

# 1 Cognitive reasoning in the chemical sciences 4.9

## Study group review questions

- Write a Lewis structure for each of the following molecules or ions:  
a)  $\text{Cl}_4$       b)  $\text{N}_2\text{O}$       c)  $\text{SiH}_4$       d)  $\text{Cl}_2\text{O}$       e)  $\text{H}_3\text{COH}$       f)  $\text{OH}^-$   
g)  $\text{BrO}^-$
- Write Lewis structures for each of the following species.  
a)  $\text{PF}_5$       b)  $\text{I}_3^-$       c)  $\text{SF}_4$       d)  $\text{GeF}_4$
- Write the Lewis formula for each of the following species. Give resonance forms where appropriate and indicate formal charges.  
a)  $\text{CS}_3^{2-}$       b)  $\text{C}_2\text{O}_4^{2-}$       c)  $\text{NCS}^-$
- Write Lewis formulas for the resonance forms of thiosulfate ion,  $\text{S}_2\text{O}_3^{2-}$ . Indicate formal charges and discuss the bonding of this ion.
- Give the molecular class, shape, and bond angle for each of the following molecules:  
a)  $\text{XeO}_2\text{F}_4$       b)  $\text{IO}_2\text{F}_3$       c)  $\text{IO}_2\text{F}$       d)  $\text{IO}_3\text{F}$
- Predict which of the following molecules are polar:  
a)  $\text{TeBr}_4$       b)  $\text{BCl}_3$       c)  $\text{SF}_5\text{Br}$       d)  $\text{SOF}_4$
- Write a hybridization and bonding scheme for each of the following molecules or ions. Sketch the structure, including overlapping orbitals and label all bonds as either sigma or pi:  
a)  $\text{COCl}_2$       b)  $\text{BrF}_5$       c)  $\text{XeF}_2$       d)  $\text{I}_3^-$
- Sketch the bonding and antibonding molecular orbitals that result from the linear combinations of the  $2p_x$  atomic orbitals in a homonuclear diatomic molecule.
- According to MO theory, which of the following has the highest bond order? Highest bond energy? Shortest bond length?  
 $\text{C}_2, \text{C}_2^+, \text{C}_2^-$
- How many sigma bonds and pi bonds are there in the following molecules:  
a)  $\text{CH}_3\text{CHCH}_2$       b)  $\text{CH}_3\text{CHO}$       c)  $\text{CH}_3\text{CN}$       d)  $\text{CH}_3\text{OCH}_3$
- Use molecular orbital theory to determine the relative bond lengths and bond energies of a CO molecule and a  $\text{CO}^+$  ion.