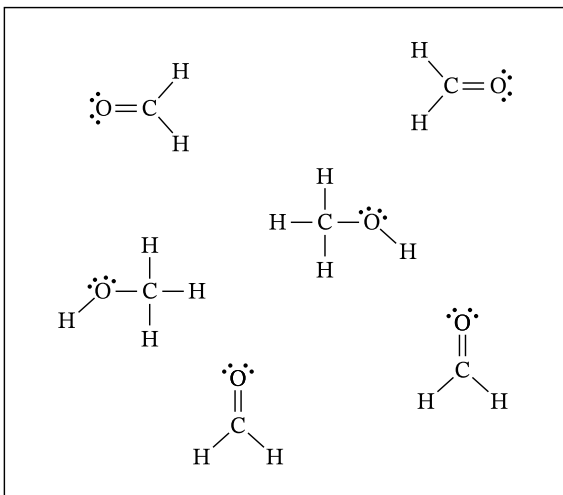


4. A scientist is investigating the properties of a mixture of CH_3OH and H_2CO . The scientist generates the following diagram to represent the mixture.



- A. Identify the hybridization of the valence orbitals of the C atom in the H_2CO molecule.
 B. In the diagram provided, draw a SINGLE dashed line (---) to represent a strong hydrogen-bonding attraction between one CH_3OH molecule and one H_2CO molecule in the mixture.
 C. The scientist plans to cool a gaseous mixture of CH_3OH and H_2CO to form a liquid mixture and finds data on the two compounds. The data are summarized in the table.

Substance	Melting Point (K)	Boiling Point (K)	Enthalpy of Vaporization (kJ/mol)
CH_3OH	176	338	37.6
H_2CO	181	254	24.2

- i. Propose a temperature to which the mixture should be cooled such that CH_3OH and H_2CO will both be liquids.
 ii. The scientist analyzes the mixture after it is cooled and determines that 8.59 g of $\text{CH}_3\text{OH}(l)$ is present. Calculate the amount of thermal energy, in kJ, that was removed to condense the 8.59 g of CH_3OH (molar mass 32.04 g/mol) at its boiling point.

5. Complete Lewis diagrams and some physical properties for compounds X and Y are given.

Compound	X	Y
Lewis diagram		
Molar mass	74.1 g/mol	90.2 g/mol
Boiling point	82°C	98°C

- A. Based on VSEPR theory, predict the geometry around the Si atom in compound Y.
 B. A student claims that compound Y has a higher boiling point than that of compound X because compound Y has stronger London dispersion forces. Do you agree or disagree? Justify your answer.
 C. An equimolar mixture of the two compounds is heated. When the mixture reaches 82°C, which compound will have the higher vapor pressure? Justify your answer.
 D. The mixture is heated to 198°C in a sealed, rigid 12.5 L container; at which point both substances are gases and the total pressure in the container is 2.30 atm. Calculate the number of moles of gas particles in the container.