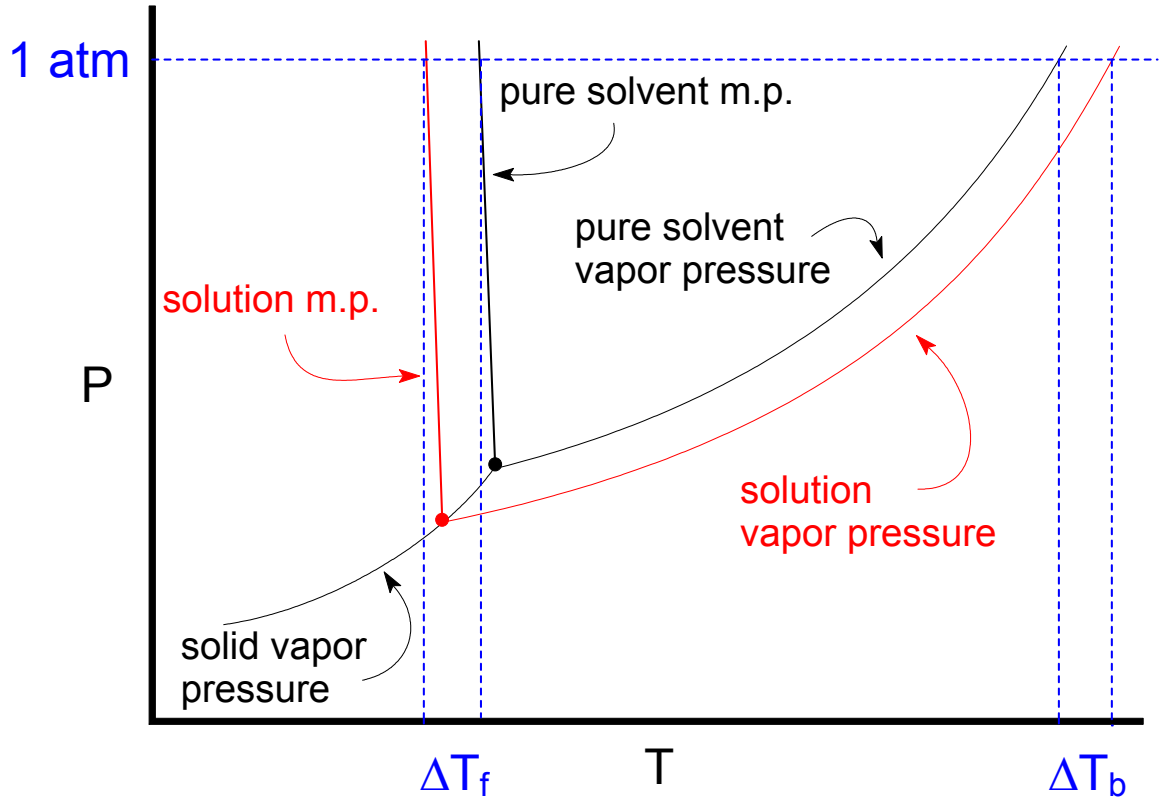
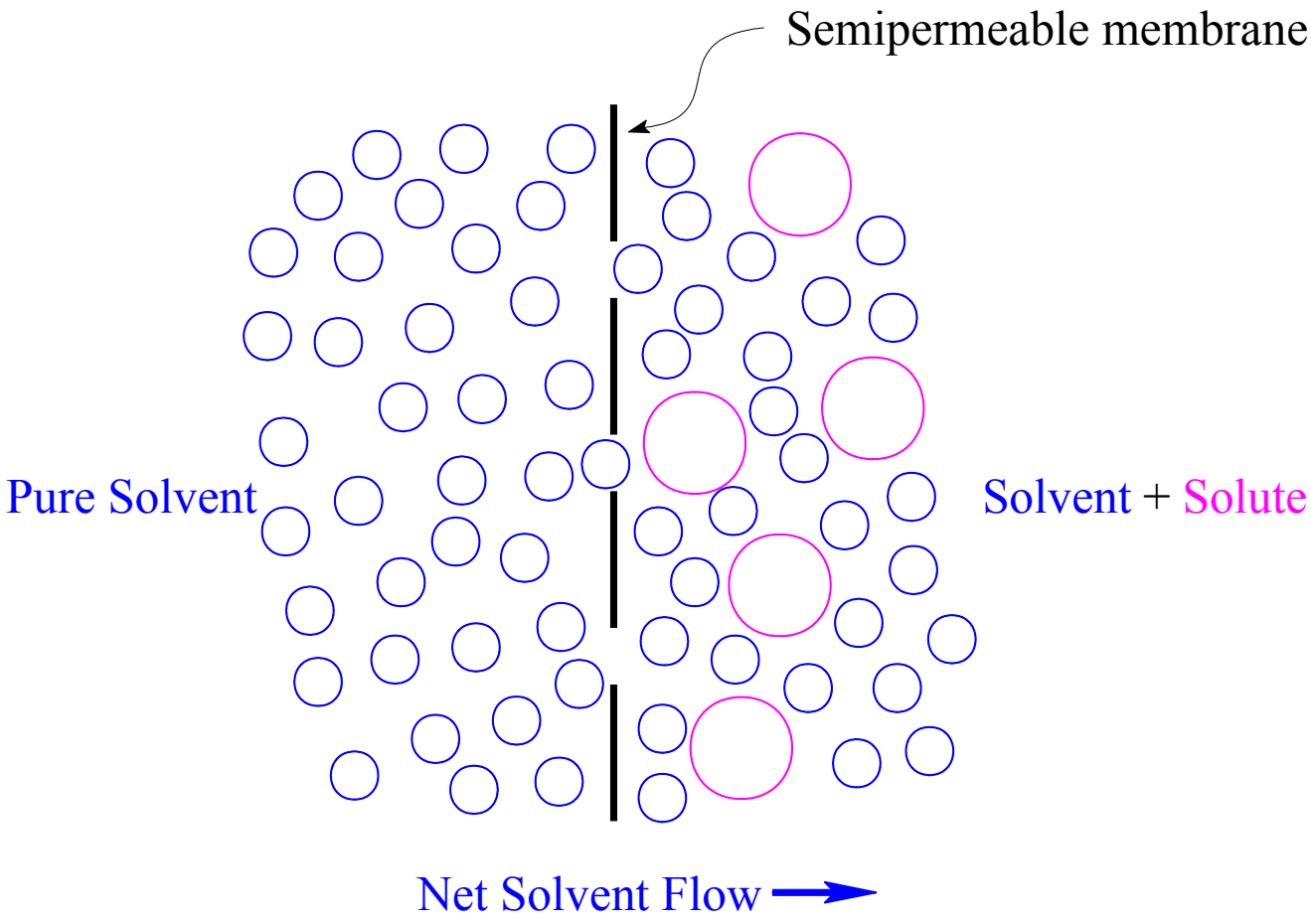
Freezing Point Depression
and
Boiling Point Elevation



$$\Delta T_b = K_b m$$

$$\Delta T_f = K_f m$$

Model of Osmotic Flow



Osmotic Pressure

Jacobus van't Hoff - 1887

Osmotic pressure, π, is the minimum applied pressure that must be applied to the solution side to stop the diffusion of solvent across a semi-permeable membrane into the solution, given by

$$\pi V = nRT$$

where n = moles of solute in V liters of solution
T = temperature in Kelvin
R = 0.0821 L·atm/K·mol

But molarity is moles/liter,

$$\text{molarity} = M = n/V$$

so

$$\boxed{\pi = MRT}$$