1. Formic acid (HCOOH) is a carboxylic acid that deprotonates easily to form the formate ion.

   a) How do the pi orbitals differ in these two molecules? It will probably be helpful to draw the hybrid orbitals at the central carbon to answer this.

    b) C-O bond lengths in ketones are generally around 1.2 Å, but in ethers are about 1.35 Å. What range of bond lengths would be predict to measure for the C-O bond length in the formate ion?

2. Draw the Lewis dot structure of the aldehyde propylaldehyde (CH_3CH_2COH). Determine the hybridization of each atom, and draw the correct three dimensional structure of the molecule.

3. In words, describe all changes necessary to convert cholesterol to cortisone (Figure 7.33 in your book).

4. For each of the following molecules, name the functional groups present and define the hybridization of each C, N, and O atom.

a)

b)

c)

d)

e)

f)
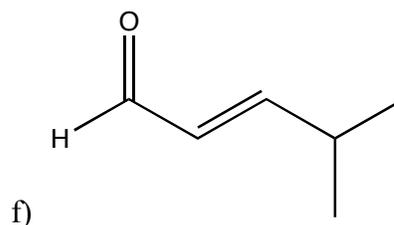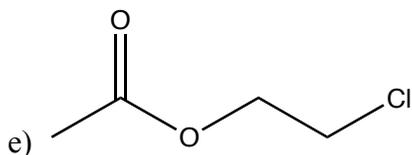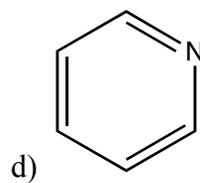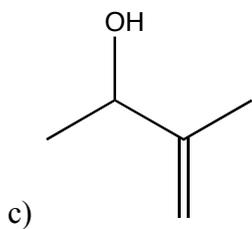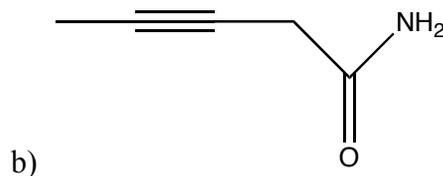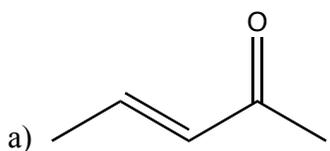
5. What pressure is exerted by 250 g of CO_2 gas at 25°C in a container 1.5 dm^3 in volume if it behaves as a perfect gas? What pressure would it exert if it behaves as a van der Waals gas? Comment on any differences.

6. A 2.0 L vessel is filled with N_2 at a pressure of 3.0 atm. The tank is connected to a 5.0 L vessel that is under vacuum, and a valve between the two tanks is opened. Determine the total pressure of the two-tank system at equilibrium. You may assume temperature remains constant and that the volume of the apparatus connecting the two tanks is negligible.

7. Compare the root mean square speed of He atoms near the surface of the sun, which is approximately 6000 K, with that of He atoms in an interstellar dust cloud which is approximately 100 K.