

Name \_\_\_\_\_ per \_\_\_\_\_

### Chemistry II Practice: "Intermolecular Forces"

1. Describe the three types of intermolecular forces. Include in your explanation how they work on the submicroscopic level.

2. Explain the difference between a chemical bond and an intermolecular force. Compare the relative amounts of energy involved in the forming and breaking of these forces.

3. What is the difference between a temporary and a permanent dipole? Give an example of each.

4. Explain, in terms of intermolecular forces, why water has an unusually high boiling point.

If the statement is true, write "true". If it is false, change the underlined word to make it true.

5. Intermolecular forces determine, metallic properties such as the boiling point of a substance.

6. Intermolecular forces are forces of attraction between atoms.

7. Chemical bonds are the forces between molecules.

8. Covalent bonds result from electrons being shared between atoms in a molecule.

9. Intermolecular forces result from the electron interactions between neighboring molecules.

10. When the electron cloud around a molecule is not distributed symmetrically, a molecule is polar.

11. Chemical bonds include ionic bonds and hydrogen bonds.

12. Intermolecular forces include dispersion forces, dipole interactions and helium-bond forces.

**Complete each of the sentences with the appropriate word or words.**

**13.** The stronger the intermolecular forces in a liquid, the \_\_\_\_\_ boiling point.

**14.** The state (solid, liquid or gas) of a substance at room temperature depends on \_\_\_\_\_.

**15.** Water molecules in an ice cube are held together by \_\_\_\_\_ forces or more specifically \_\_\_\_\_.

**On the line at the left, write the letter of the term that matches each description below. Each choice may be used more than once. More than one choice may be used as an answer.**

**a.** dispersion

**b.** dipole-dipole

**c.** hydrogen bonding

**16.** the force between  $\text{SO}_2$  molecules. **hint:** draw the 3D Lewis Diagram

\_\_\_\_\_ **17.** The force that accounts for HF being a liquid, while  $\text{H}_2$  and  $\text{F}_2$  are gases at room temperature.

\_\_\_\_\_ **18.** The force that results from temporary, induced dipoles.

\_\_\_\_\_ **19.** The only intermolecular force that exists in noble gases.

\_\_\_\_\_ **20.** The attractive force between dipole molecules.

\_\_\_\_\_ **21.** The force that arises because of the large difference in electronegativity between N and H in an ammonia ( $\text{NH}_3$ ) molecule.

**22.** Which of the following statements could be used to explain why water has an unusually high boiling point? Check all of the statements that could be used to justify your explanation.

\_\_\_\_\_ **a.** Water molecules have very strong intermolecular forces.

\_\_\_\_\_ **b.** Oxygen is much more electronegative than hydrogen.

\_\_\_\_\_ **c.** A water molecule has a bent molecular geometry.

\_\_\_\_\_ **d.** Water does not contain metallic bonds.

\_\_\_\_\_ **e.** Oxygen atoms are smaller than hydrogen atoms.

**23.** Give a macroscopic observation besides water's high boiling point that suggests that the intermolecular forces in water are very strong compared to other liquids.

Name

Key

per

## Chemistry II Practice: "Intermolecular Forces"

1. Describe the three types of intermolecular forces. Include in your explanation how they work on the submicroscopic level.

Dipole Interactions are the attraction between the + and - ends of dipoles.

Dispersion forces are attractions between molecules that become temporary dipoles

Hydrogen Bonds are attractions between hydrogen atoms and lone pairs on adjacent molecules.

2. Explain the difference between a chemical bond and an intermolecular force. Compare the relative amounts of energy involved in the forming and breaking of these forces.

A chemical bond is formed between atoms within a molecule and intermolecular forces are bonds between molecules. Chemical bonds are generally stronger than intermolecular forces and much greater amounts of energy are involved in their formation.

3. What is the difference between a temporary and a permanent dipole? Give an example of each.

A temporary dipole occurs when electrons are denser on one end of a molecule. All molecules can become temporary dipoles.

A permanent dipole is a molecule which has a negatively and positively charged end resulting from polar bonds.

4. Explain, in terms of intermolecular forces, why water has an unusually high boiling point.

Water molecules have very high intermolecular forces resulting from hydrogen bonding, which is the strongest intermolecular force.

If the statement is true, write "true". If it is false, change the underlined word to make it true.

Physical

molecules

True

True

True

True

Covalent bonds

hydrogen bond

5. Intermolecular forces determine, metallic properties such as the boiling point of a substance.

6. Intermolecular forces are forces of attraction between atoms.

7. Chemical bonds are the forces between molecules.

8. Covalent bonds result from electrons being shared between atoms in a molecule.

9. Intermolecular forces result from the electron interactions between neighboring molecules.

10. When the electron cloud around a molecule is not distributed symmetrically, a molecule is polar.

11. Chemical bonds include ionic bonds and hydrogen bonds.

12. Intermolecular forces include dispersion forces, dipole interactions and helium-bond forces.

Complete each of the sentences with the appropriate word or words.

13. The stronger the intermolecular forces in a liquid, the higher the boiling point.
14. The state (solid, liquid or gas) of a substance at room temperature depends on the strength of intermolecular forces.
15. Water molecules in an ice cube are held together by dipole-dipole forces or more specifically hydrogen bonding.

On the line at the left, write the letter of the term that matches each description below. Each choice may be used more than once.

a. dispersion

b. dipole-dipole

c. hydrogen bonding

- a. 16. the force between  $\text{SO}_2$  molecules. hint: draw the 3D Lewis Diagram
- c. 17. The force that accounts for HF being a liquid, while  $\text{H}_2$  and  $\text{F}_2$  are gases at room temperature.
- a. 18. The force that results from temporary, induced dipoles.
- a. 19. The only intermolecular force that exists in noble gases.
- b. 20. The attractive force between dipole molecules.
- c. 21. The force that arises because of the large difference in electronegativity between N and H in an ammonia ( $\text{NH}_3$ ) molecule.
22. Which of the following statements could be used to explain why water has an unusually high boiling point? Check all of the statements that could be used to justify your explanation.
- ☒ a. Water molecules have very strong intermolecular forces.
- ☒ b. Oxygen is much more electronegative than hydrogen.
- ☒ c. A water molecule has a bent molecular geometry.
- ☐ d. Water does not contain metallic bonds.
- ☐ e. Oxygen atoms are smaller than hydrogen atoms.

23. Give a macroscopic observation besides water's high boiling point that suggests that the intermolecular forces in water are very strong compared to other liquids.

When drops of water are carefully placed on a penny, the water stays on the penny rather than flowing off of it, showing that there must be some cohesion between the water particles.