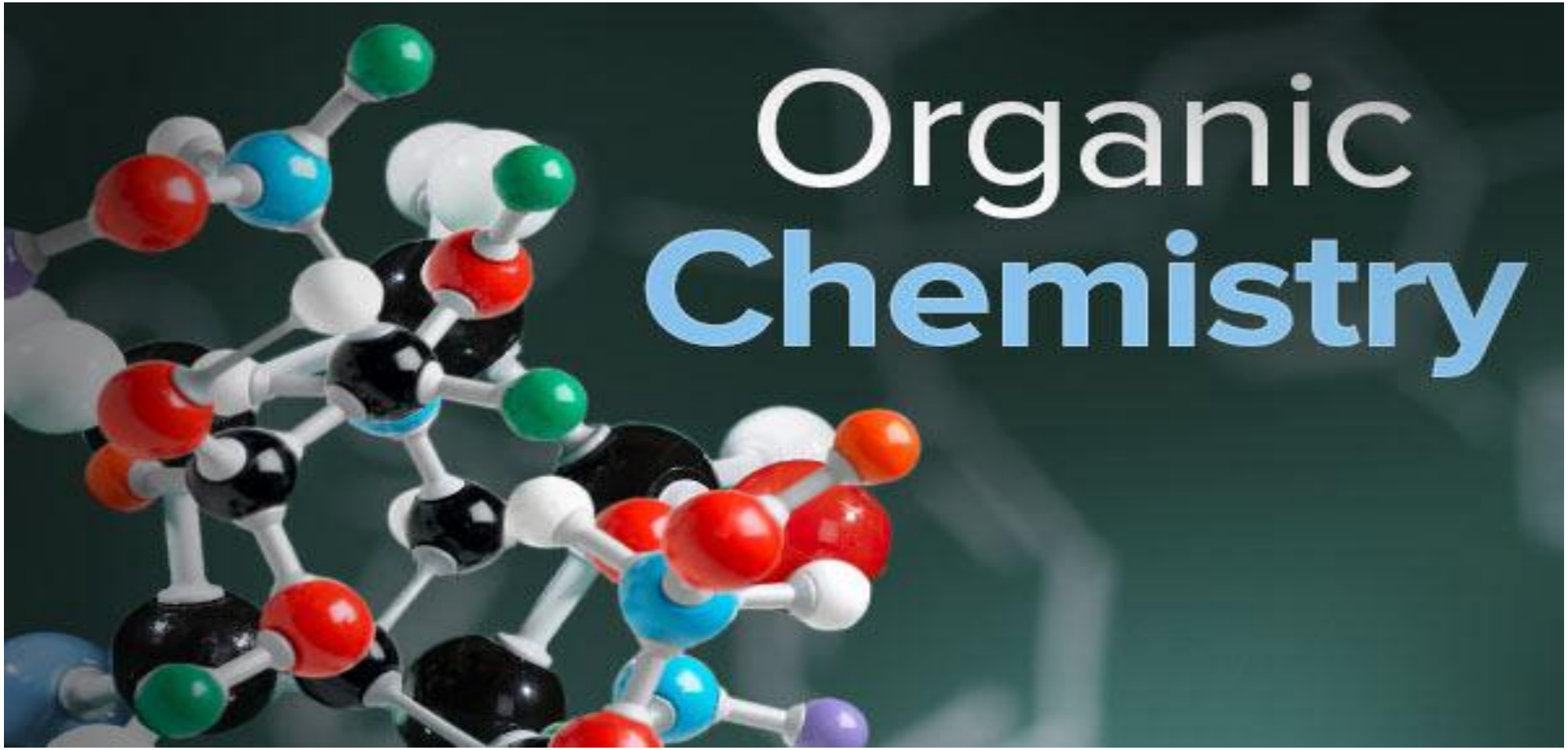
الكلية	العلوم
القسم	الكيمياء
المادة باللغة الانجليزية	Organic Chemistry
المادة باللغة العربية	الكيمياء العضوية
المرحلة الدراسية	الاولى
اسم التدريسي	محمد عدنان عبد منديل
عنوان المحاضرة باللغة الانجليزية	Dipole Moment
عنوان المحاضرة باللغة العربية	عزم ثنائي الاقطاب
رقم المحاضرة	الثانية
المصادر والمراجع	الكيمياء العضوية لمؤلفه (كلايدن)
	مبادي الكيمياء العضوية لمؤلفيه (موريون و بويد)



Organic Chemistry 1st level

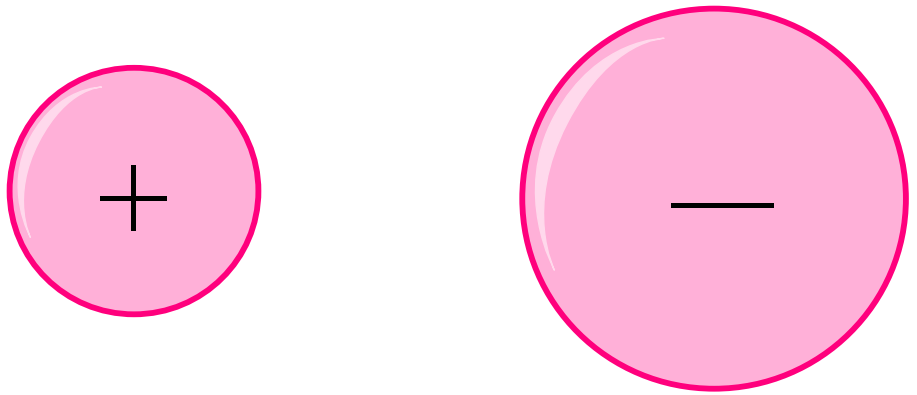
Introduction to Organic Chemistry

- Dipole Moments
- Structure
- Resonance (we may not able to cover this in our lecture today)

Introduction to Organic Chemistry

Dipole Moment

It occurs when there is a separation of charge, this happen when atoms in a molecule share electrons unequally.



It can also occur between two ions in an ionic bond or between atoms in a covalent bond

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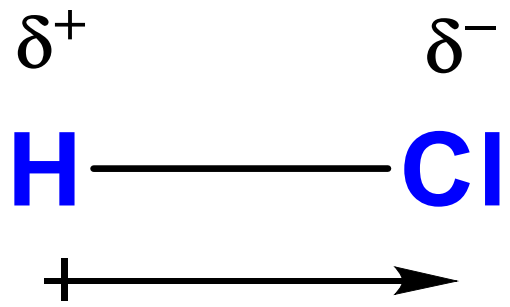
Dipole Moment occurs

- when one atom is more electronegative than another, resulting in that atom pulling more tightly on the shared pair of electrons.



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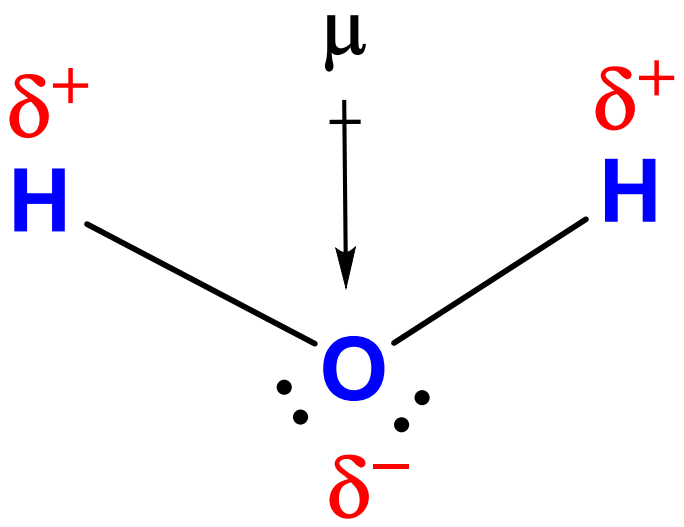
- when one atom has a lone pair of electrons and the difference of electronegativity vector points in the same way e.g H_2O



μ: is the Dipole Moments and measured by Debye unit

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- The dipole moment has a magnitude and a direction.
- It can be noted that the symbols δ^+ and δ^- represent the two electric charges that arise in a molecule which are equal in magnitude but are of opposite signs.
- Dipole moment decreases when the bond length is increasing.
- Dipole moment is proportional with electronegativity.

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Table 1: *Relationship between Bond length, Electronegativity and Dipole moments in simple Diatomics*

Compound	Bond Length (Å)	Electronegativity Difference	Dipole Moment (D)
HF	0.92	1.9	1.82
HCl	1.27	0.9	1.08
HBr	1.41	0.7	0.82
HI	1.61	0.4	0.44

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Polarity and Structure of Molecules

- The shape of a molecule and the polarity of its bonds determine the OVERALL POLARITY of that molecule.
- A molecule that contains polar bonds, might not have any overall polarity, depending upon its shape.
- The simple definition of whether a complex molecule is polar or not depends upon whether its overall centers of positive and negative charges overlap.
- If these centers lie at the same point in space, then the molecule has no overall polarity (and is non polar). If a molecule is completely symmetric, then the dipole moment vectors on each molecule will cancel each other out, making the molecule nonpolar.
- A molecule can only be polar if the structure of that molecule is not symmetric.

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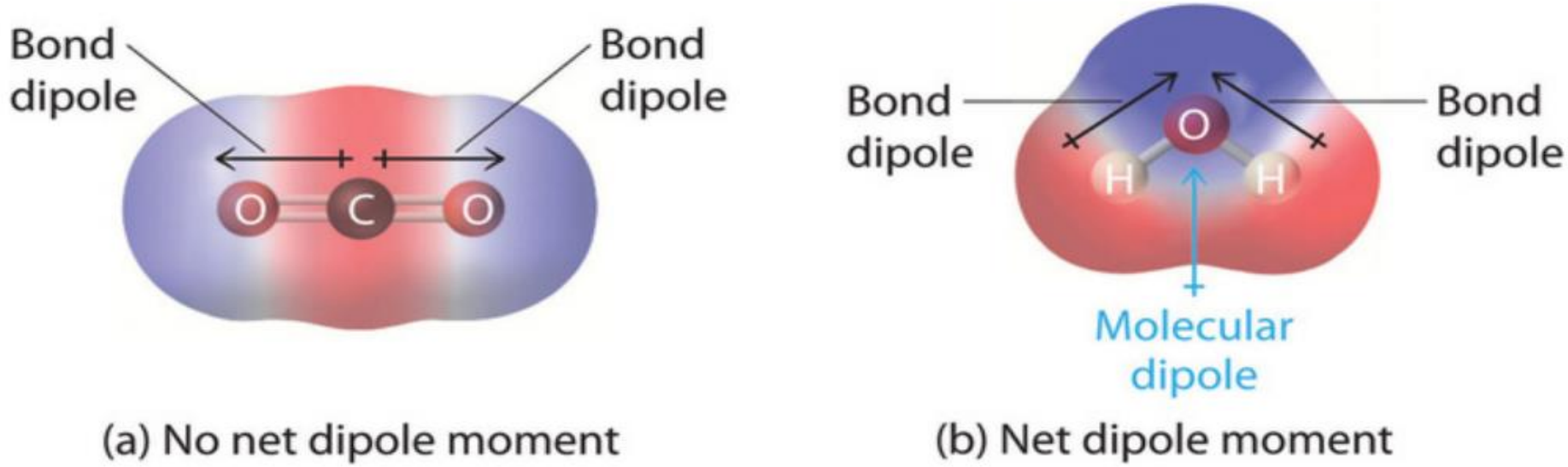
Polarity and Structure of Molecules



- A good example of a nonpolar molecule that contains polar bonds is carbon dioxide (in Figure above in the left). This is a linear molecule and each C=O bond is, in fact, polar. The central carbon will have a net positive charge, and the two outer oxygen atoms a net negative charge. However, since the molecule is linear, these two bond dipoles cancel each other out (*i.e.* the vector addition of the dipoles equals zero) and the overall molecule has a zero dipole moment ($\mu=0$).

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Bonds dipoles in BeF_2

Total bond moment in BeF_2

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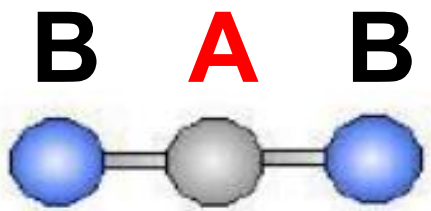
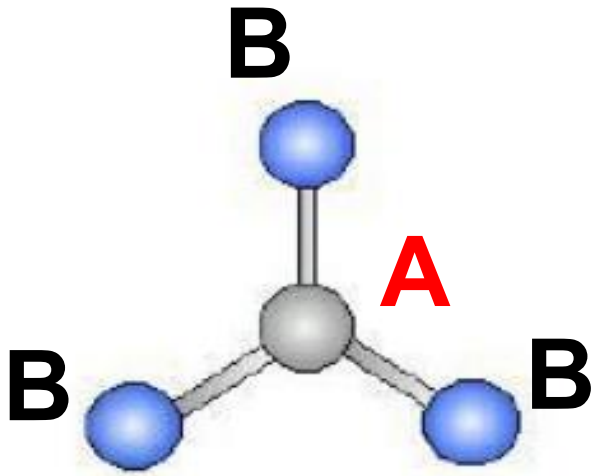
Polarity and Structure of Molecules

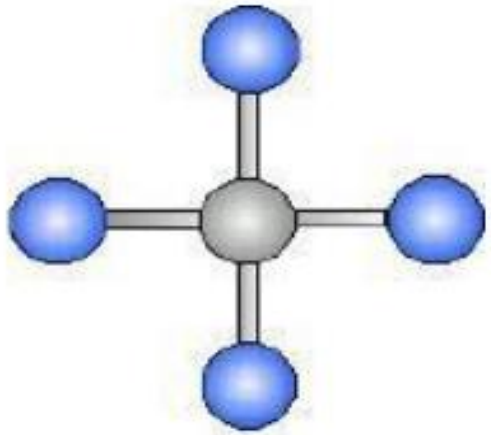
For AB_n molecules, where A is the central atom and B are all the same types of atoms, there are certain molecular geometries which are symmetric. Therefore, they will have no dipole even if the bonds are polar. These geometries include linear, trigonal planar, tetrahedral, octahedral and trigonal bipyramid.



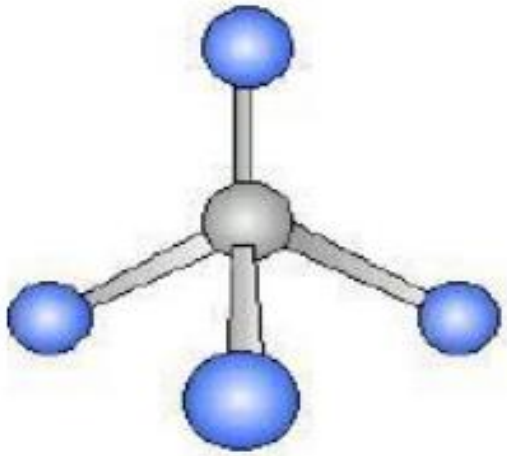
Linear



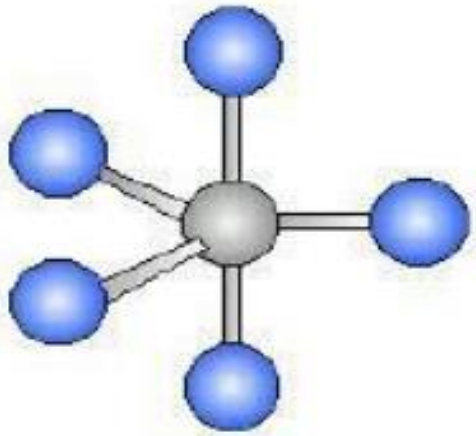
Trigonal Planar



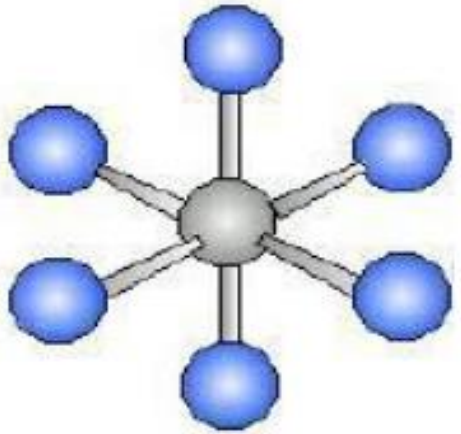
Square Planar



Tetrahedral



Trigonal Bipyramidal



Octahedral

Molecular geometries with exact cancellation of polar bonding to generate a non-polar molecule ($\mu = 0$)

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To summarise

- The bond dipole moment uses the idea of electric dipole moment to measure the polarity of a chemical bond within a molecule. It occurs whenever there is a separation of positive and negative charges.
- The shape of a molecule and the polarity of its bonds determine the OVERALL POLARITY of that molecule.
- If a molecule is completely symmetric, then making the molecule nonpolar.
- These geometries include linear, trigonal planar, tetrahedral, octahedral and trigonal bipyramid will have no dipole moment even if the bonds are polar.

Thank you for attention