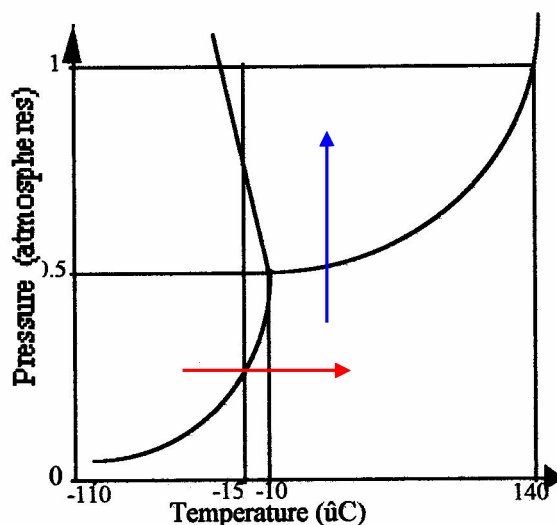


REVIEW QUESTIONS

Chapter 11

1. Use the phase diagram above to answer the following questions:



A) What is the normal boiling point of the substance above? 140 °C

B) What are the critical pressure and the critical temperatures for this substance?

$T_c =$ 140 °C $P_c =$ 1 atm

C) What phase change occurs when the temperature of a sample of this substance is increased from -20°C to 20°C at 0.3 atm pressure?

Sublimation (see red arrow on diagram above)

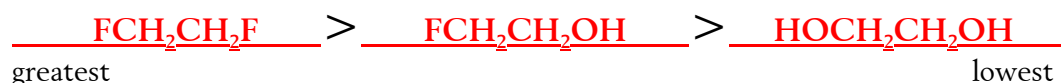
D) What phase change occurs when the pressure of a sample of this substance is increased from 0.4 atm to 0.8 atm at 0°C ?

Condensation (see blue arrow on diagram above)

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

Compound	Intermolecular Forces		
	London Forces	Dipole-Dipole	H-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	-	-	+

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



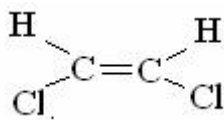
- FCH₂CH₂F only has dipole-dipole and London forces, so it has the highest vapor pressure.
- FCH₂CH₂OH can also hydrogen bond on one side, so it has stronger IM forces and therefore lower vapor pressure.
- HOCH₂CH₂OH can hydrogen bond on both sides, so it has the strongest IM forces and therefore the lowest vapor pressure.

4. Arrange the following substances in order of increasing volatility. Explain your answer.

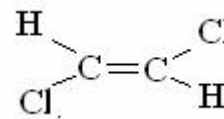


- All of these molecules are either non-polar or very little polarity. Therefore the IM forces present are the London forces which increase with molecular weight.
- The greater the molecular weight, the greater the IM forces and the lower the volatility.

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



cis isomer
60.3



trans isomer
47.5

B.p. (°C)

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

Both these molecules have the same molecular weight. So their London forces would be expected to be similar to one-another.

The cis isomer, however, is polar since the polarities of the bonds do not cancel one-another. Therefore, the cis isomer would be expected to have greater dipole-dipole forces which would cause its greater boiling point.

6. 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.

7. For each pair of substances shown below, predict which would have the higher melting point and indicate why:

- a) **KBr** and Br_2

KBr has ionic bond, while Br_2 has a molecular bond. Ionic bonds are stronger than molecular bonds.

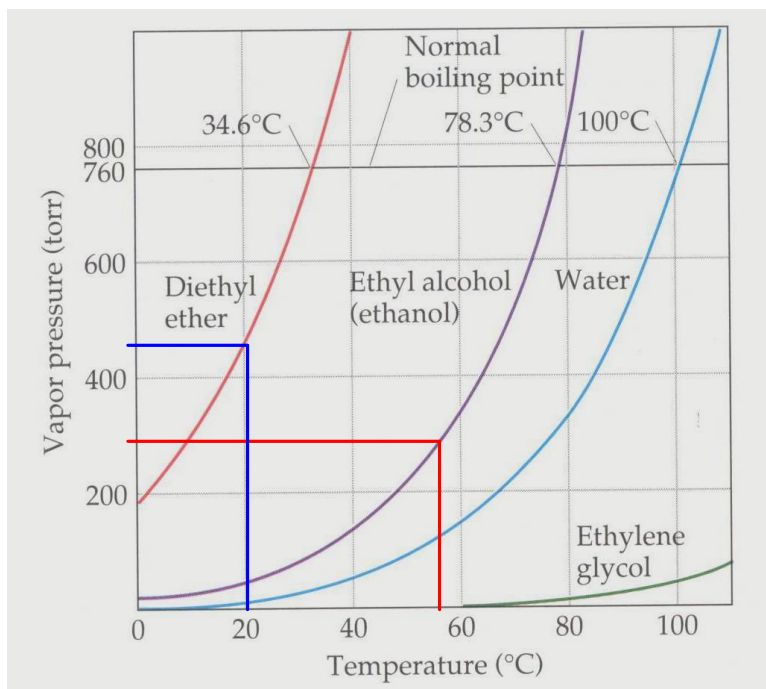
- b) **SiO_2** and CO_2

SiO_2 has a network covalent bond, while CO_2 has molecular bonds. Network covalent bonds are stronger than molecular bonds.

- c) NaF and **MgF_2**

NaF and MgF_2 both have ionic bonds. However, MgF_2 has stronger lattice energy (due to its +2 charge), which would make the bond stronger than NaF .

8. Use the graph below to answer the following questions:



a) What is the boiling point of ethyl alcohol at 300 torr?

55 °C (see red lines on graph)

b) At what pressure will diethyl ether boil at 20°C?

450 torr (see blue line on graph)

c) Which liquid is least volatile? Which is most volatile?

Water is least volatile

Diethyl ether is most volatile