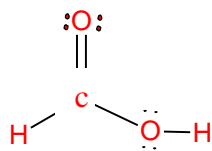
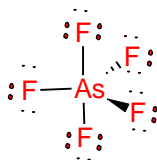
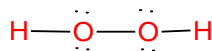
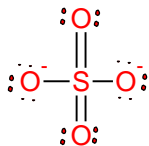
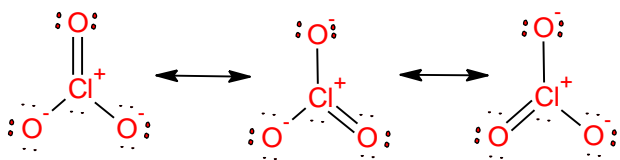


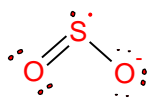
1. Draw Lewis dot structures for the following molecules and include any formal charges on the atoms. (20 pts)



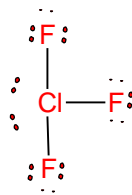
2. Draw the possible resonance structures for  $\text{ClO}_3^-$  and include any formal charges on the atoms. (10 pts)



3. Using VSEPR theory, draw the correct molecular geometry for each of the following molecules. (10 pts)



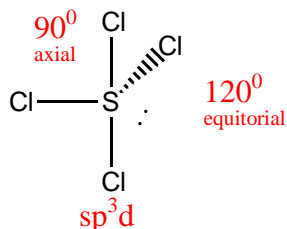
Bent



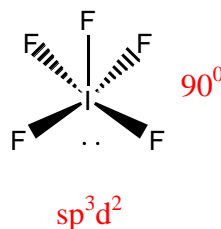
T-shaped

4. Give the expected bond angles for the following molecules and predict what hybrid orbitals are expected for each: (10 pts)

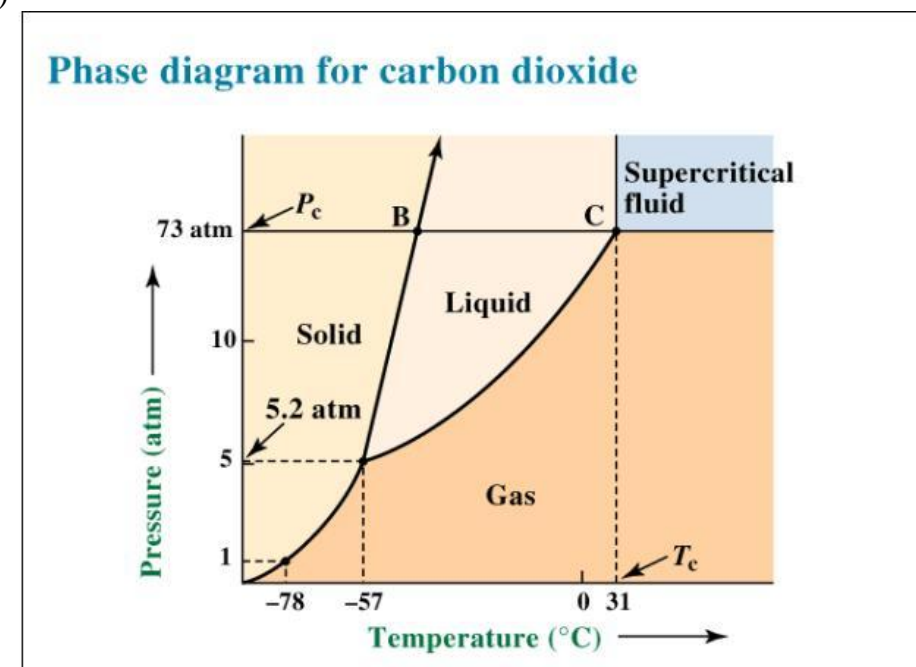
a)



b)



5. Use the accompanying phase diagram for carbon to answer the following questions. (20 pts)



a) Is it possible to form a liquid by compressing  $\text{CO}_2$  at  $50^\circ\text{C}$ ?

**No, already past the critical temperature.**

b) What phase is present at STP?

**Gas**

c) What is the boiling point of  $\text{CO}_2$  at 1 atm?

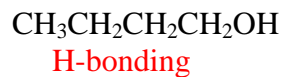
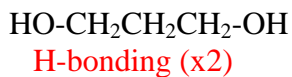
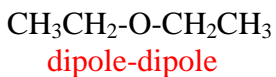
**$\text{CO}_2$  sublimates at  $-78^\circ\text{C}$ .**

d) What is the highest temperature  $\text{CO}_2$  will sublime?

**$-57^\circ\text{C}$  (at 5.2 atm)**



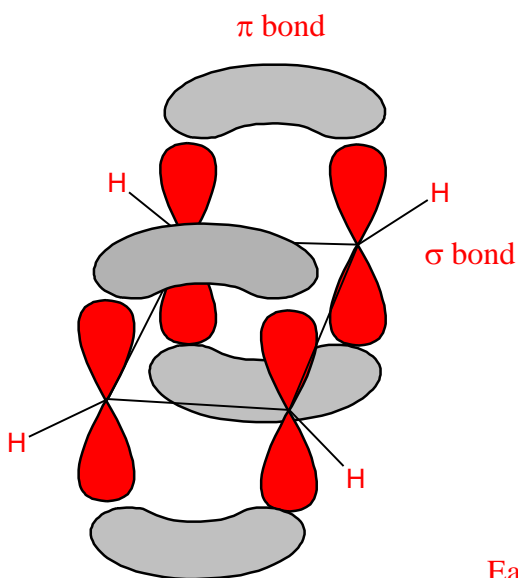
7. Which of the following molecules would have the highest vapor pressure and which would have the lowest vapor pressure? (10 pts)



Highest Vapor Pressure  
(lowest boiling point)

Lowest Vapor Pressure  
(highest boiling point)

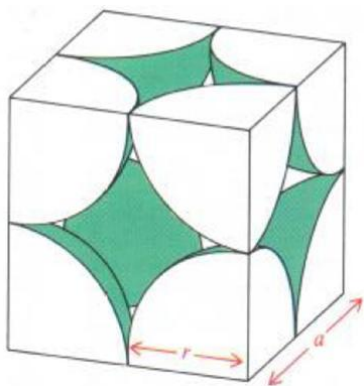
8. Draw  $\text{C}_4\text{H}_4$  (*Hint: cyclic*) showing the hybrid orbitals of carbon involved in bonding. Show all of the  $\sigma$  bonds and  $\pi$  bonds. What is the hybridization of carbon in this molecule? (10 pts)



Each carbon contains a p-orbital for  $\pi$ -bonding.

Each carbon is a  $sp^2$  hybrid.

9. Extra Credit. Crystalline polonium has a simple cubic structure. The atomic radius of polonium is 167 pm. Calculate the volume of this unit cell. (5 pts)



$$\text{Volume} = a^3 \quad 1 \text{ pm} = 10^{-12} \text{ m} \quad 1 \text{ cm}^3 = 1 \text{ mL}$$

$$a = 2r$$

$$V = (2r)^3 = 8r^3 = 8(1.67 \times 10^{-8} \text{ cm})^3 = 3.73 \times 10^{-23} \text{ mL}$$