

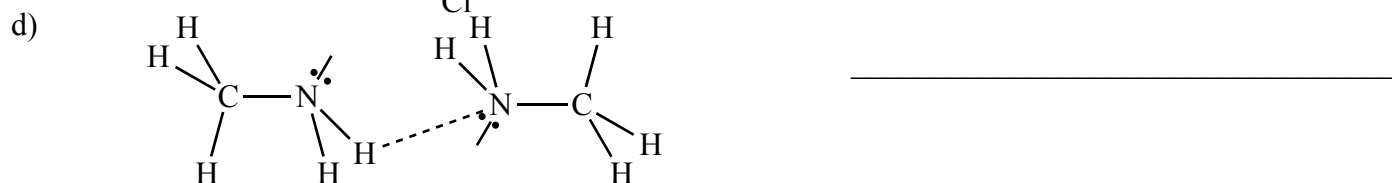
1) Review of Intermolecular forces:

- What type of intermolecular bond attract two nonpolar covalent molecules? _____
- What two types of intermolecular bonds could attract two polar covalent molecules?

- How do you know if a molecule can do hydrogen bonding instead of just dipole-dipole?

2) Look at the diagrams below. Put in any significant partial charges. An intermolecular force has been shown with dots for each situation. Determine what type of intermolecular force is shown in each case.

Intermolecular force
 (dispersion, dipole-dipole, H-bonding)



3) Now, it is your turn. Do the Lewis dots for each of these molecules, draw the 3D shape and put in partial charges. Then, draw the same 3D molecule again with partial charges. Draw **dots** between the molecules to show an intermolecular attraction and determine the type of intermolecular force.

	<u>Lewis dot</u>	<u>3-D shape</u> (with δ^- , δ^+)	<u>Another 3D shape</u> (with δ^- , δ^+)	<u>Intermolecular force</u>
		H		
a) CH ₃ OH	H C O H			
		H		
b) CH ₃ F	H C F			
		H		

- 4) What type of bond must break when a molecular substance boils? Intramolecular or intermolecular? _____
- 5) Thus, the strength of intermolecular bonds directly affects the temperatures at which substances melt and boil. (*The strengths affect boiling points and melting points.*)
- a) Rank the three intermolecular forces from weakest to strongest.
 weakest _____ _____ _____ strongest
- b) The stronger the intermolecular forces, the **(more, less)** heat is needed to break those attractions.
- c) The stronger the intermolecular forces, the **(lower, higher)** the melting point and boiling point.

- 6) Besides molecular (covalent) substances, there are also metallic and ionic substances.
- a) What types of species are attracted in metallic substances? _____
- b) Thus, when metallic substances are melted or boiled, attractions between **(partial, full)** charges are broken.
- c) What type of species are attracted in ionic substances? _____
- d) Thus, when an ionic substance is melted or boiled, attractions between **(partial full)** charges are broken.
- e) When a molecular substance is melted or boiled, attractions between **(partial, full)** charges are broken.

- 7) *From your answers in the previous question above, you should now realize that ionic and metallic bonds are more difficult to break than intermolecular forces. Thus, ionic and metallic substances have higher melting points and boiling points (b/c has stronger attractions) than molecular (covalent) substances.*

For each substance below, label whether each is **Covalent**, **Ionic** or **Metallic**. Then, **circle** the substance in each pair with the higher boiling point.

- a) CH₄ or CaCl₂ b) Fe or H₂O c) NH₃ or NaCl
- C, I, M → _____ _____ _____ _____

- 8) Draw the Lewis Dots and 3D structures of the following molecular substances. Put in partial charges and then what type of intermolecular bonding each molecule can do.

Lewis Dot

3D Shape

Intermolecular bonding

a) SO₂

b) CO₂

c) CH₂O

- 9) Explain why the boiling point SO₂ is higher than that of CO₂. (Refer to structures on front or above.)

- 10) Explain why the boiling point of H₂O is higher than that of CH₂O. (Refer to structures on front or above.)

- 11) Use your own logic to predict which substance below has the higher boiling point? _____ Explain.

- a) CH₄
 b) CH₃CH₃