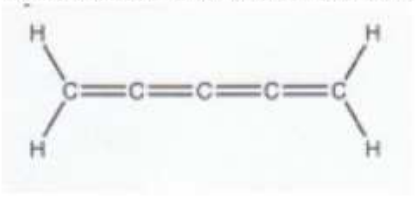
1 Cognitive reasoning in the chemical sciences 5.9

Study group review questions

1. Draw the Lewis dot structures of the following molecules, show or state their geometry, and state if they are polar or nonpolar.
a. BrF_5 b. SF_4 c. BeH_2 d. $CHCl_3$ e. ICl_4 f. ClO_2

2. Which is more stable according to bond order: $CH_3CO_2^+$ or $CH_3CO_2^-$?

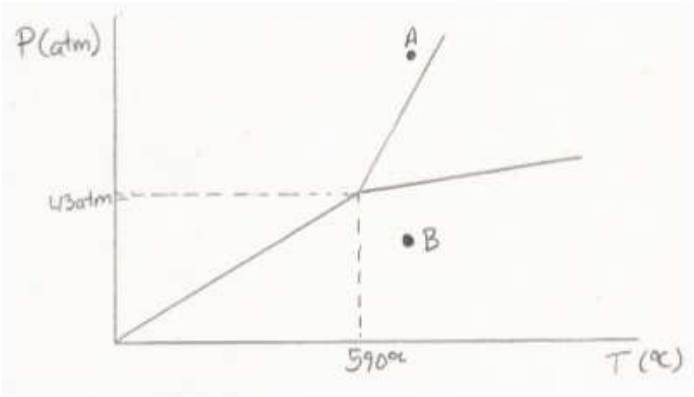
3. Draw all of the orbitals of the C_5H_4 (shown). Is the molecule planar? Notice there are two distinct sets of delocalized electrons. Draw the MO diagram of one of the two sets of delocalized electrons. How would the second set of electrons look different from the set you drew?



4. Identify the intermolecular forces involved in the following substances and for each species, indicate the strongest intermolecular force: CH_3CH_2OH, H_2, KBr, CH_3OH, CH_4. Predict the order of the compounds in increasing boiling point.

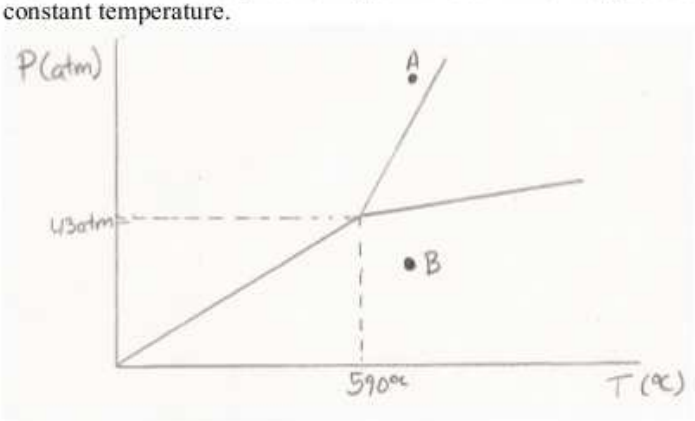
5. Shown below is a phase diagram for an unknown species.

a) Indicate the phases present in the regions seprarated by solid lines.



b) A sample of this species cannot be melted by heating in a container open to the atmosphere. Explain why this is so.

c). State and trace the phase changes that occur when the pressure on a sample is reduced from A to B, at constant temperature.



6. **H_2O CHF_3 KBr CH_4 CO_2**

Arrange the above molecules in order of decreasing boiling temperatures. Clearly state your reasoning for your answer.

7. Draw the lewis structures of SCN^- and NO_2^-. State the possible shapes of the two, the hybridization, and whether or not the molecule is polar. Do any of the two have delocalized MOs? If so, then draw the delocalized MOs for that molecule.

8. a) Draw the molecular orbital diagram of CS^- showing the molecular orbital diagram of CS^- showing clearly the combination of atomic orbitals (AO) to form molecular orbitals (MOs) in the diatomic anion. Fill the levels with electrons and label the AO's and the MO's.
b) Mark the HOMO and LUMO levels.
c) Is the diatomic anion paramagnetic. Explain your answer.
d) Sketch how the AOs bond to from MOs in the above diatomic anion.