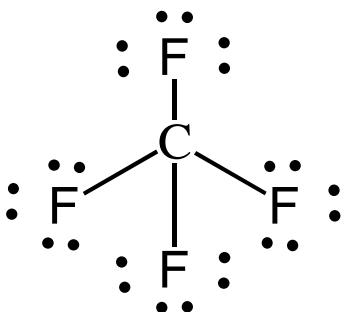


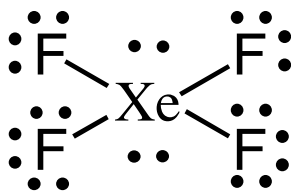
Ch. 8 AP Review Answers

- 1)  $\text{CF}_4$                        $\text{XeF}_4$                        $\text{ClF}_3$

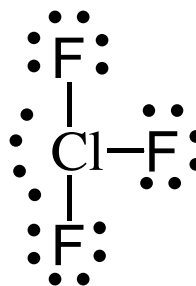
(a) Draw a Lewis electron-dot structure for each of the molecules above and identify the shape of each.



*Tetrahedral*



*Square planer*



*T-shaped*

(b) Use the valence shell electron-pair repulsion (VSEPR) model to explain the geometry of each of these molecules.

*Electrons all have negative charge and therefore repel each other. VSEPR says that we try to minimize the repulsive forces between electron pairs by maximizing the distance between electron pairs.*

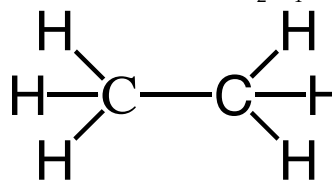
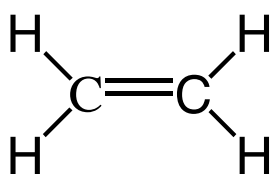
*For  $\text{CF}_4$  there are 4 electron pairs, all of which are bonding, the best way to arrange them is a tetrahedral structure. As there are no lone pairs the structure is name tetrahedral.*

*For  $\text{XeF}_4$  there are 6 electron pairs, 4 of which are bonding, the best way to arrange 6 pairs of electrons is in an octahedral structure. The 2 lone pairs are arranged  $180^\circ$  from each other because they are larger than the bonding pairs. That leaves use with the 4 bonding pairs arranged in a square planer shape.*

*For  $\text{ClF}_3$  there are 5 electron pairs, 3 of which are bonding, the best way to arrange 5 pairs of electrons is a trigonal bipyramidal structure. The lone pairs are best placed on the equatorial  $120^\circ$  positions. This means that the three flourines will be placed in a geometry called "T" shaped.*

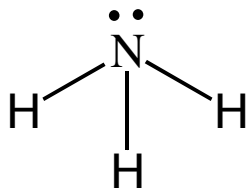
2) Use simple structure and bonding models to account for each of the following.

(a) The bond length between the two carbon atoms is shorter in  $\text{C}_2\text{H}_4$  than in  $\text{C}_2\text{H}_6$ .



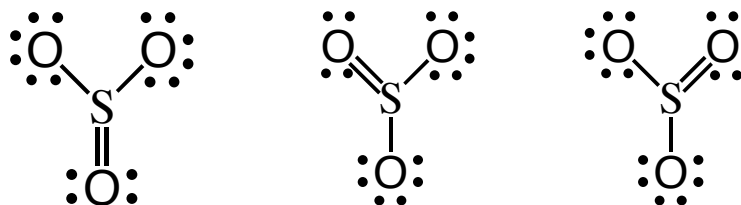
*In  $\text{C}_2\text{H}_4$  the carbons are double bonded this is a stronger and much shorter bond than the single bond that the carbon-carbon single bond in  $\text{C}_2\text{H}_6$ .*

(b) The H - N - H bond angle is  $107.5^\circ$  in  $\text{NH}_3$ .



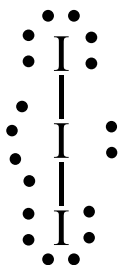
*The normal bond angle for a tetrahedral arrangement is  $109.5^\circ$ . The bond angle in ammonia is  $107.5^\circ$  because the lone pair of electrons take up more space than a bonding pair this compresses the bonds.*

(c) The bond lengths in  $\text{SO}_3$  are all identical and are shorter than a sulfur-oxygen single bond.



*The bond lengths in  $\text{SO}_3$  are identical because the double bond is actually spread around all of the S-O bonds. This is what is known as resonance, we use three Lewis structures to represent the delocalized nature of the double bond. This structure causes all the bonds to become equivalent to one and a third bond.*

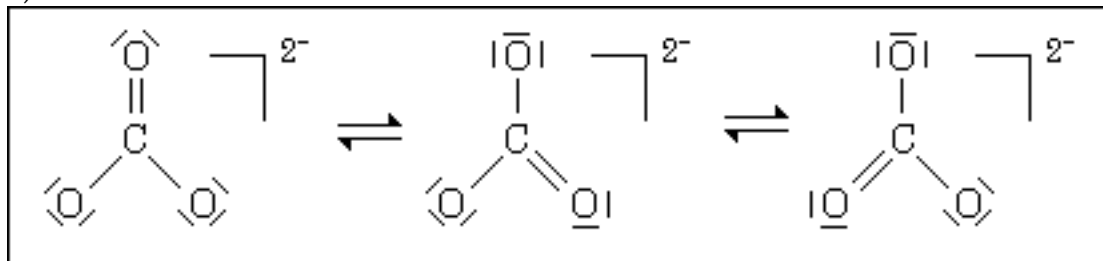
(d) The  $\text{I}_3^-$  ion is linear.



*In the triiodide molecule there are 5 electron pairs on the central iodine, this gives a basic arrangement of a trigonal bipyramidal but, the triiodide molecule has three lone pairs on the central atom to minimize the repulsion these lone pairs are found at the three equatorial  $120^\circ$  positions, with the two bonds at the  $180^\circ$  positions. This gives an overall linear structure to the triiodide molecule.*

3)

a)



b) The carbon in the carbonate ion has 3 effective electron pairs giving it a  $sp^2$  hybridization. Because of the way  $\pi$  bonds form the p orbitals used do not hybridize. SO the double bond counts as only one pair of electrons for hybridization.

c) All of the bonds in  $CO_3^{2-}$  are the same length the double bond is delocalized across all of the carbon oxygen bonds, giving a bond length of  $\sim 1 \frac{1}{3}$ .

d) In  $CO_2$  all of the bonds are double bonds, double bonds are shorter and stronger than the  $1 \frac{1}{3}$  bonds of  $CO_3^{2-}$ .