

REVIEW QUESTIONS

Chapter 11

1. For each compound listed below, identify the intermolecular forces present. Use (–) to indicate non-predominant forces and (+) to indicate predominant force.

Compound	Intermolecular Forces		
	Dispersion Force	Dipole-Dipole Force	Hydrogen bonding
Cl ₂	+		
HBr	–	+	
NH ₃	–	–	+
CH ₃ OCH ₃	–	+	
CH ₃ OH	–	–	+
CH ₃ CH ₃	+		
FCH ₂ CH ₂ F	–	+	
HOCH ₂ CH ₂ OH	–	–	+
FCH ₂ CH ₂ OH	–	–	+

2. Predict the order of decreasing vapor pressure for FCH₂CH₂F, HOCH₂CH₂OH, and FCH₂CH₂OH. Give an explanation for your choices.

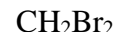
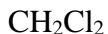


FCH₂CH₂F only has dipole-dipole and dispersion forces, so it has the highest vapor pressure.

FCH₂CH₂OH is capable of hydrogen bonding on one side, so it has stronger intermolecular force than FCH₂CH₂F and therefore has lower vapor pressure.

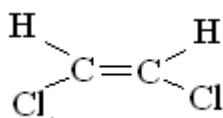
HOCH₂CH₂OH can hydrogen bond on both sides, so it has the strongest intermolecular forces and therefore the lowest vapor pressure.

3. Arrange the following substances in order of decreasing boiling point. Explain your answer.



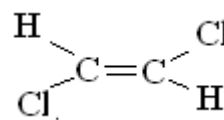
All of these molecules are either non-polar or very little polarity. Therefore, the intermolecular forces present are primarily the dispersion force, which increase with molar mass. The greater the molar mass, the greater the dispersion force and the lower the volatility.

4. Shown below are the two isomers of 1,2-dichloroethene and their respective boiling points:



cis isomer

60.3



trans isomer

47.5

boiling pt ($^{\circ}\text{C}$)

Give an explanation for the larger boiling point of the cis isomer.

Both these molecules have the same molar mass. Therefore, the magnitude of the dispersion force present in each would be expected to be similar.

The trans isomer is non-polar since the dipoles of the C–Cl bonds and C–H bonds cancel one another due to the planar shape of the molecule. The cis isomer, on the other hand, is polar since the polarities of the bonds do not cancel one another, and there is a net dipole for the molecule. Therefore, the cis isomer would be expected to have greater dipole-dipole forces which would cause its greater boiling point.

5. Trimethylamine, $(\text{CH}_3)_3\text{N}$ and propylamine $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$, have fishy, ammonia-like odors. Explain why propylamine has a lower vapor pressure than trimethylamine.

Trimethylamine cannot hydrogen bond, since there are no hydrogens attached to the nitrogen atom. Propylamine, however, can hydrogen bond and therefore has the lower vapor pressure.

6. Explain the observed trend in the boiling points of the compounds listed below:

H ₂ Te	-2°C
H ₂ Se	-41.5°C
H ₂ S	-60.7°C
H ₂ O	+100°C

The boiling points for these compounds generally increase based on their molar mass, because the primary intermolecular force between the molecules of each substance is the dispersion force, which is affected by molar mass.

Water is an exception to this trend because its molecules can also form hydrogen bond. As a result, despite its low molar mass, water has the highest boiling point among the four.