Teacher's Tools® Chemistry
Chemical Bonding: Valence Bond Theory: Worksheet 4

1. Phosphorus reacts with chlorine to form two compounds PCl_3 and PCl_5. What is the hybridization and shape for each molecule?

2. What is the bond hybridization and approximate bond angles in each of the following? Justify your answers.

   (A) ONO in NO_3^-

   (B) HPH in PH_3

   (C) FSF in SF_6

3. SiF_4 can react with F^- to give SiF_6^{2-} but CF_4 does not react with F^- to form CF_6^{2-}. Explain this observation in terms of structural and bonding considerations. Draw Lewis structures for SiF_4, SiF_6^{2-}, and CF_4 and explain their shapes to reinforce your answer.

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

   (A) The bond angle in H_2O is 104.5°.

   (B) Each of the NO bonds in NO_3^- are of equivalent length and strength.

   (C) SF_4 is not tetrahedral with 109.5° bond angles.

5. Using Valence Bond Theory:

   (i) Give the hybridization of the central atom.

   (ii) Predict the geometry of the following species.

   (A) BrF_5 (B) CS_2 (C) SiF_4 (D) NO_3^- (E) AlF_6^{3-}