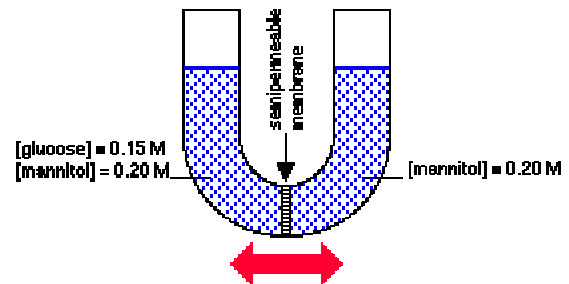
Ozmózis

2005/23

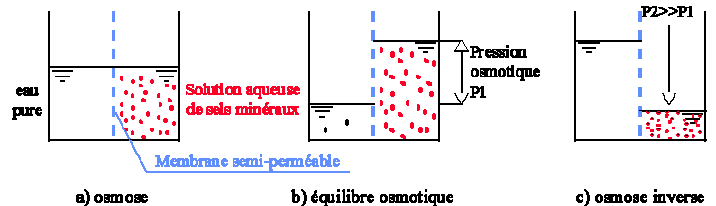
"Féligáteresztő" (szemipermeábilis) hártya: csak a kis molekulák jutnak át



Merre mozdul el a folyadékszint?



Ozmózis és inverz ozmózis



Az ozmózis kvantitatív törvénye:

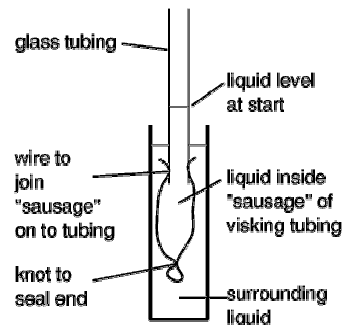
van't Hoff kimutatta, hogy teljes analógia a gáztörvénnyel:

$$\Pi V = n R T$$

Megj.:Az oldott részecskék számával arányos. *Disszociáció* esetén (elektrolitok), arányosan nő az ozmózisnyomás.

Mérése: az ozmométer elve:

THE VISKING OSMOMETER



Kolloidok

Meghatározás: olyan diszperz rendszer, melyben a diszpergált részecskék mérete legalább egy irányban $\sim 1 - 1000$ nm; vagy ilyen méretű diszkontinuitások vannak (porózus anyagok). A rendszer lehet összefüggő *háló* is (gélek, stb.).

IUPAC: www.iupac.org/reports/2001/colloid_2001/manual_of_s_and_t/node33.html

the molecules or polymolecular particles dispersed in a medium have at least in one direction a dimension roughly between 1 nm and 1 μ m, or that in a system discontinuities are found at distances of that order. It is not necessary for all three dimensions to be in the colloidal range: fibers in which only two dimensions are in this range, and thin films, in which one dimension is in this range, may also be classified as colloidal. Nor is it necessary for the units of a colloidal system to be discrete: continuous network structures, the basic units of which are of colloidal dimensions also fall in this class (e.g. porous solids, gels and foams).

Aprítás: durva diszperzió \rightarrow **kolloid** \rightarrow valódi oldat

Különbég valódi oldatoktól: Tyndall-jelenség



Három alapvető típus: **diszperzió**
polimer oldata
micella

Diszperziók felosztása

közeg (diszpergá lószer)	diszpergált fázis (diszperzum)		
	Szilárd	folyadék	gáz
Szilárd	szil. <i>Szol:</i> rubinüveg *	-- (<i>emulzió</i>) vaj	szil. <i>hab</i> horzszakő
Folyadék	<i>szol:</i> keményítő oldat	<i>emulzió</i> tej, majonéz	<i>hab:</i> szappan-, borotvahab
Gáz	<i>aeroszol</i> füst	<i>köd</i> légköri köd	-----

* aranyzol, üvegszínező

Zsigmondy, a kolloidika atyja

Austrian chemist, born April 1, 1865, Vienna; died September 23, 1929, Göttingen.

Richard Adolf Zsigmondy was the son of Adolf Zsigmondy, a physician, who died when Zsigmondy was only 15 years old. Encouraged by their mother, Irma von Szakmary, ...He first studied chemistry ... in Vienna, ...In 1925, Zsigmondy was awarded the Nobel Prize for his work on colloid chemistry and the invention of the ultramicroscope.

The ultramicroscope is not an instrument for magnifying images, as in a microscope or other such device. Rather, it is a system of illumination for extremely small objects such as colloidal particles, fog droplets, or smoke particles. ... Ultramicroscopes are used in the study of Brownian motion,

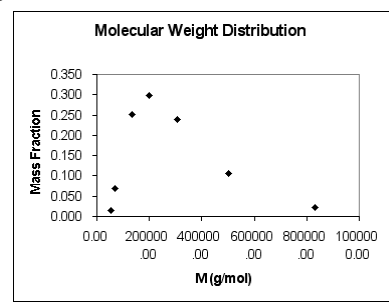
Polimer oldatok vizsgálata.

1. Fényszórás. A legfontosabb módszer; elv: ha a fény fullámhossza és a részecske mérete azonos nagyságrendű, a fény szóródik (scattering). Ennek jellege függ a molekula méretétől.

One of the main problems with the [light scattering method](#) is that the polymer solution must be perfectly dust free in order to get good results. To obtain these perfectly clean solutions they are usually filtered very carefully. Despite this difficulty of making a clean solution, light scattering is probably [the most widely used technique](#) for measuring molecular weights. It is useful for a very broad range, from 10,000 to 10 million g/mol.

2. Ultracentrifuga

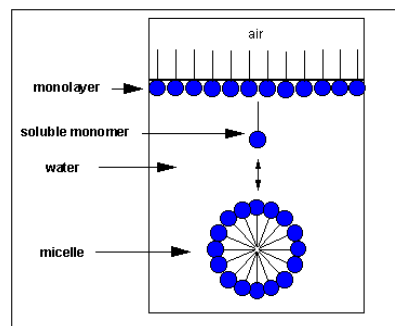
Polimeroldatokban a moláris tömeg általában nem egységes (polimeriz. foka különböző):
heterodiszperz rendszer



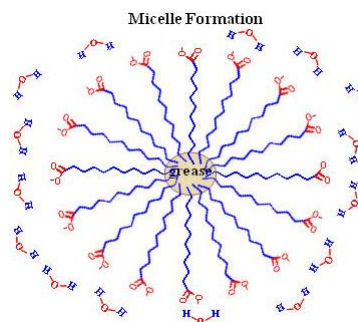
3. Kromatográfia

Gel permeation chromatography has become the most commonly used method in recent years for the determination of molecular weight distribution. The method separates polymers on the basis of size by passing the polymer in solution, through a series of columns that are packed with gel.

Intermol. kölcsönhatás **kolloid** rendszerekben:
micella (mosószerek, biológia)



Micella: <http://onsager.bd.psu.edu/~jircitano/micelle.jpg>



Termokémia

Hőmennyiség, hőkapacitás: $Q = C \Delta T$

C - *hőkapacitás*; *extenzív* menny.; fajlagos hőkap. (fajhő)

Q dimenziója: kJ, kcal 1 cal = 4.184 J

Reakcióhő: a változással kapcsolatos hőmennyiség, a rendszer szempontjából: a rendszerrel közölt hő.

Hőtermelő (*exoterm*) reakció esetén tehát negatív.

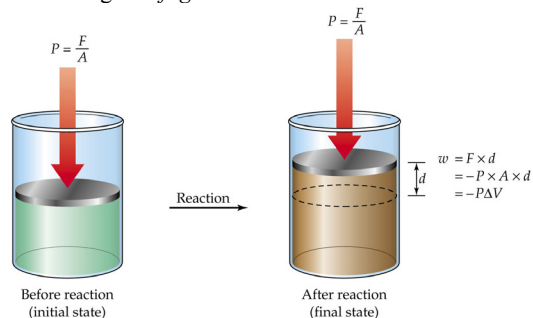
Hess-tétel: a r.hő független az úttól, a kezdeti és végállapot egyértelműen meghatározza.

Két eset:

V = const.; $Q = \Delta U$ U - *belsőenergia*

p = const.; $Q = \Delta H$ H - *entalpia* (T mindkét esetben const.)

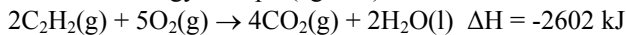
Különbség a *térfogati munkából* adódik.



Az entalpia definíciója: $H = U + pV$

megváltozása, ha p = const., $\Delta H = \Delta U + p \Delta V$, a reakcióhő

Termokémiai egyenlet pl. (égéshő):



Képződéshő: azon folyamat reakcióhője, melyben 1 mól anyag elemeiből keletkezik. Következmény tehát: az elemek

képződéshője zérus. *Standard áll.:* fentieket pontosítani kell, hiszen az állapotjelzőktől függenek: 25°C, 1 atm. forrás: Brady, T6.1.

Substance	ΔH_f (kJ/mol)	Substance	ΔH_f (kJ/mol)	Substance	ΔH_f (kJ/mol)
Al ₂ O ₃ (s)	-1676	C ₄ H ₁₀ (g)	-126	MgCl ₂ ·2H ₂ O(s)	-1280
Al ₂ (SO ₄) ₃ (s)	-3441	C ₆ H ₆ (l)	+49.0	Mg(OH) ₂ (s)	-924.7
AsH ₃ (g)	+66.4	CH ₃ OH(l)	-238	KMnO ₄ (s)	-813.4
As ₄ O ₆ (s)	-1314	C ₂ H ₅ OH(l)	-278	MnSO ₄ (s)	-1064
As ₂ O ₃ (s)	-925	HCHO(g) (formaldehyde)	-108.6	NH ₃ (g)	-46.0
BaCO ₃ (s)	-1219	CH ₃ CHO(g) (acetald.)	-167	NH ₄ Cl(s)	-314.4
BaCl ₂ (s)	-860.2	(CH ₃) ₂ CO(l) (acetone)	-248.1	NO(g)	+90.4
Ba(OH) ₂	-998.22	C ₆ H ₅ CO ₂ H(s) (benz. acid)	-385.1	NO ₂ (s)	+34
BaSO ₄ (s)	-1465	CO(NH ₂) ₂ (s) (urea)	-333.5	N ₂ O(g)	+81.5
Br ₂ (g)	+30.9	HCl(g)	-92.5	HNO ₃ (l)	-174.1
HBr(g)	-36	HCl(aq)	-167.2	O ₃ (g)	+143
CaCO ₃ (s)	-1207	Cr ₂ O ₃ (s)	-1141	P(s, white)	0
CaCl ₂ (s)	-795.8	(NH ₄) ₂ Cr ₂ O ₇ (s)	-1807	P ₄ O ₁₀ (s)	-2984
CaO(s)	-635.5	K ₂ Cr ₂ O ₇ (s)	-2033.01	H ₃ PO ₄ (s)	-1279
Ca(OH) ₂ (s)	-986.6	CuCl ₂ (s)	-172	KCl(s)	-436.8
Ca ₃ (PO ₄) ₂ (s)	-4119	CuO(s)	-155	SiH ₄ (g)	+33
CaSO ₃ (s)	-1156	Cu ₂ S(s)	-79.5	SiO ₂ (s, alpha)	-910.0
CaSO ₄ (s)	-1433	CuS(s)	-53.1	NaF(s)	-571
CaSO ₄ ·1/2H ₂ O(s)	-1573	CuSO ₄ (s)	-771.4	NaCl(s)	-413
CaSO ₄ ·2H ₂ O(s)	-2020	CuSO ₄ ·5H ₂ O(s)	-2279.7	NaBr(s)	-360
C(s, graphite)	0	HF(g)	-271	NaI(s)	-288
C(s, diamond)	+1.88	H ₂ O(l)	-286	NaHCO ₃ (s)	-947.7
CCl ₄ (l)	-134	H ₂ O(g)	-242	Na ₂ CO ₃ (s)	-1131
CO(g)	-110	H ₂ O ₂ (l)	-187.8	Na ₂ O ₂ (s)	-504.6
CO ₂ (g)	-394	I ₂ (g)	+62.4	NaOH(s)	-426.8
CO ₂ (aq)	-413.8	HI(g)	+26	Na ₂ SO ₄ (s)	-1384.49
H ₂ CO ₃ (aq)	-699.65	Fe ₂ O ₃ (s)	-822.2	S(s, rhombic)	0
CS ₂ (l)	+89.5	Fe ₃ O ₄ (s)	-1118.4	SO ₂ (g)	-297
CS ₂ (g)	+117	PbO(s)	-217.3	SO ₃ (g)	-396
CH ₄ (g)	-74.9	PbO ₂ (s)	-277	H ₂ SO ₄ (l)	-813.8
C ₂ H ₂ (g)	+227	Pb(OH) ₂ (s)	-515.9	SnCl ₄ (l)	-511.3
C ₂ H ₄ (g)	+51.9	PbSO ₄ (s)	-920.1	SnO ₂ (s)	-580.7
C ₂ H ₆ (g)	-84.5	LiCl(s)	-408.8	ZnO(s)	-348
C ₃ H ₈ (g)	-104	MgCl ₂ (s)	-641.8	ZnSO ₄ (s)	-982.8

2005/25

Olvasáshők, párolgási hők:

néhány adatot l. 19-20. melléklet

Allotróp módosulatok átalakulása:

S(rombos) → S(monoklin) $\Delta H = + 0.08 \text{ kcal/mol}$

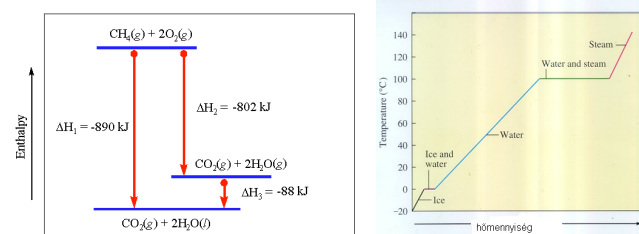
P(sárga) → P(vörös) $\Delta H = - 3.7 \text{ kcal/mol}$

Oldáshők

Enthalpy of Solvation (H_{soln} kJ/mol) of Some

Substanc	H_{soln}	Substance	H_{soln}
AlCl ₃ (s)	-373.63	H ₂ SO ₄ (l)	-95.28
LiNO ₃ (s)	-2.51	LiCl(s)	-37.03
NaNO ₃ (s)	20.50	NaCl(s)	3.88
KNO ₃ (s)	34.89	KCl(s)	+17.22
NaOH(s)	-44.51	NH ₄ Cl(s)	14.77

Entalpiadiagramok: Fázisátalakulásoknál: pl. fűtési görbe



Korábbi: Born-Haber körfolyamat, 14. mell.

