

## Ch. 8&9 Review Answers

- 1- C
- 2- A
- 3- B
- 4- A
- 5- D
- 6- A

7) Which of the following pairs has the most exothermic lattice energy? Explain your answer.

- A) LiI, LiBr
- B) NaF, CsF
- C) KCl, K<sub>2</sub>S

A) The LiBr will have the more exothermic lattice energy because the Br is smaller than the I the smaller

the ions are the more exothermic the lattice energy will be.

B) The NaF will have the more exothermic lattice energy because the Na is smaller than the Cs.

C) The K<sub>2</sub>S will have the more exothermic lattice energy the S has a negative 2 charge while the Cl has a negative 1 charge. The greater the charge on the ions the more exothermic the lattice energy will be.

8

13) Using the principles of bonding and molecular structure explain the following statements.

A) The angle between the N-F bonds in  $\text{NF}_3$  is smaller than the angle between the B-F bonds in  $\text{BF}_3$ .



Boron is an element that typically has less than eight valence electrons, so the boron trifluoride compound has a trigonal planar structure and  $sp^2$  hybridization. The best way to arrange three electron pairs around a sphere is with  $120^\circ$  angles between the pairs. In ammonia there are four pairs of electrons

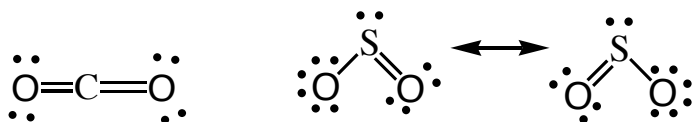
B) More energy is required to break up  $\text{CaO}_{(s)}$  crystals into ions than to break up a  $\text{KF}_{(s)}$  crystal into ions.

In  $\text{CaO}$  the lattice energy is much higher than in  $\text{KF}$ . This is because  $\text{Ca}$  has a +2 charge and  $\text{O}$  has a -2 charge, while  $\text{K}$  has a +1 charge and  $\text{F}$  has a -1 charge. The greater the charge the stronger the attractive force between the ions and the more energy it takes to break the bonds.

C) Liquid oxygen is strongly attracted to a magnet, whereas liquid nitrogen is not.

Liquid oxygen is a paramagnetic substance with which an electron configuration of  $(\sigma_{2s})^2 (\sigma_{2s}^*)^2 (\sigma_{2p})^2 (\pi_{2p})^4 (\pi_{2p}^*)^2$  this configuration has two unpaired electrons. Liquid nitrogen has an electron configuration of  $(\sigma_{2s})^2 (\sigma_{2s}^*)^2 (\sigma_{2p})^2 (\pi_{2p})^4 (\pi_{2p}^*)^4$  this configuration has no unpaired electrons and liquid nitrogen is diamagnetic.

D) The  $\text{SO}_2$  molecule has a dipole moment, whereas the  $\text{CO}_2$  molecule has no dipole moment. Include Lewis structures in your explanation.



In  $\text{CO}_2$  the molecule is linear and the opposing C-O bonds provide no net dipole moment. While in  $\text{SO}_2$  the lone pair of electrons on S create a bent structure with a net dipole moment.

9

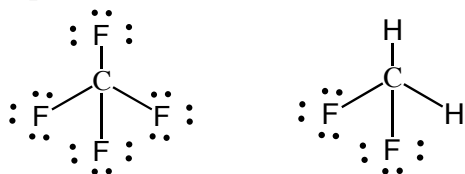
14) What is meant by the lattice energy of an ionic compound? What quantities need to be determined and how are they used to calculate the lattice energy of an ionic compound.

The lattice energy of an ionic compound is the energy change when two gaseous ions form a solid ionic compound. The value of the lattice energy is dependant on the charge on the ions and the distance

between the ions. 
$$LE = \frac{(Q_1 Q_2)}{r}$$

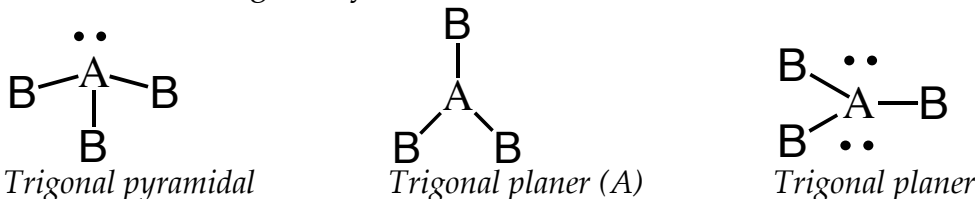
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15) Discuss briefly the relationship between the dipole moment of a molecule and the polar character of the bonds within it. With this as the basis, account for the difference between the dipole moments of  $\text{CH}_2\text{F}_2$  and  $\text{CF}_4$



In  $\text{CF}_4$  the more electronegative fluorine is arranged symmetrically around the carbon this means there is no net movement of electrons and a non-polar molecule with no net dipole moment. In  $\text{CH}_2\text{F}_2$  the hydrogen is less electronegative than the carbon this means there will be a net movement of electrons towards the fluorine and the molecule will be polar and have a net dipole moment.

11  
16) Suppose that a molecule has the formula  $\text{AB}_3$ . Sketch and name two different shapes that this molecule may have. For each of the two shapes, give an example of a known molecule that has that shape. For one of the molecules you have named, interpret the shape in the context of a modern bonding theory.



Trigonal pyramidal

Trigonal planer (A)

Trigonal planer

With only three bonding pairs and no lone pairs the trigonal planer(A) structure has bonds spaced at  $120^\circ$  and  $sp^2$  hybridization. With three bonding pairs and one lone pair the trigonal pyramidal structure has the electron pairs arranged in a tetrahedral structure and has  $sp^3$  hybridization with bonds  $\sim 109.5^\circ$  the structure of this molecule would have bonds less than that due to the lone pair which takes up more space than the bonding pairs.

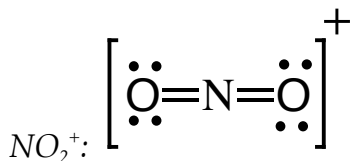
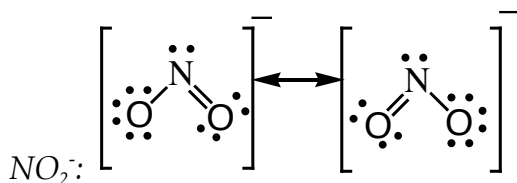
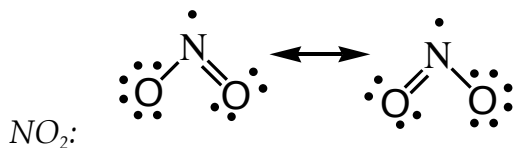
12

17)



Nitrogen is the central atom in each of the species given above.

(a) Draw the Lewis electron-dot structure for each of the three species.



(b) List the species in order of increasing bond angle. Justify your answer.



*NO<sub>2</sub><sup>+</sup> has no lone pairs on the nitrogen with the two attached atoms this gives a bond angle of 180°. The NO<sub>2</sub> has a single electron on the nitrogen atom this will force the two bonds much closer together. In NO<sub>2</sub><sup>-</sup> the pair of un-bonded electrons on the nitrogen will take up even more space than the lone electron on the NO<sub>2</sub> molecule this will force the bonds even closer together.*

(c) Select one of the species and give the hybridization of the nitrogen atom in it.

*In NO<sub>2</sub><sup>-</sup> there are three effective electron pairs around the nitrogen atom this gives sp<sup>2</sup> hybridization.*

*In NO<sub>2</sub><sup>+</sup> there are only two effective electron pairs around the nitrogen atom this gives sp hybridization.*

(d) Identify the only one of the species that dimerizes and explain what causes it to do so.

*NO<sub>2</sub> as a lone electron on the nitrogen this is a very reactive species and will generally cause it to react with another NO<sub>2</sub> molecule to form N<sub>2</sub>O<sub>4</sub>. The N<sub>2</sub>O<sub>4</sub> molecule will have no un-paired electrons and will be much less reactive than the NO<sub>2</sub> molecule.*