



7. Draw a molecular orbital (MO) diagram for NO. (assume same order of MOs as O<sub>2</sub>)

a. What is the bond order (BO) based on MO theory?

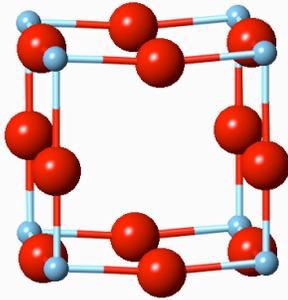
b. Draw the Lewis structure.

c. What is the BO based on the Lewis structure?

d. Is the molecule diamagnetic or paramagnetic?

e. Draw the shape of the highest occupied molecular orbital (HOMO)?

8. Below is the  $\text{ReO}_3$  structure.



- a. What is the CN for Re?
- b. What is the CN for O?
- c. How many nearest neighbors does the Re have?
- d. What is the distance from the Re atom to the nearest neighbor as a fraction of  $a$ ?
- e. How many next nearest neighbors does the Re have?
- f. What is the distance from the Re atom to the next nearest neighbor as a fraction of  $a$ ?
- g. How many next next nearest neighbors does the Re have?
- h. What is the distance from the Re atom to the next next nearest neighbor as a fraction of  $a$ ?
- i. If  $a = 5.2 \text{ \AA}$ , then what is the density?

j. Draw a Born-Haber cycle for the formation of  $\text{ReO}_3$ .

9. Draw the distribution diagram for  $\text{H}_2\text{SO}_4$ . (label the points for  $\text{pK}_{\text{a}1}$  and  $\text{pK}_{\text{a}2}$ )

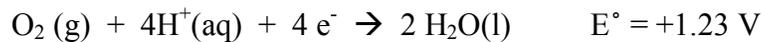
10. a. If your solvent is liquid ammonia, what is the chemical equation for autoprotolysis?

b. Write the expression for  $K_{\text{ammonia}}$  ( $K_{\text{am}}$ )

c. What is the consequence for  $\text{pK}_{\text{am}} = 33$  compared to  $\text{pK}_{\text{w}}$ ?

11. Arrange the oxides  $\text{Al}_2\text{O}_3$ ,  $\text{B}_2\text{O}_3$ ,  $\text{BaO}$ ,  $\text{CO}_2$ ,  $\text{Cl}_2\text{O}_7$ , and  $\text{SO}_3$  in order from most acidic to most basic.

12. For zinc placed in an aqueous acidic solution:



a. What is the standard emf of the cell?

b. Is the reaction spontaneous?

c. What is K?

given:

$$F = 9.649 \times 10^4 \text{ C/mol}$$

$$R = 8.314 \text{ J/molK}$$

At 298 K.