Chemistry Class 11 NCERT Solutions: Chapter 4 Chemical Bonding and Molecular Structure Part 4

Q: 16 Whrite the significance/applications of dipole moment.

Answer:

In heteronuclear molecules, polarization arises due to a difference in the electronegativities of the constituents of atoms. As a result, one end of the molecule acquires a positive charge while the other end becomes negative. Hence, a molecule is siad to possess a dipole.

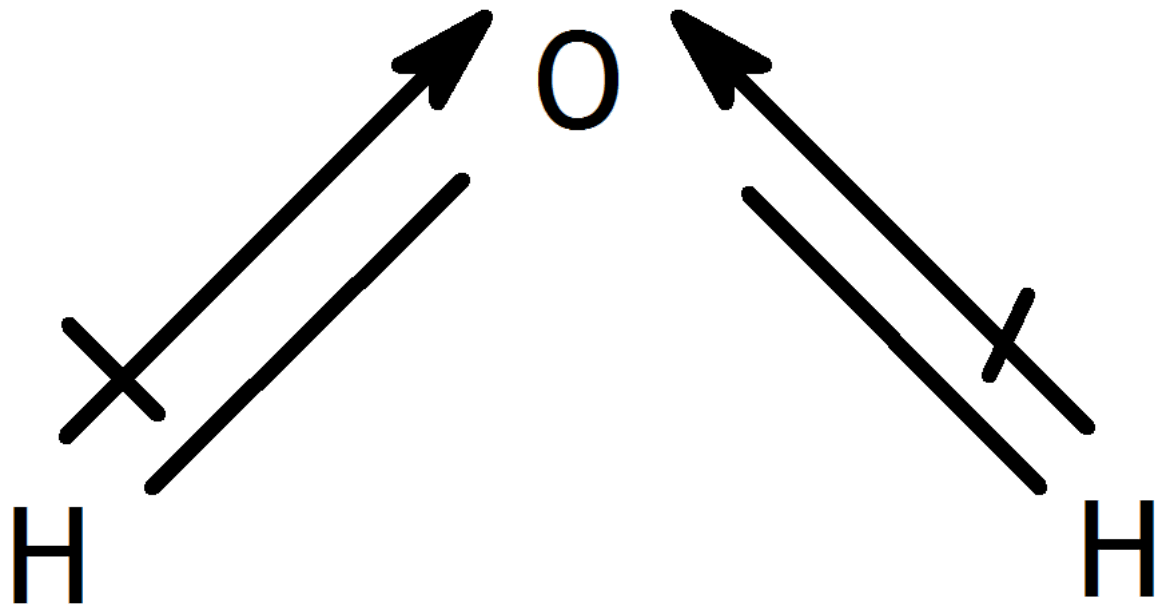
The product of the magnitude of the charge and the distance between the centres of positive-negative charges is called the dipole moment ( ) of the molecule. It is a vector quantity and is represented by an arrow with its tail at the positive centre and head pointing towards a negative centre.

Dipole moment ( ) = charge (Q) × distance of separation (r)

The SI unit of a dipole moment is $'esu'$.

$1\ esu = 3.335 \times 10^{-30}$ cm

Dipole moment is the measure of the polarity of a bond. It is used to differentiate between polar and non-polar bonds since all non – polar molecules $(e.g. H_2, O_2)$ have zero dipole moments. It is also helpful in calculating the percentage ionic character of a molecule.



$\mu = 1.84D\ \mu = 0 \mu = 1.84D\ \mu = 0$

Q: 17 Define electronegativity. How does it differ from electron gain enthalpy?

Answer:

Electronegativity is the ability of an atom in a chemical compound to attract a bond pair of electrons towards itself.

Electronegativity of any given element is not constant. It varies according to the element to which it is bound. It is not a measurable quantity. It is only a relative number. On the other hand, electron gain enthalpy is the enthalpy change that takes place when an electron is added to a neutral gaseous atom to form an anion. It can be negative or positive depending upon whether the electron is added or removed. An element has a constant value of the electron gain enthalpy that can be measured experimentally.

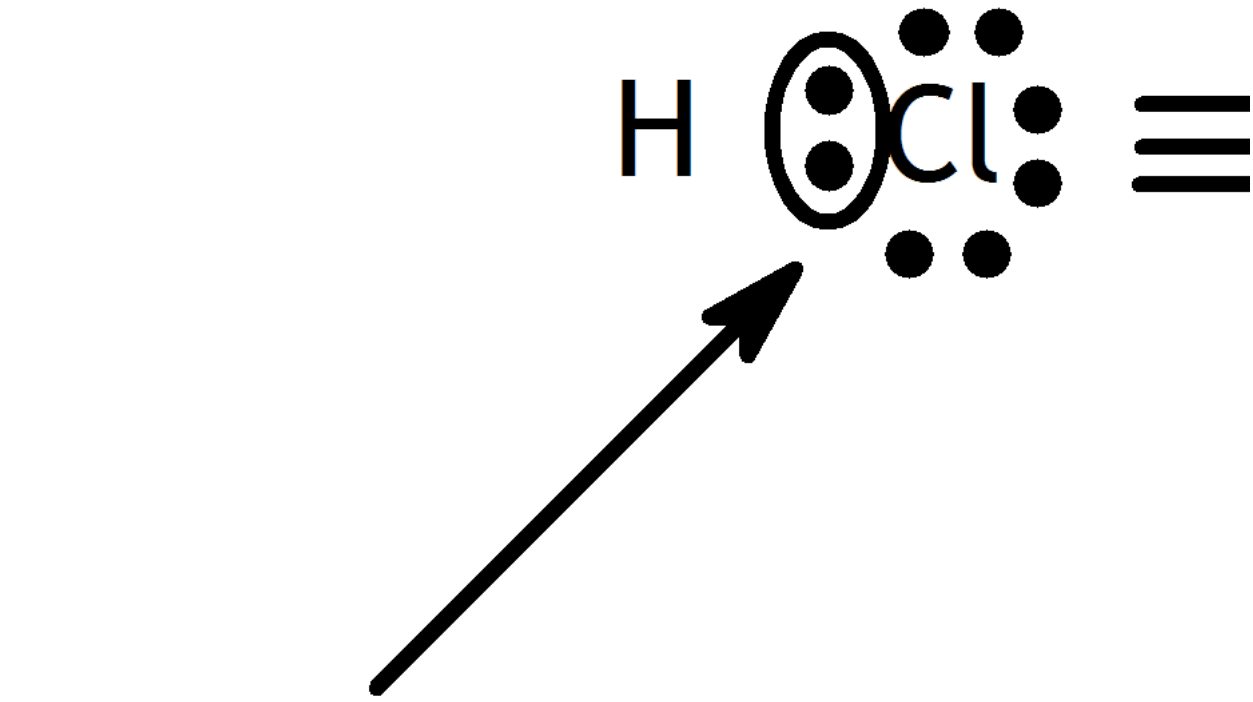
Q: 18 Explain with the help of suitable example polar covalent bond.

Answer:

When two dissimilar atoms having different electronegativities combine to form a covalent bond, the bond pair of electrons is not shared equally. The bond pair shifts towards the nucleus of the atom having greater electronegativity. As a result, electron distribution gets distorted and the electron cloud is displaced towards the electronegative atom.

As a result, the electronegative atom becomes slightly negatively charged while the other atom becomes slightly positively charged. Thus, opposite poles are developed in the molecule and this type of a bond is called a polar covalent bond.

HCI, for example, contains a polar covalent bond. Chlorine atom is more electronegative than hydrogen atom. Hence, the bond pair lies towards chlorine and therefore, it acquires a partial negative charge.



Bond pair attracted n
toward

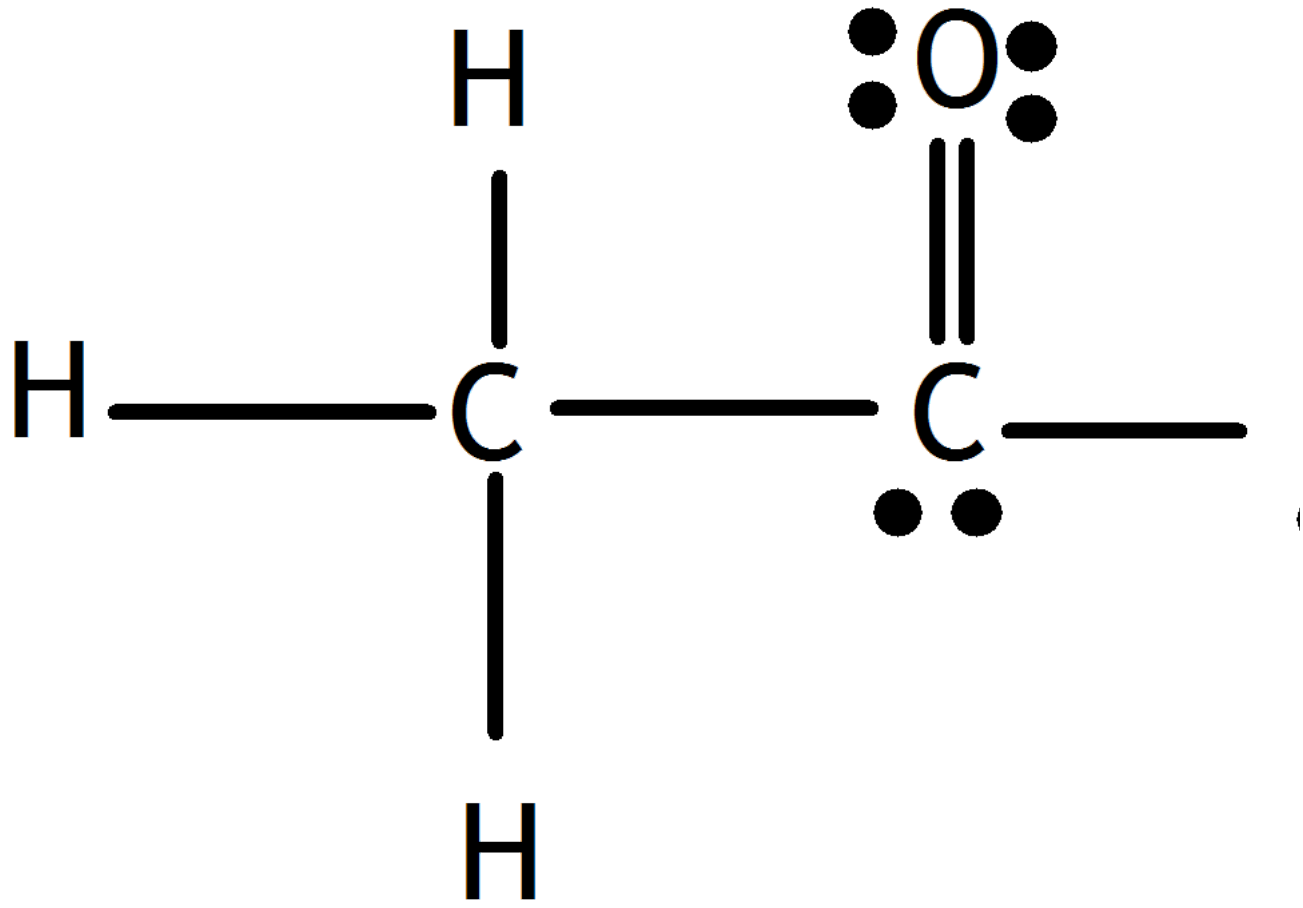
Q: 19 Arrange the bonds in order of increasing ionic character in the molecules: LiF, K_2O, N_2, SO_2 and ClF_3.

Answer:

The ionic character in a molecule is dependent upon the electronegativity difference between the constituting atoms. The greater the difference, the greater will be the ionic character of the molecule.

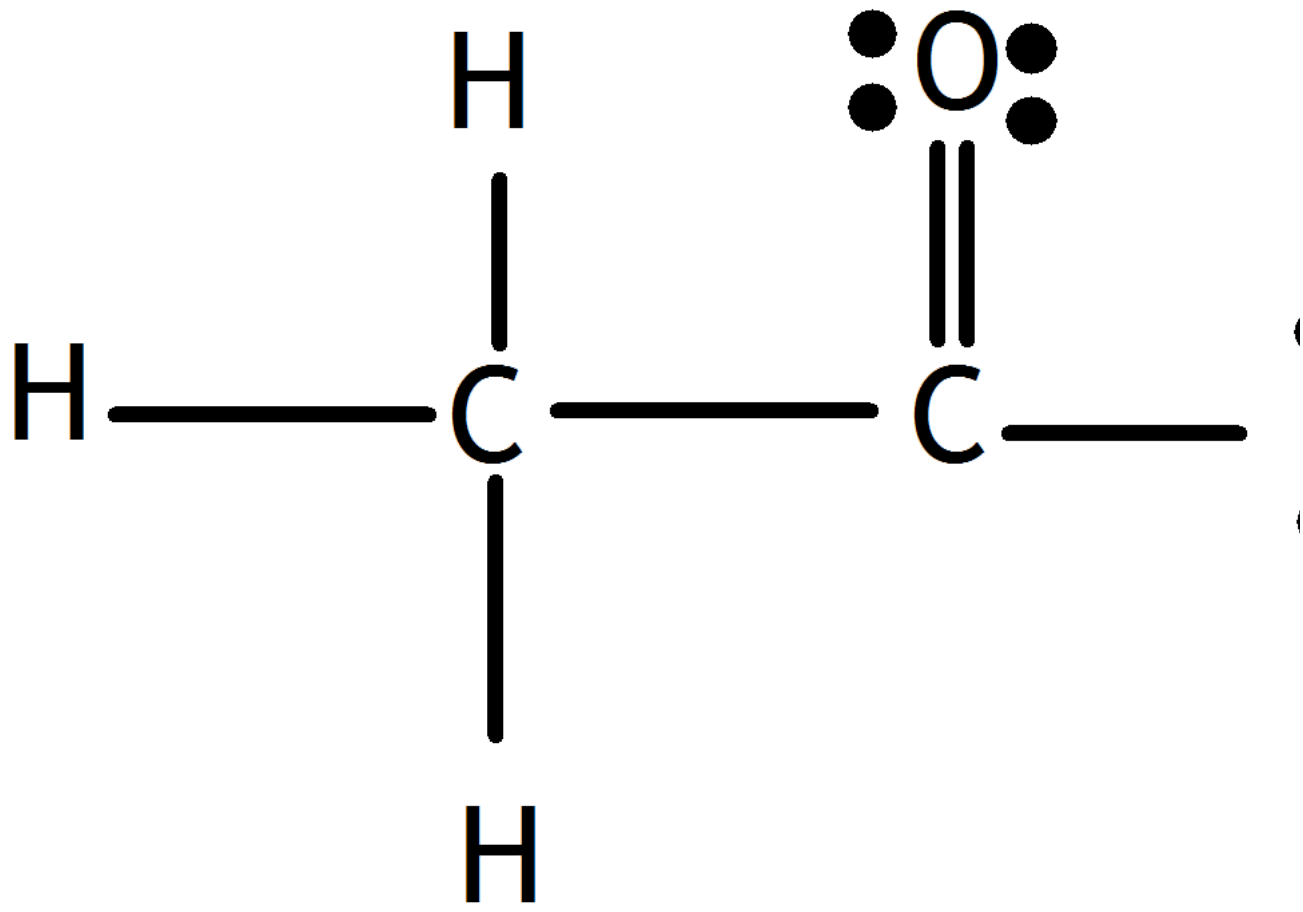
On this basis, the order of increasing ionic character in the given molecules is $N_2 < SO_2 < ClF_3 < K_2O < LiF$.

Q: 20 The skeletal structure of CH_3COOH as shown below is correct, but some of the bonds are shown incorrectly. Write the correct Lewis Structure for acetic acid.



Answer:

The correct Lewis Structure for acetic acid as follows:



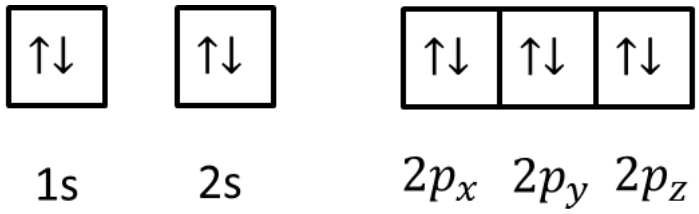
Q: 21 Apart from tetrahedral geometry, another possible geometry for CH_4 is square planar with the four H atoms at the corners of the square and C atom at its centre. Explain why CH_4 is not square planar?

Answer:

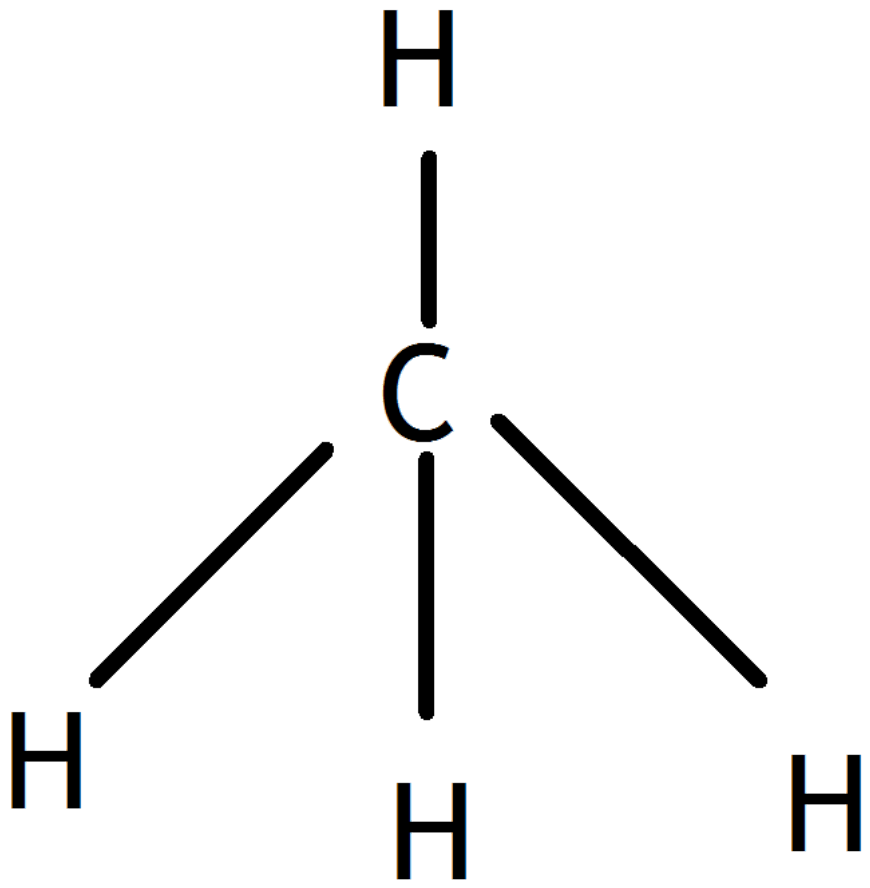
Electronic configuration of carbon atom:

$_6C : 1s^2 2s^2 2p^2$

In the excited state, the orbital picture of carbon can be represented as:



Hence, carbon atom undergoes sp^3 hybridization in CH_4 molecule and takes a tetrahedral shape.



For a square planar shape, the hybridization of the central atom has to be dsp^2 . However, an atom of carbon does not have d – orbitals to undergo dsp^2 hybridization.

Hence, the structure of CH_4 cannot be square planar.

Moreover, with a bond angle of 90° in square planar, the stability of CH_4 will be very less because of the repulsion existing between the bond pairs. Hence, VSEPR theory also supports a tetrahedral structure for CH_4 .