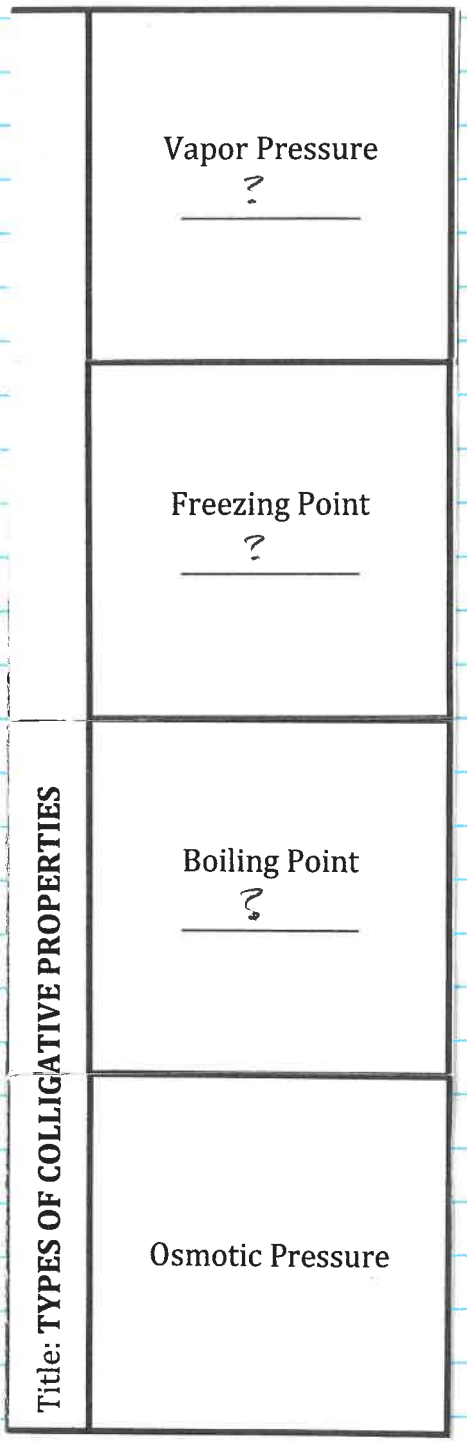
(14.5) Colligative properties of solutions

colligative properties – properties of a solution that depend on the number of solute particles in solution and not the nature of the solute (i.e., identity of the solute particles)



(14.5) Colligative properties of solutions

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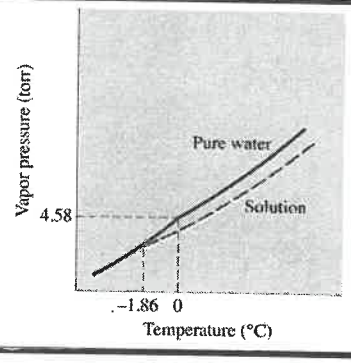
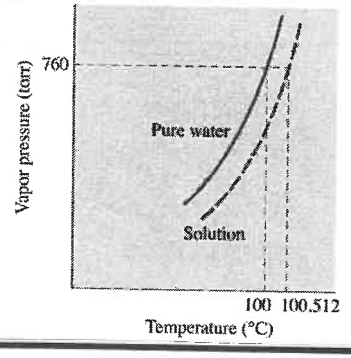
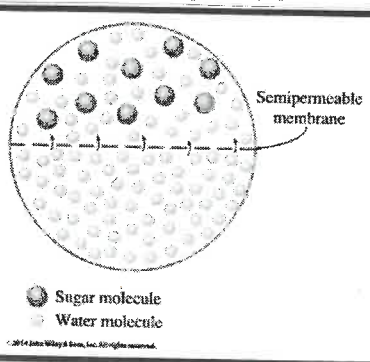
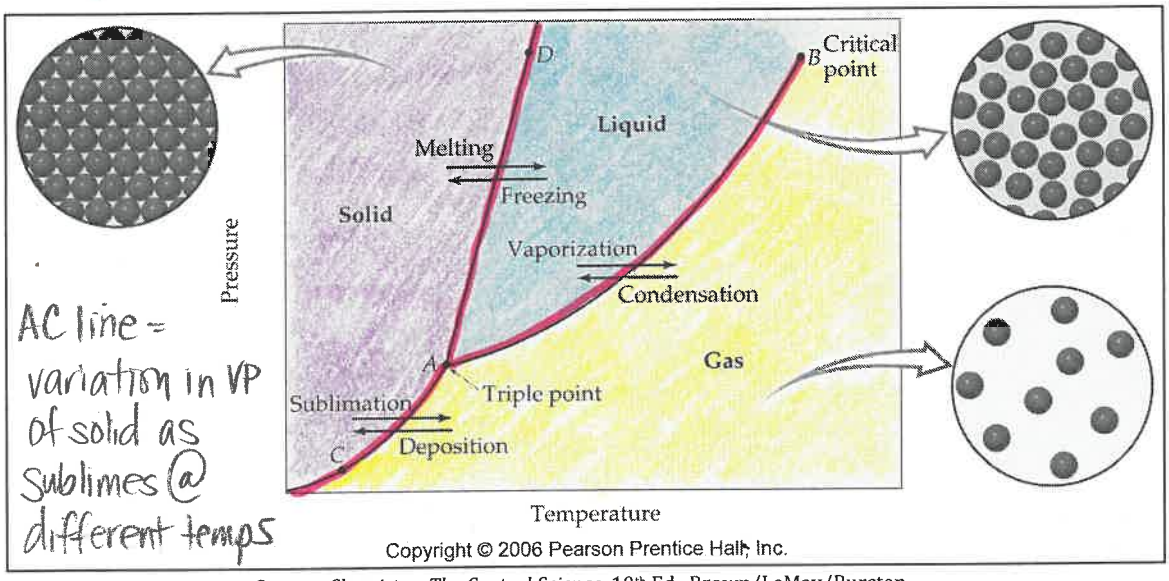
	Vapor pressure is the pressure of the vapor over a liquid at equilibrium. A substance with no measurable vapor pressure is *nonvolatile* and, a substance that has vapor pressure is *volatile*.	Adding a nonvolatile solute to a solvent always lowers the vapor pressure. = *Vapor Pressure Depression*
	The *melting point* (or freezing point) is the temperature at which the solid and liquid states of a substance are in equilibrium.	The freezing point of a solution is lower than that of the pure liquid. = *Freezing Point Depression*
	The *boiling point* is the temperature at which the vapor pressure of a liquid is equal to the pressure above the liquid. This is called the normal boiling when the pressure is 1 atm.	The boiling point of a solution is higher than that of the pure liquid. = *Boiling Point Elevation*
	**Osmotic pressure** is the difference between atmospheric pressure and an applied pressure that is required to prevent **osmosis** (i.e., diffusion of water through a **semipermeable membrane**) from occurring.	In osmosis, the net transfer of water is always from a less concentrated to a more concentrated solution. Thus, the effect is toward equalization of the concentration on both sides of the membrane.

phase diagram for a three-phase system

phase diagram – a graphic representation of the equilibria among the solid, liquid, and gaseous phases of a substance as a function of temperature and pressure

AD line = change in MP of solid with increasing temp

beyond the critical point, the liquid and gas phase become indistinguishable



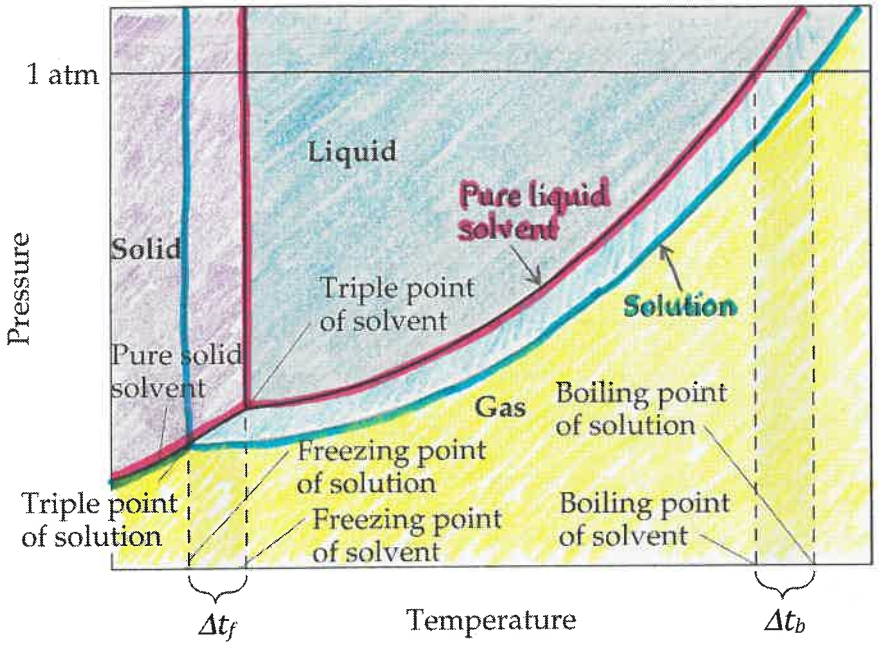
Source: *Chemistry: The Central Science*, 10th Ed., Brown/LeMay/Bursten

AC line = variation in VP of solid as sublimes @ different temps

at the triple point all three phases are in equilibrium at this temp. and pressure

AB line = equilibrium btwn liquid and gas phase

phase diagrams for a pure solvent and for a solution of a nonvolatile solute



Source: *Chemistry: The Central Science*, 10th Ed., Brown/LeMay/Bursten

molality (m) – an expression of the number of moles of solute dissolved in 1000 g of solvent

$$m = \frac{\text{mol solute}}{\text{kg solvent}}$$

$\Delta t_f = m K_f$

Δt_f = freezing pt. depression (°C)

K_f = freezing pt. depression constant (°C·kg/mol)

$\Delta t_b = m K_b$

Δt_b = boiling pt. elevation (°C)

K_b = boiling pt. elevation constant (°C·kg/mol)