Chemistry Study Materials for Class 11
(NCERT Questions -Answers of Chapter- 04)
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CHEMICAL BONDING AND MOLECULAR STRUCTURE

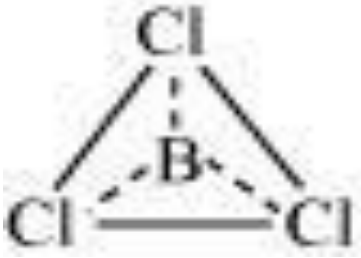
Question 4.7: Discuss the shape of the following molecules using the VSEPR model: $BeCl_2$, BCl_3, $SiCl_4$, AsF_5, H_2S, PH_3

Answer: **$BeCl_2$:**

The central atom has no lone pair and there are two bond pairs. i.e., $BeCl_2$ is of the type AB_2. Hence, it has a linear shape.

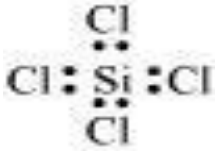
BCl_3:

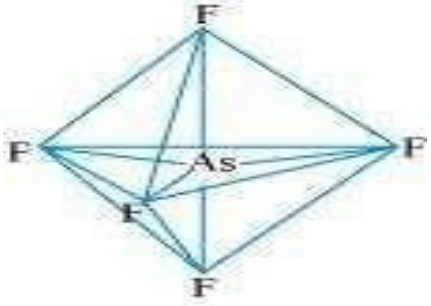
The central atom has no lone pair and there are three bond pairs. Hence, it is of the type AB_3. Hence, it is trigonal planar.



$SiCl_4$:

The central atom has no lone pair and there are four bond pairs. Hence, the shape of $SiCl_4$ is tetrahedral being the AB_4 type molecule.





AsF_5: The central atom has no lone pair and there are five bond pairs.

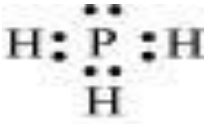
Hence, AsF_5 is of the type AB_5. Therefore, the shape is trigonal bipyramidal.

H_2S: The central atom has one lone pair and there are two bond pairs.

Hence, H_2S is of the type AB_2E. The shape is Bent.

PH_3: The central atom has one lone pair and there are three bond pairs.

Hence, PH_3 is of the AB_3E type. Therefore, the shape is trigonal bipyramidal.



Question 4.8: Although geometries of NH_3 and H_2O molecules are distorted tetrahedral, bond angle in water is less than that of ammonia. Discuss.

Answer: The molecular geometry of NH_3 and H_2O can be shown as:

The central atom (N) in NH_3 has one lone pair and there are three bond pairs. In H_2O, there are two lone pairs and two bond pairs.

The two lone pairs present in the oxygen atom of H_2O molecule repels the two bond pairs. This repulsion is stronger than the repulsion between the lone pair and the three bond pairs on the nitrogen atom.

Since the repulsions on the bond pairs in H_2O molecule are greater than that in NH_3, the bond angle in water is less than that of ammonia.

Question 4.9: How do you express the bond strength in terms of bond order?

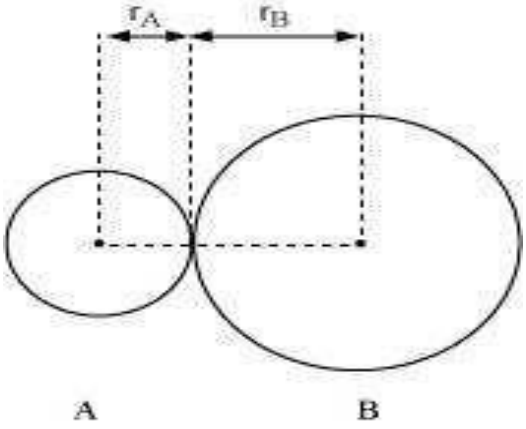
Answer: Bond strength represents the extent of bonding between two atoms forming a molecule. The larger the bond energy, the stronger is the bond and the greater is the bond order**.**

Question 4.10: Define the bond length.

Answer: Bond length is defined as the equilibrium distance between the nuclei of two bonded atoms in a molecule**.**

Bond lengths are expressed in terms of Angstrom (10^{-10} m) or picometer (10^{-12} m) and are measured by spectroscopic X-ray diffractions and electron-diffraction techniques.

In an ionic compound, the bond length is the sum of the ionic radii of the constituting atoms ($d = r_+ + r_-$). In a covalent compound, it is the sum of their covalent radii ($d = r_A + r_B$).

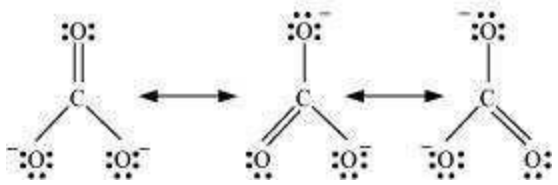


Question 4.11: Explain the important aspects of resonance with reference to CO_3^{2-} the ion.

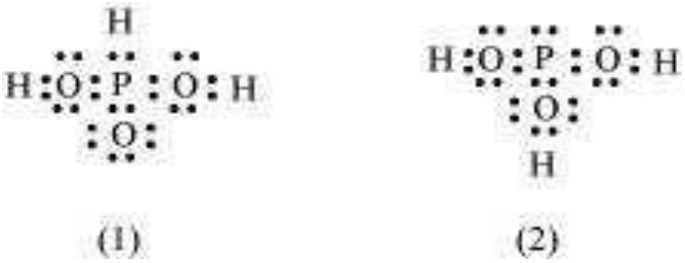
Answer: According to experimental findings, all carbon to oxygen bonds in CO_3^{2-} are equivalent.

Hence, it is inadequate to represent CO_3^{2-} ion by a single Lewis structure having two single bonds and one double bond.

Therefore, carbonate ion is described as a resonance hybrid of the following structures:



Question 4.12: H_3PO_3 can be represented by structures 1 and 2 shown below. Can these two structures be taken as the canonical forms of the resonance hybrid representing H_3PO_3? If not, give reasons for the same.



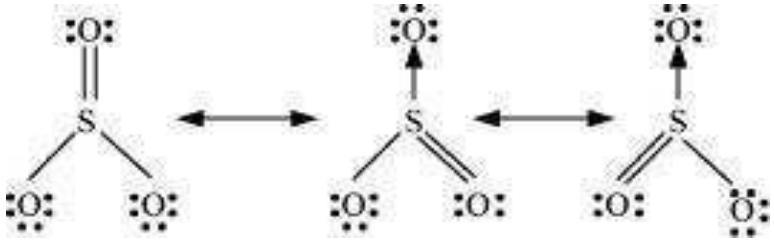
(1) (2)

Answer: The given structures cannot be taken as the canonical forms of the resonance hybrid of H_3PO_3 because the positions of the atoms have changed.

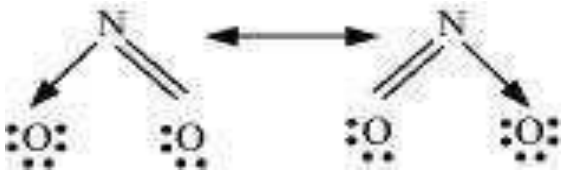
Question 4.13: Write the resonance structures for SO_3, NO_2 and .

Answer: The resonance structures are:

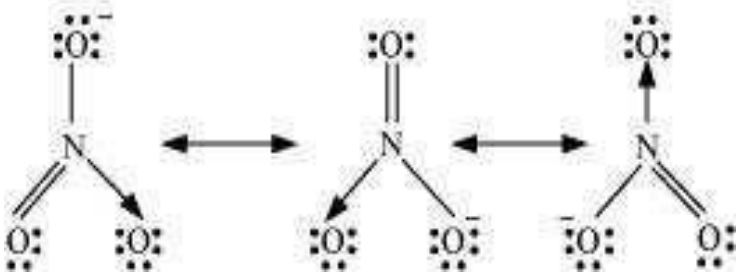
(a) SO_3:



NO_2 :



(c) NO_3^-:



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