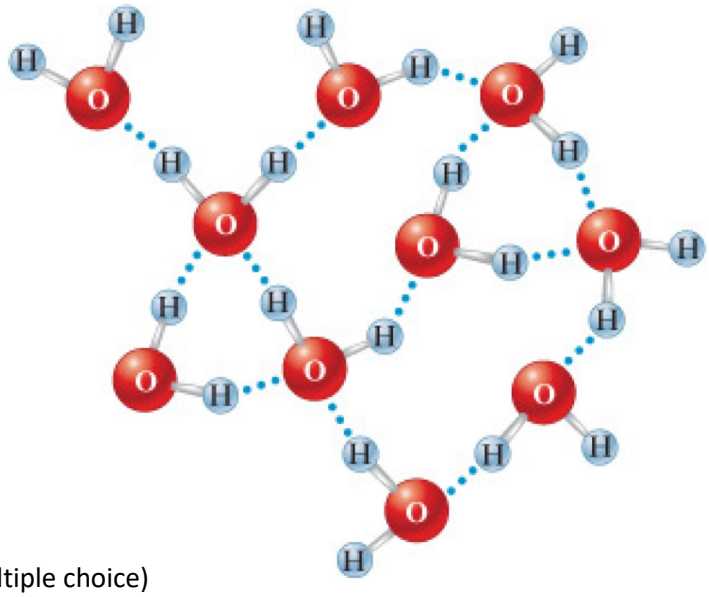
CHAPTER 10 suggested end-of-chapter problems

13. In the diagram below, which lines represent the hydrogen bonding?



(Multiple choice)

a. the dotted lines between the hydrogen atoms of one water molecule and the oxygen atoms of a different water molecule

b. the solid lines between a hydrogen atom and oxygen atom in the same water molecule

c. Both the solid lines and dotted lines represent hydrogen bonding.

d. There are no hydrogen bonds represented in the diagram.

21. How does each of the following affect the rate of evaporation of a liquid in an open dish?

a. intermolecular forces

b. temperature

c. surface area

23. When a person has a severe fever, one therapy used to reduce the fever is an "alcohol rub." Explain how the evaporation of alcohol from a person's skin removes heat energy from the body.

24. Why is a burn from steam typically much more severe than a burn from boiling water?

35. Identify the most important types of interparticle forces present in the solids of each of the following substances.

a. Ar

c. HF

d. $CaCl_2$

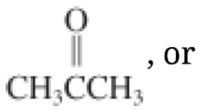
e. CH_4

41. In each of the following groups of substances, pick the one that has the given property. Justify your answer.

a. highest boiling point: HBr, Kr, or Cl_2

c. lowest vapor pressure at $25°C$: Cl_2, Br_2, or I_2

e. lowest boiling point: CH_4, CH_3CH_3, or $CH_3CH_2CH_3$

g. lowest vapor pressure at $25°C$: $CH_3CH_2CH_3$,  , or $CH_3CH_2CH_2OH$

42. In each of the following groups of substances, pick the one that has the given property. Justify each answer.

a. highest boiling point: CCl_4, CF_4, CBr_4

c. smallest vapor pressure at $25°C$: CH_3OCH_3, CH_3CH_2OH, $CH_3CH_2CH_3$

e. greatest heat of vaporization: H_2CO, CH_3CH_3, CH_4

f. smallest enthalpy of fusion: I_2, $CsBr$, CaO

43. The shape of the meniscus of water in a glass tube is different from that of mercury in a glass tube. Why?

H_2O in glass

Hg in glass

132. You and a friend each synthesize a compound with the formula $\mathbf{XeCl_2F_2}$. Your compound is a liquid and your friend's compound is a gas (at the same conditions of temperature and pressure). Explain how the two compounds with the same formulas can exist in different phases at the same conditions of pressure and temperature.

Answers:

13. Answer a is correct. Intermolecular forces are the forces between molecules that hold the substances together in the solid and liquid phases. Hydrogen bonding is a specific type of intermolecular forces. In this figure, the dotted lines represent the hydrogen bonding interactions that hold individual H_2O molecules together in the solid and liquid phases. The solid lines represent the O–H covalent bonds.

21. a. As the strength of the intermolecular forces increase, the rate of evaporation decreases.

b. As temperature increases, the rate of evaporation increases.

c. As surface area increases, the rate of evaporation increases.

23. $C_2H_5OH(l) \rightarrow C_2H_5OH(g)$ is an endothermic process. Heat is absorbed when liquid ethanol vaporizes; the internal heat from the body provides this heat, which results in the cooling of the body.

35. Ionic compounds have ionic forces. Covalent compounds all have London dispersion (LD) forces, whereas polar covalent compounds have dipole forces and/or hydrogen bonding forces. For hydrogen-bonding (H-bonding) forces, the covalent compound must have either a N–H, O–H, or F–H bond in the molecule.

a. LD only
b. Ordinary dipole-dipole, H-bonding, LD
d. ionic, LD
e. LD only

l.)

41. Boiling points and freezing points are assumed directly related to the strength of the intermolecular forces, whereas vapor pressure is inversely related to the strength of the intermolecular forces.

a. HBr; HBr is polar, whereas Kr and Cl_2 are nonpolar. HBr has dipole forces unlike Kr and Cl_2. So HBr has the stronger intermolecular forces and the highest boiling point.
c. I_2; all are nonpolar, so the largest molecule (I_2) will have the strongest LD (London Dispersion) forces and the lowest vapor pressure.
e. CH_4; smallest, nonpolar molecule, so it has the weakest LD forces.
g. $CH_3CH_2CH_2OH$; H-bonding, unlike the others, so it has strongest intermolecular forces.

42. a. CBr_4; largest of these nonpolar molecules, so it has the strongest LD (London Dispersion) forces.

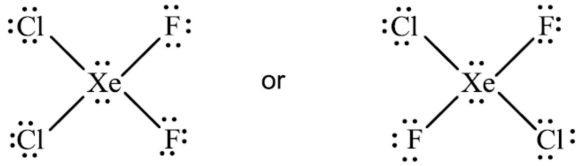
c. CH_3CH_2OH; can form H-bonding interactions, unlike the other covalent compounds.

e. H_2CO; H_2CO is polar, so it has dipole forces, unlike the other nonpolar covalent compounds, so H_2CO will have the highest enthalpy of vaporization.

f. I_2; I_2 has only LD forces, whereas CsBr and CaO have much stronger ionic forces. I_2 has the weakest intermolecular forces, so it has smallest ΔH_{fusion}.

43. The attraction of H_2O for glass is stronger than the H_2O–H_2O attraction. The miniscus is concave to increase the area of contact between glass and H_2O. The Hg–Hg attraction is greater than the Hg–glass attraction. The miniscus is convex to minimize the Hg–glass contact.

132. $XeCl_2F_2$, 8 + 2(7) + 2(7) = 36 e^-



polar (Bond dipoles do not cancel each other.)

nonpolar (Bond dipoles cancel each other.)

These are two possible square planar molecular structures for $XeCl_2F_2$. One structure has the Cl atoms 90° apart; the other has the Cl atoms 180° apart. The structure with the Cl atoms 90° apart is polar; the other structure is nonpolar. The polar structure will have additional dipole forces, so it has the stronger intermolecular forces and is the liquid. The gas form of $XeCl_2F_2$ is the nonpolar form having the Cl atoms 180° apart.