

11.2

ai) Hydrogen Bonding

a ii) Induced Dipole

a iii) Ion/Dipole

a iv) Dipole/Dipole

b) The induced dipole in a ii will be the weakest

11.3

a) a, b, and c can form dipole-dipole interactions

b) a and c can form hydrogen forces

11.17

a) induced dipoles

b) dipole/dipole

c) hydrogen bonding

11.19

- a) SO_2 is a bent molecule, making it polar and allowing it to exhibit dipole/dipole IMF's. These are the forces that must be overcome to vaporize its liquid.
- b) CH_3COOH contains an OH group, allowing it to exhibit hydrogen bonding. These are the forces that must be overcome to vaporize its liquid.
- c) H_2S is a bent molecule, making it polar and allowing it to exhibit dipole/dipole IMF's. These are the forces that must be overcome to vaporize its liquid.

11.20

- a) CH_3OH exhibits hydrogen bonding. CH_3SH exhibits dipole-dipole forces. As a result, CH_3OH boils at a higher temperature.
- b) Both Xe and Ar exhibit induced dipoles. Because Xe is more massive it is more polarizable. As a result, it is a liquid at these conditions while Ar is a gas.
- c) Both Kr and Cl_2 are symmetrical and therefore non-polar. As such, they exhibit induced dipoles, whose strength depends on polarizability, which varies directly with mass and elongation. Because Cl_2 is both more massive and elongated compared to Kr, its IMF's are strong and it boils at a higher temperature.
- d) Both molecules are non-symmetrical and therefore polar. Because acetone contains a highly electronegative oxygen atom, it will be more polar than 2-methylpropane and will boil at a higher temperature.

11.22

a) True

b) False, going down the noble gas column, the atoms become more polarizable as their masses increase. This results in higher boiling points.

c) False, while dipole/dipole forces are general stronger when comparing molecules of similar shape and mass, induced dipoles can actually be stronger than dipole/dipole forces in some instances.

d) True

11.23

a) H_2S , it is more massive

b) CO_2 , it is more massive and elongated

c) GeH_4 , it is more massive

11.26

Both propyl and isopropyl alcohol contain -OH groups which all for hydrogen forces. This said, propyl alcohol is a more elongated molecules, making it more polarizable. This would suggest that propyl alcohol will have strong induced dipole forces and a higher boiling point.

11.27

a) For a molecule to exhibit hydrogen bonding, it most contain hydrogen bonded to O, N, or F.

b) CH_3F cannot hydrogen bond, its H atoms are not bonded to F.
 CH_3NH_2 can hydrogen bond.

CH_3OH can hydrogen bond.

11.33

The negative charge on SO_4^{2-} is greater than the negative charge on BF_4^- . The greater negative charge on sulfate creates strong ion-ion attractions, drawing the ions together as a solid. The weaker ion-ion attractions in BF_4^- containing salts allow it to exist as a liquid at room temperature.