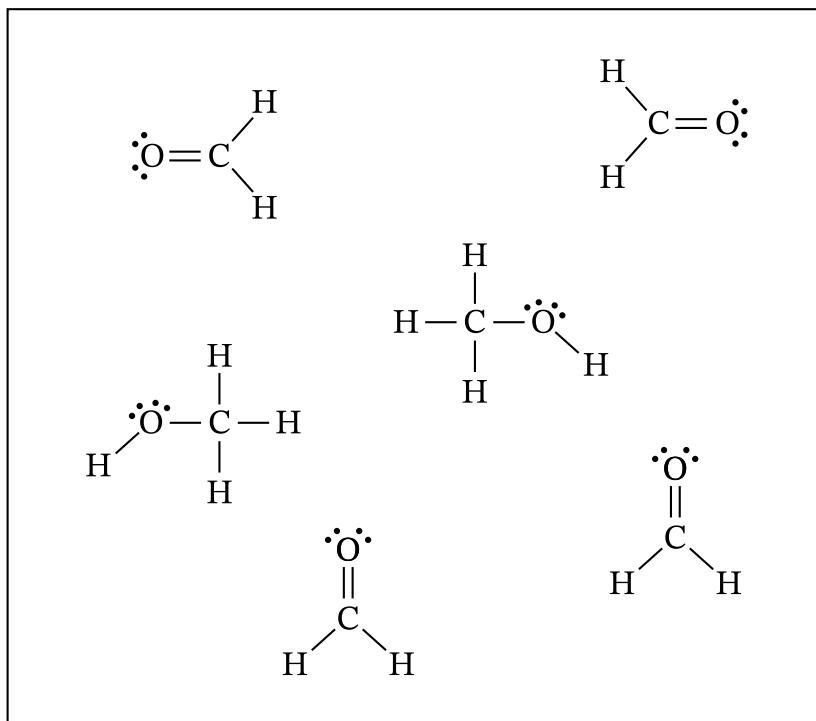


4. A scientist is investigating the properties of a mixture of CH_3OH and H_2CO . The scientist generates the following diagram to represent the mixture.



- 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

- Propose a temperature to which the mixture should be cooled such that CH_3OH and H_2CO will both be liquids.
- 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.