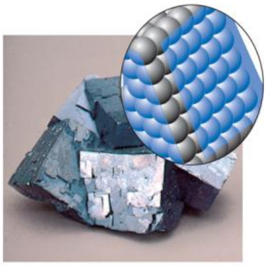
Föreläsning Läsvecka 3

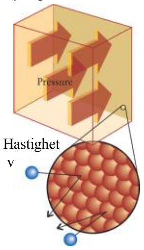
Vätskor och fasta faser



AJ Kapitel 5

Björn Åkerman, Kemi och Bioteknik

Repetition Läsvecka 2: Gaser



Tryck är kollisioner

Temperatur är kinetisk energi

$E_{kin} = {}^{1}/_{2}mv^{2} = {}^{3}/_{2}kT$

Ideal gas

$pV = nRT = NkT$

Densitet

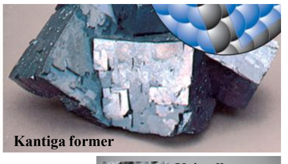
$\rho = pM/RT$

Ideal gas	22.41
Argon	22.09
Carbon dioxide	22.26
Nitrogen	22.40
Oxygen	22.40
Hydrogen	22.43

Verkliga gaser

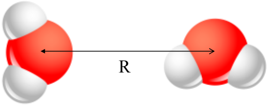
Ideal gas är en bra modell

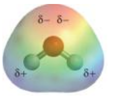
Vätskor och fasta ämnen antar en viss form



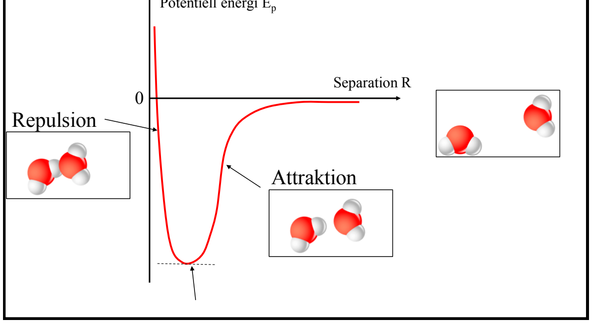
men gaser tar upp all tillgänglig volym

Krafter mellan molekyler

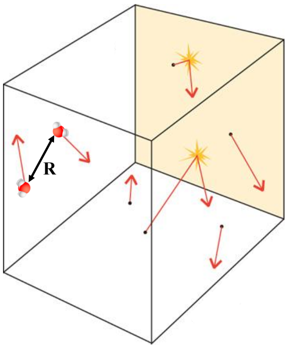


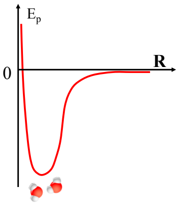


Växelverkansenergi mellan molekyler (potentiell energi)



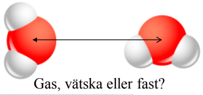
Därför är idealgas en så bra modell för gaser



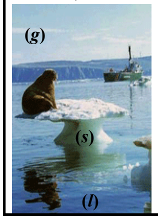


Intermolekylära och intramolekylära krafter

Intermolekära krafter
är **mellan** molekyler

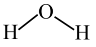


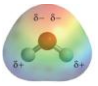
Gas, vätska eller fast?



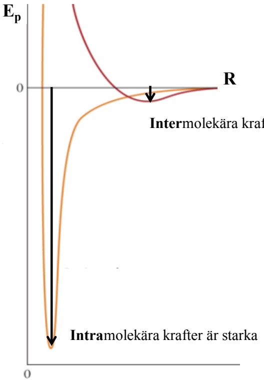
Intramolekära krafter
är **inom** molekyler

Kemisk bindning



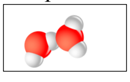


Energiskillnaden mellan inter- och intramolekylära krafter

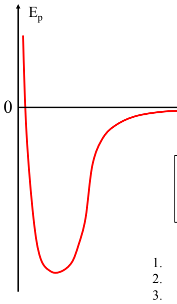


Hur uppstår repulsion och attraktion mellan molekyler?

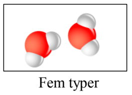
Repulsion



Repulsion mellan elektronerna



Attraktion



Fem typer

1. Jon-jon
2. Jon-dipol
3. Dipol-dipol
4. London
5. Vätebindning

Attraktiva typer av växelverkan

1. Jon-jon

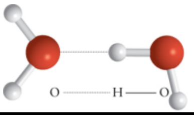
2. Jon-dipol

3. Dipol-dipol

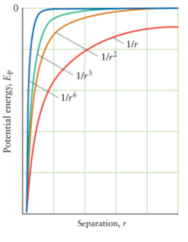
Attraktiva typer av växelverkan (fortsättning)

4. London

5. Vätebindning



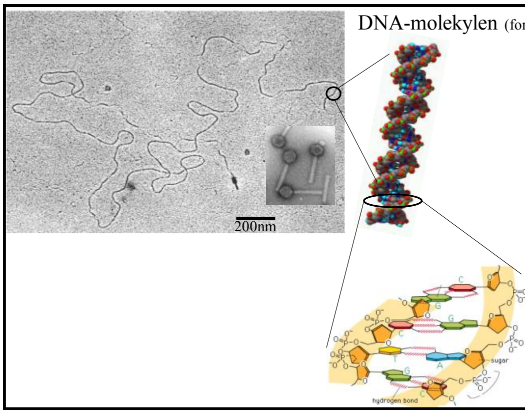
Attraktiva typer av växelverkan (översikt)



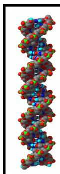
Type of interaction	Typical energy ($kJ\cdot mol^{-1}$)
ion–ion	250
ion–dipole	15
dipole–dipole	2
	0.3
dipole–induced-dipole	2
London (dispersion)†	2
hydrogen bonding	20

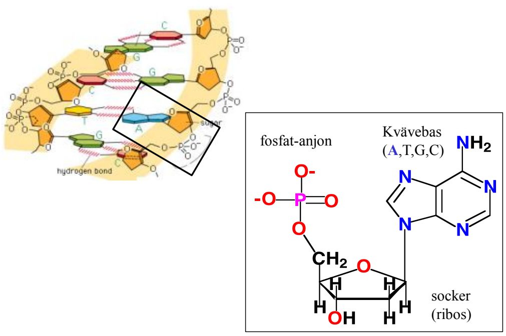
DNA-molekylen som exempel

DNA-molekylen (forts 1)

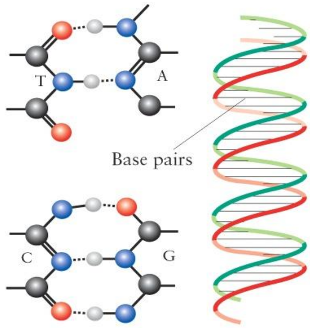


DNA-molekylen (forts 2)

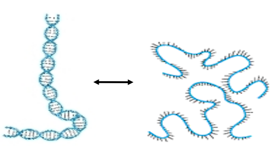




DNA-molekylen (forts 3)



Vilka intermolekylära krafter är viktiga för DNA?



Frågor

Varför är H_2O en vätska men H_2S en gas ?

Varför är Br_2 en vätska men I_2 ett fast ämne ?

Varför är margarin mjukt och smör hårt ?

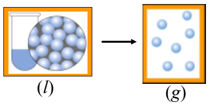
Varför är CH_3CH_2OH en vätska men CH_3OCH_3 en gas ?

Varför har is lägre densitet än vatten ?

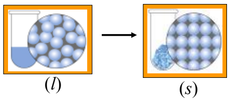
Varför förlorade Napoleon kriget mot Ryssland ?

Egenskaper hos vätskor

Kokpunkt



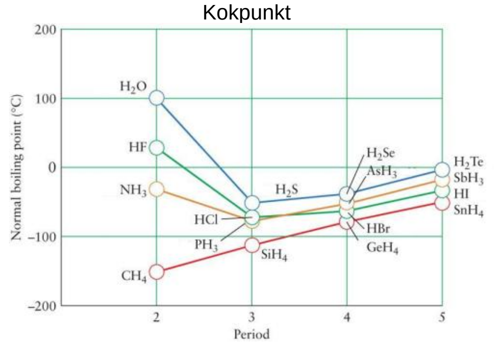
Fryspunkt



Viskositet

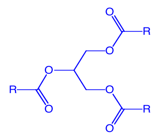
Ytspänning

Kokpunkt

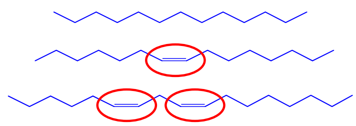


Smältpunkt

Varför är margarin mjukt och smör hårt ?

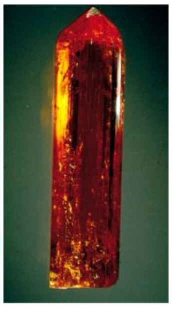


R=



Ytspänning

Fasta faser (solids)

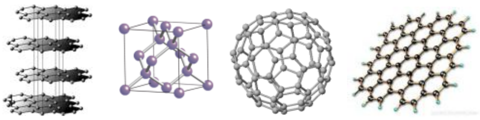


rubin **safir** **topaz**

Strukturer hos fasta ämnen

SiO_2: Kvarts och glas

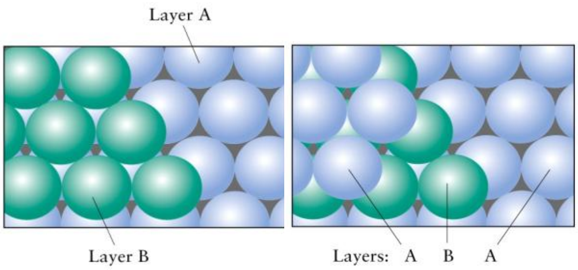
Kol: grafit, diamant, fulleren och grafen



Tätpackade ämnen
- Metaller
- Jonkristaller

Tätpackning

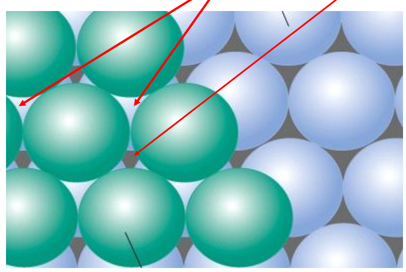
Tätpackning av metall-atomer



ABABAB = hcp (hexagonal close-packed)

Det 3:e lagret kan läggas på ett andra sätt
ABCABC = ccp (cubic close-packed)

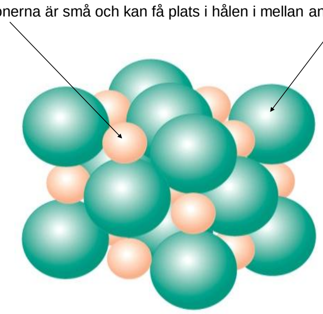
I en tätpackad struktur finns det tetraedriska och oktaedriska hål



Tetraedriska hål: två per atom och små
Oktaedriska hål: ett per atom och större

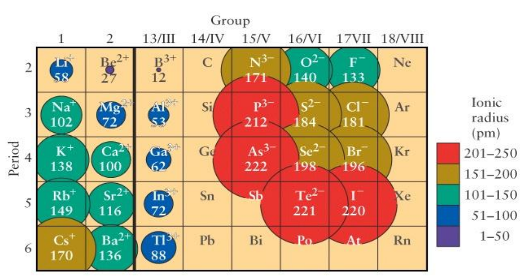
Tätpackning i saltkristaller

Katjonerna är små och kan få plats i hålen i mellan anjonerna

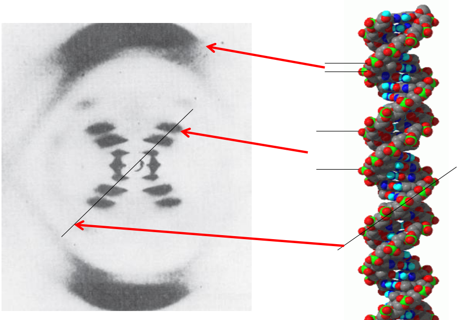


Anjoner och katjoners storlek

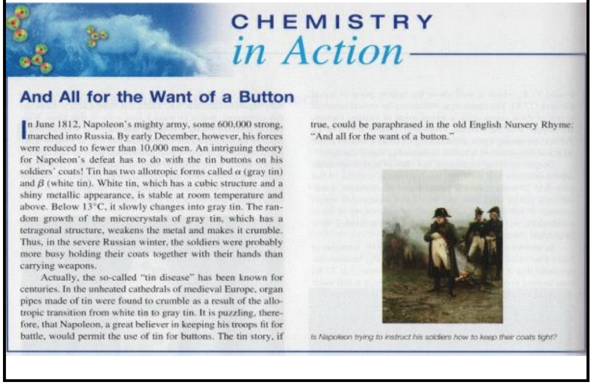
- Anjoner är stora katjoner är små
- Följer trender i periodiska systemet



DNA-strukturen från röntgenkristallografi



AJ s 203-204



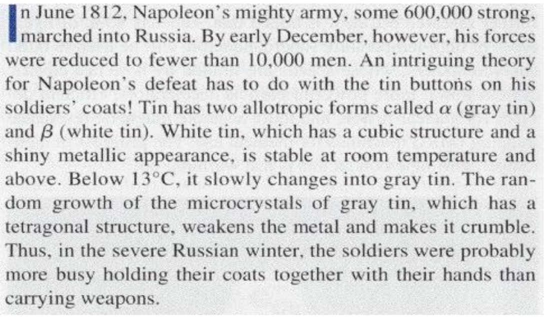
CHEMISTRY *in Action*

And All for the Want of a Button

In June 1812, Napoleon's mighty army, some 600,000 strong, marched into Russia. By early December, however, his forces were reduced to fewer than 10,000 men. An intriguing theory for Napoleon's defeat has to do with the tin buttons on his soldiers' coats! Tin has two allotropic forms called α (gray tin) and β (white tin). White tin, which has a cubic structure and a shiny metallic appearance, is stable at room temperature and above. Below 13°C, it slowly changes into gray tin. The random growth of the microcrystals of gray tin, which has a tetragonal structure, weakens the metal and makes it crumble. Thus, in the severe Russian winter, the soldiers were probably more busy holding their coats together with their hands than carrying weapons.

Actually, the so-called "tin disease" has been known for centuries. In the unheated cathedrals of medieval Europe, organ pipes made of tin were found to crumble as a result of the allotropic transition from white tin to gray tin. It is puzzling, therefore, that Napoleon, a great believer in keeping his troops fit for battle, would permit the use of tin for buttons. The tin story, if true, could be paraphrased in the old English Nursery Rhyme: "And all for the want of a button."

Is Napoleon trying to instruct his soldiers how to keep their coats tight?



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Tenn-pest

1 sekund av filmen motsvarar en timma i verkligheten
www.periodictable.ru
Youtube

Frågor och svar

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