10.7 Vapor Pressure and Changes of State

Vapor: Gaseous phase of a substance that is normally a liquid at room temperature.

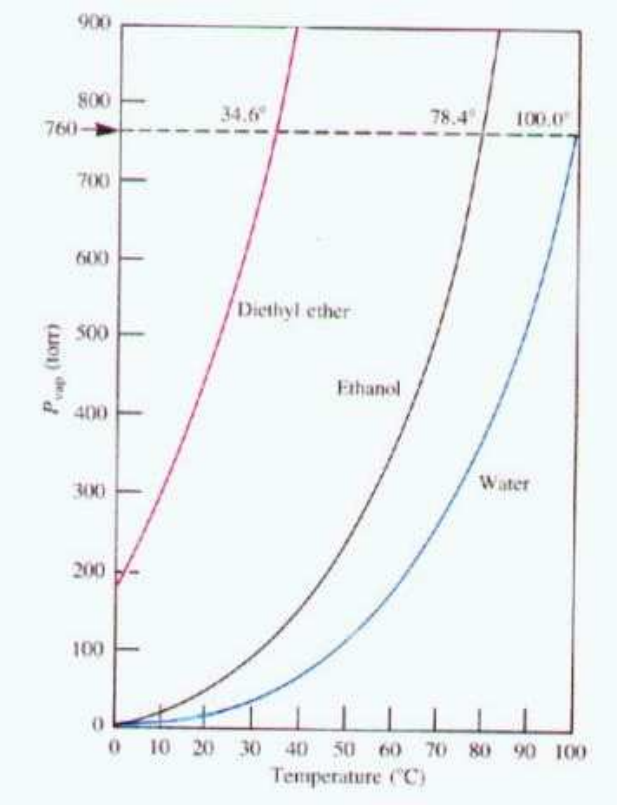
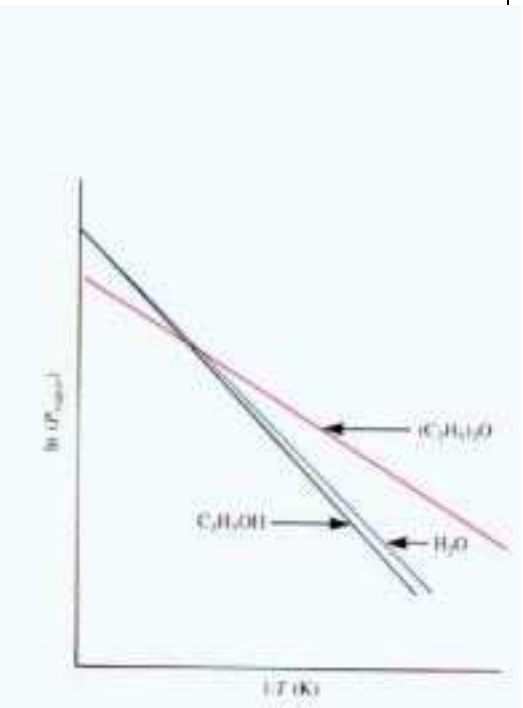
Evaporation (vaporization) is an endothermic process, "cooling"

Heat of vaporization, ΔH_{vap}, energy required to vaporize one mole of substance at 1 atm pressure.

Ex. ΔH_{vap} H_2O = 40.7 kJ/mol, Useful as the planet's and body's cooling system.

Condensation: Vapor molecules return to the liquid.

Vapor Pressure: The pressure of a vapor in a closed system when the rate of vaporization equals the rate of condensation, equilibrium is achieved. Dynamic, physical equilibrium, with no net change in amounts of liquid or vapor.

Vapor Pressure vs. Temperature	Linear: ln VP vs. 1/T (absolute T)
	

Volatile: Liquid with high vapor pressure, weak intermolecular attractions (or low molar mass). Higher molar mass have larger London dispersion forces (more polarizable with large number of electrons).

Temperature: An increase in temperature shifts the equilibrium to the side of more vapor. More molecules have the needed energy to escape and overcome the intermolecular attraction at the surface. Hence, losing the higher KE molecules means that the average KE drops, temperature lowers.

Liquid $\longleftrightarrow$ Vapor

The **Clausius-Clapeyron** equation: Describes the relationship between the vapor pressure and absolute temperature: (puts the non-linear increase into a linear form)

$\ln P_{vap} = -\frac{\Delta Hvap}{R}\left(\frac{1}{T}\right)+C$ **or to compare two points**: subtract the 2 equations $\ln\left(\frac{P_{T_1}^{vap}}{P_{T_2}^{vap}}\right)=\frac{\Delta Hvap}{R}\left(\frac{1}{T_2}-\frac{1}{T_1}\right)$ **or** $\ln\left(P_{T1}^{vap}\right)-\ln\left(P_{T2}^{vap}\right)=\frac{\Delta Hvap}{R}\left(\frac{1}{T_2}-\frac{1}{T_1}\right)$	y = ln (P_{vap}) x = $\left(\frac{1}{T}\right)$ m = slope = $-\frac{\Delta Hvap}{R}$, R = 8.3145 J/mol K b = y intercept = C

In Class Practice, Ex. 10.6; Calculate the vapor pressure of water at 50ºC using the Clausius-Clapeyron.

Some substances can convert directly from the solid to the gaseous phase, this is known as **sublimation**, an endothermic process, ex. $CO_{2(s)} \longrightarrow CO_{2(g)}$. The reverse process, ex. $I_{2(g)} \longrightarrow I_{2(s)}$ (exothermic) is called **deposition**.

Practice Problems: P.474 #2, 18, 19, 79, 80, 81, 82, 83, 84, 99