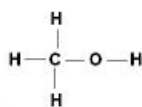
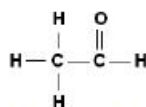
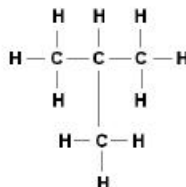
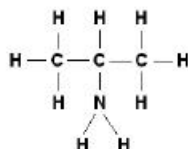


### 3.1 Intermolecular Forces Worksheet

- 1) For each pair of compounds listed below, identify the compound that has the highest boiling point. Justify your choice in terms of intermolecular forces.
- |                                     |  |  |
|-------------------------------------|--|--|
| a. $\text{Br}_2$ and $\text{I}_2$   | f. $\text{Cl}_2$ and $\text{H}_2$                | k. $\text{CaOH}$ or $\text{H}_2\text{O}$               |
| b. $\text{NH}_3$ and $\text{NCl}_3$ | g. $\text{H}_2\text{O}$ and $\text{H}_2\text{S}$ | l. $\text{KCl}$ or $\text{Cl}_2$                       |
| c. $\text{NH}_3$ and $\text{CH}_4$  | h. $\text{CH}_4$ and $\text{SnH}_4$              | m. $\text{F}_2$ or $\text{Cl}_2$                       |
| d. $\text{CH}_4$ and $\text{CCl}_4$ | i. $\text{NH}_3$ and $\text{PH}_3$               | n. $\text{C}_2\text{H}_6$ or $\text{C}_4\text{H}_{10}$ |
| e. $\text{He}$ and $\text{Ar}$      | j. $\text{AsH}_3$ and $\text{SbH}_3$             |  |
- 2) Explain why  $\text{Cl}_2$  is a gas and  $\text{Br}_2$  is a liquid at  $25^\circ\text{C}$  and 1 atm.
- 3) Explain why  $\text{H}_2$  is a gas and  $\text{I}_2$  is a solid at  $25^\circ\text{C}$  and 1 atm.
- 4) Explain why ethane,  $\text{C}_2\text{H}_6$ , melts at  $-183^\circ\text{C}$  and nonane,  $\text{C}_9\text{H}_{20}$ , melts at  $-54^\circ\text{C}$ .
- 5) Explain why propane,  $\text{C}_3\text{H}_8$ , is a gas and decane,  $\text{C}_{10}\text{H}_{22}$ , is a liquid at  $25^\circ\text{C}$  and 1 atm.
- 6) The structures for ethanal,  $\text{C}_2\text{H}_4\text{O}$ , and methanol,  $\text{CH}_3\text{OH}$ , are shown below.



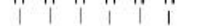
- a. Identify the types of intermolecular forces that exist in a pure sample of ethanal.
- b. Identify the types of intermolecular forces that exist in a pure sample of methanol.
- 7) The structures for aminopropane,  $\text{CH}_3\text{CHNH}_2\text{CH}_3$ , and isobutane,  $\text{C}_4\text{H}_{10}$ , are shown below.




- a. Identify the types of intermolecular forces that exist in a pure sample of aminopropane.
- b. Identify the types of intermolecular forces that exist in a pure sample of isobutane.
- c. Which pure liquid has the highest boiling point? Explain.
- d. Explain why aminopropane is soluble in water, whereas isobutene is not soluble in water.

$$\begin{array}{c} \text{H} \quad \text{O} \\ | \quad || \\ \text{H}-\text{C}-\text{C}-\text{H} \\ | \\ \text{H} \end{array} \qquad \begin{array}{c} \text{H} \quad \text{O} \\ | \quad || \\ \text{H}-\text{C}-\text{C}-\text{O}-\text{H} \\ | \\ \text{H} \end{array}$$

- 9) Explain why oxygen gas,  $O_2$ , is able to dissolve in water.

i. 

ii. 

12) Draw the complete Lewis diagrams, showing all lone pairs, for water and ammonia in an orientation that allows for a hydrogen bond. Use a line to indicate the location of the hydrogen bond.

$$\begin{array}{ccccccc} \text{O} & & \text{O} & & \text{O} & & \text{O} \\ \parallel & & \parallel & & \parallel & & \parallel \\ -\text{C}-\text{N}-\text{N}-\text{C}-\text{N}-\text{N}-\text{C}-\text{N}-\text{N}-\text{C}-\text{N}-\text{N}- & & & & & & \\ | & | & | & | & | & | & | \\ \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \end{array}$$
[illegible]