

تفريغ فيزيكال

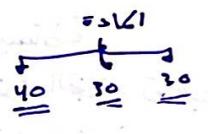


اسم الموضوع: Intermolecular
forces

إعداد الصيدلاني/ة: حلا سامر



لجان الزفعات



States of Matter

Dr Nizar Al-Zoubi

بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِیْمِ

(states of matter) (حالات المادة)

Binding forces between molecules

- For molecules to exist as aggregates in gases, liquids, and solids, intermolecular forces must exist.
- These intermolecular forces involve both attractive and repulsive forces.
- These forces must be balanced in an energetically favored arrangement for the molecules to interact.

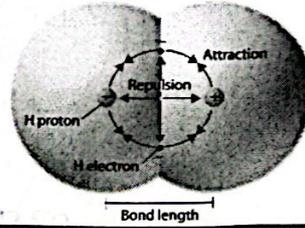
القوى
التجاذبية
طبيعية
المعاكسة

القوى

مثال: ... ذرات H اقترابا من بعضه ← H₂ (الذرة) قوى التجاذب تتغلب على قوى التنافر

Repulsive and Attractive Forces

- When two atoms or molecules are brought closer together, the opposite charges and binding forces in the two molecules are closer together than the similar charges and forces, causing the molecules to attract one another.
- When the molecules are brought so close that the similar charges touch, they repel each other like rigid elastic bodies.
- At a certain equilibrium distance, (about 3–4 Å), the repulsive and attractive forces are equal. At this position, the potential energy of the two molecules is a minimum and the system is most stable.



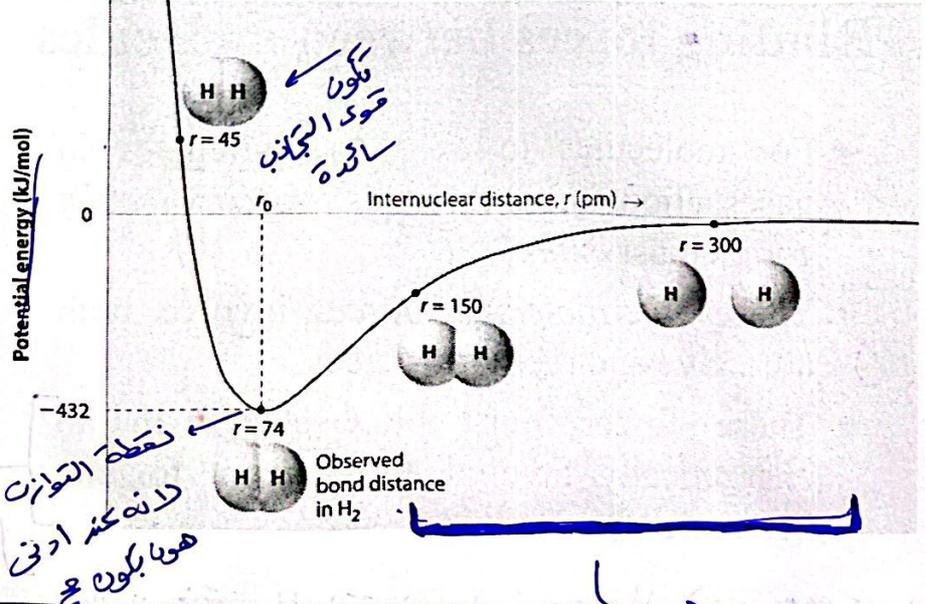
ببساطة
قوى التجاذب تعالج
قوى التنافر
تجاذب الجزيئات
تتقرب من بعضها
البعض
لكن في حالة
اقتراب كثير من
بعض وقتها
تصبح قوى التنافر
اقوى مما يكفي
لرد الجزيئات
على بعضها

كشأن صين لازم يكون
في مسافة محددة حتى
تكون مجموع القوى صفر.

④ قوى التجاذب تعتمد على
قرب المادة.

مثال: الزنبرك
مثلا
اد الكرة
المطاطية

Repulsive and Attractive Forces



يكون
قوى التجاذب
سائدة
نقطة التوازن
لانه كنه ادني طاقة
هوا يكون مجموع القوى صفر

لما هوون كما تزيد المسافة بشكل هفوط
تلقائيا رح تخلص قوى التنافر
فد رح تزداد الطاقة الكامنة
فيصبح في مستقر

Intermolecular forces

Intermolecular forces can be divided into:

- Van der Waals forces
- Ion-dipole interaction
- Ion-induced dipole interaction
- Ion-ion interaction
- Hydrogen bonds

قوى ضعيفة

① Van der Waals forces

- Van der Waal interactions are weak forces that involve the dispersion of charge across a molecule called a dipole.
- Van der Waal interactions can be classified into:
 - (A) Dipole-dipole interaction, orientation effect, or Keesom force
 - (B) Dipole-induced dipole interaction, induction effect, or Debye force
 - (C) Induced dipole-induced dipole interaction, dispersion effect, or London force

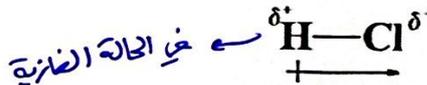
يعني بتشتت الشحنات و بتصرفهم عن بعض.

انواعها
القوى
القوى
القوى

@ Van der Waals forces

dipoles
دائري

- Keesom forces occur between polar molecules in which the permanent dipoles interact with one another (dipole-dipole interactions) or (orientation effect).
- Polar molecules have polar covalent bonds which are unevenly distributed in space due to the difference in the electronegativity of the atoms forming the bond e.g. HCl.
- The nucleus of the chlorine atom pulls the electron pair involved in the chlorine-hydrogen bond closer to itself and creates a permanent partial positive charge on the hydrogen and a permanent partial negative charge on the chlorine (Permanent dipole),



Dipole Moment has a Magnitude and a Direction

بسبب حركة الكهروسلبية

Cl يتسحب الالكترون ثوي لعنصرها

عشان هيك بتصير partially (جزئياً) سالبة.

Van der Waals forces

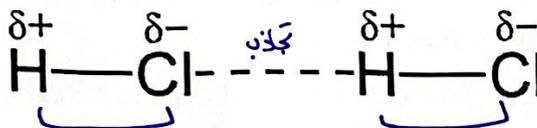
- The Partial opposite charges (permanent dipoles) attract one another (dipole-dipole interactions)
- The dipole-dipole forces increases as the polarity of the molecule increases.
- Keesom forces are much weaker than ionic bonds because the charges involved in bonding are partial.

كقوة جاذبية

Keesom < ionic

لأنه يكون هجول

جزئياً (partially)

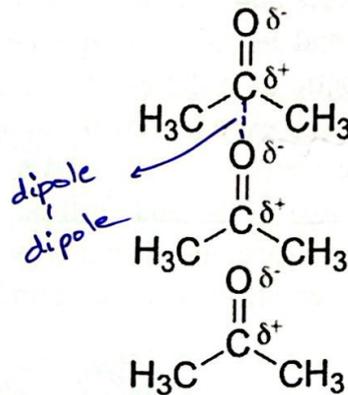


dipole-dipole ← قوة تجاذب
covalent ← روابط

Van der Waals forces

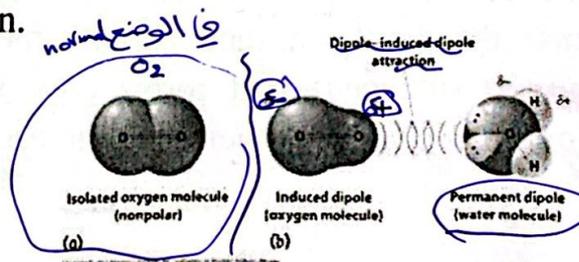
- Example of Keesom forces

- Acetone



(B) Van der Waals forces

- Debye forces occur between a polar and a nonpolar molecule in which the permanent dipole in the polar molecule induce an electric dipole in the non polar one (dipole-induced dipole interactions) or (induction effect) e.g. water and oxygen.



عندما يقترب من non polar من dipole رح يتكونه (electric dipole) في non polar ← هاد الكونتر رح يسبب

اقل في الكهروستاتيكية في O_2

5

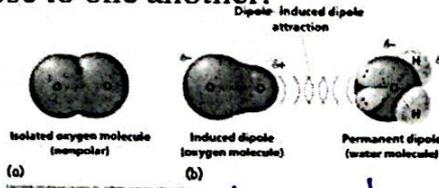
كحذاء بس .

O_2 لونه صاني
قوة في
الكهروستاتيكية
وينجلى على اي
جزية يكون
مدادتين متشابهات

مثاله :
هاد الهادي
بفسد ليه
لما مشط بلاستيك
وبفرقه بالهوف
واروح اقربيه
كل جوهنارة فحطب .

Van der Waals forces

- The oxygen molecule is nonpolar. However, when it comes close to the oxygen atom in a water molecule, the partial negative charge on the oxygen atom repels the electrons in the oxygen molecule. This causes (induces) a temporary partial positive charge in the end closest to the water molecule and a buildup of a partial negative charge in the end furthest away. This induced dipole is temporary and forms only when the two molecules are extremely close to one another.



طبقة يحدث فقط
لها O_2 تقرب
الى dipole

الشفة الجزئية الالبة في جزيء الماء
تعمل على جذب الالكترونات .

كسارج يتكون عذري (induced)

تج يصير لاحظة فقط في وقت تقرب

لكن في الوضع
الطبيعي ما
يتكون شفة جزئية.

Van der Waals forces

- The strength of Debye forces increases with the ease of distortion of the electron cloud of the nonpolar molecule (i.e. polarizability of the molecule).
- Debye forces is weaker than Keesom forces because the dipole in the nonpolar molecule is temporary (induced) and forms only when the two molecules are extremely close to each other.

سهولة
تشهيت

كتابة الالكترونات
في (non polar)

زني ما صاخر في O_2 .

شدة

يصني كل ما

بتقشنت
في الالكترونات
non polar

اسرع

تلكه القوي

more stronger

* كل نوع من القوى أكثر من الآخر لأنهم لا ينفصلون .

أضعف

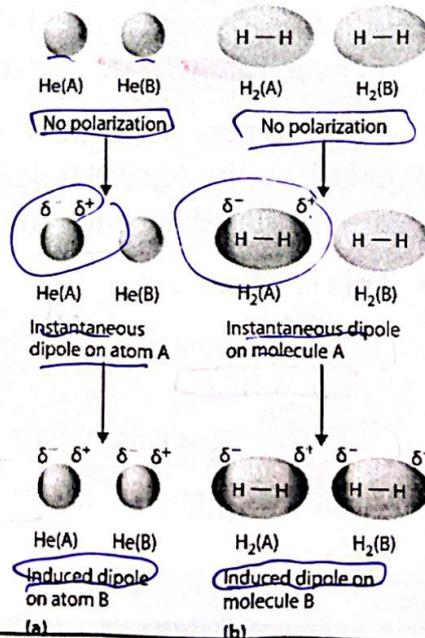
© Van der Waals forces

- London forces occur between **two nonpolar (neutral)** molecules in which molecules can **induce** polarity on each other (*induced dipole-induced dipole interactions*) or (*dispersion effect*). e.g. *Helium, Neon, hydrocarbons...*

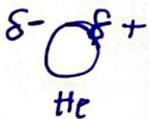
غازات خاملة

Van der Waals forces

- This attraction is produced by **temporary asymmetry** in the **distribution of the electrons around the nucleus.**



بسبب الحركة العشوائية
للكيرونات
فوجدت اختلاف/ فرق
في توزيع الالكترونات
للجزيء .

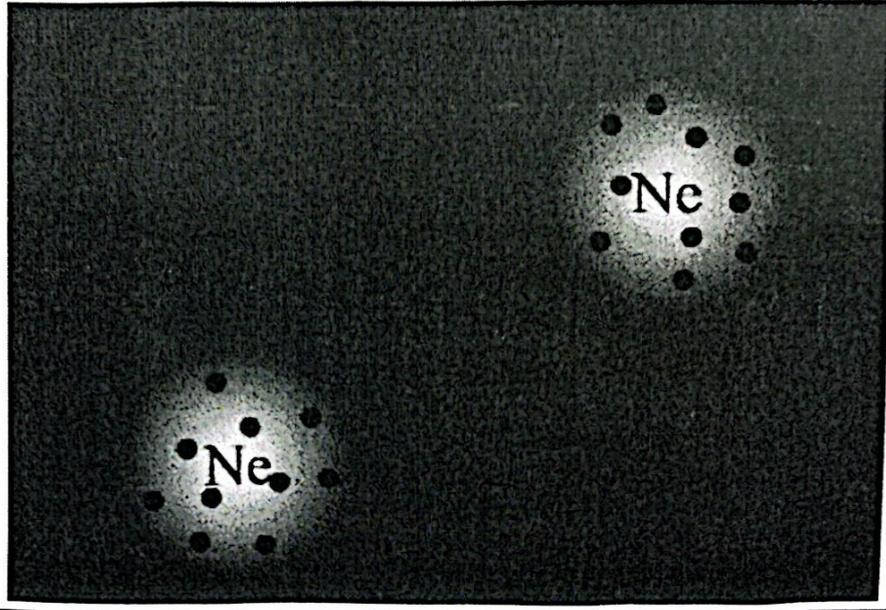


ليكون induced dipole B

لأنه اقرب منه جزيء dipole

بالتالي رح يكون induced dipole

Van der Waals forces



Van der Waals forces

- London forces occur between all atoms and molecules (between polar/polar and polar/nonpolar molecules as well)
- The larger the atom or molecule, the greater its polarizability (easier to induce a momentary dipole) and the stronger the dispersion forces become.
- This is because:
 - ① The electrons are farther from the positive nucleus and so are held less strongly
 - ② The number of electrons is greater الذرة أكبر فالعدد أكبر
- London Force is the weakest of all the intermolecular forces.

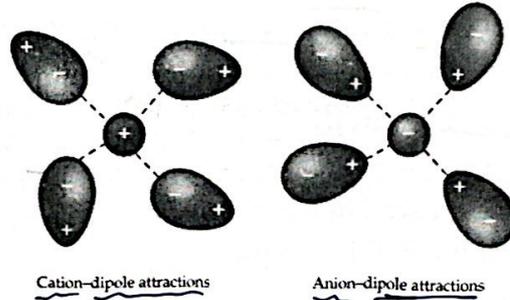
كلما كان الجزيء أكبر
امكانيته polariz أكبر

طوب
ليه؟

اقوى من قوى الترابط الجزيئية

2 Ion-dipole forces

- Ion-dipole forces occur between a charged ion and a polar molecule (i.e. a molecule with a dipole). Cations are attracted to the negative end of a dipole, while anions are attracted to the positive end of a dipole.



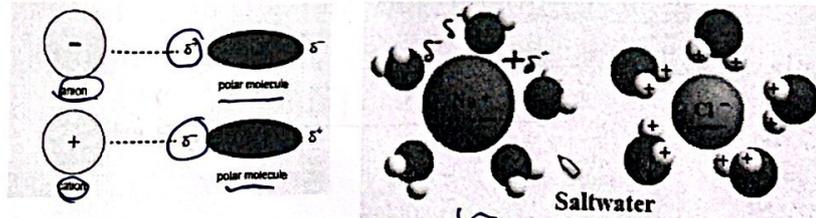
مثال :
 الاملاح في
 ذوبانها في الماء
 NaCl
 ذرات يهبطيني
 Na^+ , Cl^-

اذا كان عليه + فهو dipole

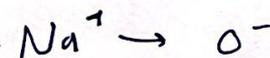
== = فقط + أو - فهو dipole
 + ← - ←

Ion-dipole forces

- These types of interactions account in part for the solubility of ionic crystalline substances in water; the cation, for example, attracts the relatively negative oxygen atom of water and the anion attracts the hydrogen atoms of the dipolar water molecules.



NaCl

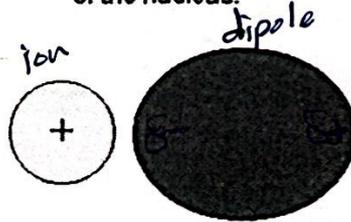


③ Ion-Induced dipole

- Ion-Induced dipole forces occur between a charged ion and a nonpolar molecule.
- These forces result when the approach of an ion induces a dipole in an atom or in a nonpolar molecule by disturbing the arrangement of electrons
- Ion-induced dipole forces are presumably involved in the formation of the iodide complex
- $I_2 + K + I^- = K + I_3^-$



Spherical atom with no dipole.
The dot indicates the location of the nucleus.



Upon approach of a charged ion, electrons in the atom respond and the atom develops a dipole.


 اة يون I⁻ يتفاعل مع جزيء اخر
 ويكون I₃⁻

non polar (A) atom induces (ion)
 molecule . فيتكون dipole
 بسبب توزيع الالكترونات

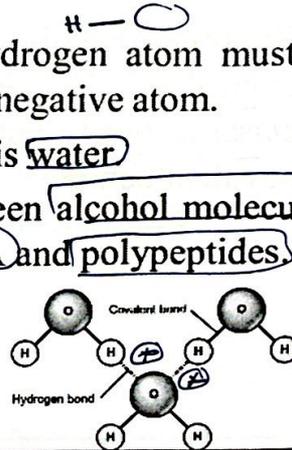
④ Ion-ion interactions

- A cation on one compound will interact with an anion of another compound. بين الجزيئات
- Ion-ion interactions may be intermolecular (e.g. a hydrochloride salt of a drug) or intramolecular (e.g., a salt bridge interaction between counter ions in proteins).
 كاتيون جزيء

داخل
 الجزيء
 ممكن
 داخل
 البروتين

⑤ Hydrogen bond

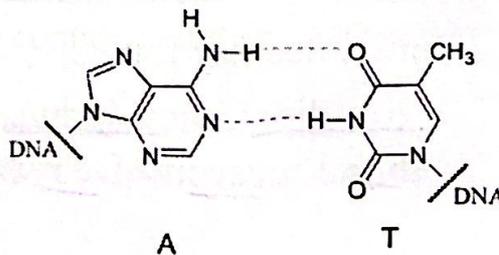
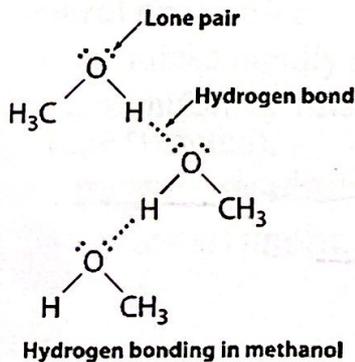
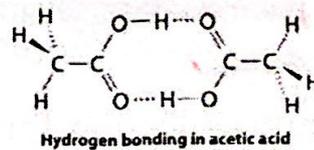
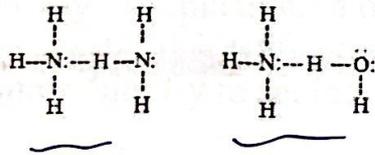
- Hydrogen bond is a strong type of dipole-dipole interaction that occurs between a molecule containing a hydrogen atom and a strongly electronegative atom such as fluorine, oxygen, or nitrogen.
- In order to create the bond, the hydrogen atom must be covalently attached to another electronegative atom.
- A perfect example of hydrogen bond is water.
- Hydrogen bonds can also exist between alcohol molecules, carboxylic acids, aldehydes, and DNA and polypeptides.



ذرة H وتبند ب O الجزيء الآخر
ب رابطة هيدروجينية.

Hydrogen bond

Examples



Hydrogen bond

- Hydrogen bonds are responsible for many unusual physical properties of water including its abnormally low vapor pressure, high boiling point, and the greater volume of ice water.
- Hydrogen bonding is stronger than all Van der Waals intermolecular forces (they are given their own classification), but are still weaker than ionic and covalent bonds.

السبب هو
قوة hydrogen bond

كل المواد
الصلة كقوة اعلى
فتمنخفضه للإسفل
في الماء
الألماء في دالتة
الصلة (الجليد)
ليطو للاحه
كقوة امك
مقال بل

ملخص Bond energies

- Bond energy is a measure of the strength of bond.

Intramolecular forces:

Ionic > covalent > metallic

Intemolecular forces:

- Ion-dipole > ion-induced dipole > hydrogen bond > keesom > Debye > London