1. Molecular Orbitals:
   a) Draw the molecular orbital diagram for an N₂ molecule. Omit 1s electrons from your diagram. (3)
   b) Calculate the bond order. (1)

2. Based on the above question:
   a) If the bond order equals the number of bonds between the two nitrogen atoms, what is the hybridization of each nitrogen atom? (1)
   b) Draw a picture of the molecule showing the relevant hybrid orbitals and how they overlap. (3)
   c) Is the molecule diamagnetic or paramagnetic? (1)

3. Draw the bonding and the anti-bonding orbitals for the hydrogen molecule. (1)
1. Sketch how the hybrid orbitals of the nitrogen and 1s orbitals of the hydrogens overlap to make up the ammonia molecule (NH₃). Indicate the type of hybridization. (5)

2. a) Label the Molecular Orbital Diagram for the molecule OH. (2)

   H

   __________

   __________

   __________  __________  __________

   __________

b) What is the bond order of OH? (1)

c) How does the bond order change for the OH⁻ radical? (1)

d) Is the molecule diamagnetic or paramagnetic? (1)
1. The structure of cocaine is shown below. Indicate the hybridization of the labeled atoms. \( \text{sp}^n, n=1,2,3 \). (4)

2. a) Fill in the molecular orbital diagram of \( \text{O}_2 \). Label the molecular orbitals and atomic orbitals. Is the molecule diamagnetic or paramagnetic? (1+1+1+1)

b) Sketch and label the atomic orbital combination that forms the pi bonding and the pi anti-bonding orbitals. (1+1)