

1982 D

- Draw the Lewis electron-dot structures for  $\text{CO}_3^{2-}$ ,  $\text{CO}_2$ , and  $\text{CO}$ , including resonance structures where appropriate.
- Which of the three species has the shortest C-O bond length? Explain the reason for your answer.
- Predict the molecular shapes for the three species. Explain how you arrived at your predictions.

1990 D (Required)

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

- The bond length between the two carbon atoms is shorter in  $\text{C}_2\text{H}_4$  than in  $\text{C}_2\text{H}_6$ .
- The H-N-H bond angle is  $107.5^\circ$ , in  $\text{NH}_3$ .
- The bond lengths in  $\text{SO}_3$  are all identical and are shorter than a sulfur-oxygen single bond.
- The  $\text{I}_3^-$  ion is linear.

1992 D



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

- Draw the Lewis electron-dot structure for each of the three species.
- List the species in order of increasing bond angle. Justify your answer.
- Select one of the species and give the hybridization of the nitrogen atom in it.
- Identify the only one of the species that dimerizes and explain what causes it to do so.

1996 D

Explain each of the following observations in terms of the electronic structure and/or bonding of the compounds involved.

- At ordinary conditions, HF (normal boiling point =  $20^\circ\text{C}$ ) is a liquid, whereas HCl (normal boiling point =  $-114^\circ\text{C}$ ) is a gas.
- Molecules of  $\text{AsF}_3$  are polar, whereas molecules of  $\text{AsF}_5$  are nonpolar.
- The N-O bonds in the  $\text{NO}_2^-$  ion are equal in length, whereas they are unequal in  $\text{HNO}_2$ .
- For sulfur, the fluorides  $\text{SF}_2$ ,  $\text{SF}_4$ , and  $\text{SF}_6$  are known to exist, whereas for oxygen only  $\text{OF}_2$  is known to exist.

1997 D (Required)

Consider the molecules  $\text{PF}_3$  and  $\text{PF}_5$ .

- Draw the Lewis electron-dot structures for  $\text{PF}_3$  and  $\text{PF}_5$  and predict the molecular geometry of each.
- Is the  $\text{PF}_3$  molecule polar, or is it nonpolar? Explain.
- On the basis of bonding principles, predict whether each of the following compounds exists. In each case, explain your prediction.
  - $\text{NF}_5$
  - $\text{AsF}_5$