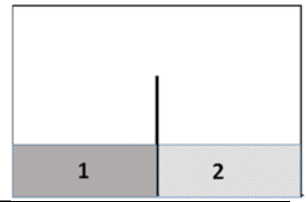
Exercise A Consider the box at right with two separated solutions at 298 K. Assume any solution acts as an ideal solution. Indicate whether any component will be transferred from one compartment to the other, which way it will be transferred, and explain your logic.



Condition	Compartment 1	Compartment 2
1	0.5 moles NaCl dissolved in 1.00 L of water at 298 K	Pure liquid water at 298 K
2	Liquid benzene at 303 K	Liquid benzene at 298 K
3	0.5 moles NaCl dissolved in 1.00 L of water at 298 K	0.5 moles KNO_3 dissolved in 1.00 L of water at 298 K

Problem 1. As Exercise A, but for the various conditions below.

Condition	Compartment 1	Compartment 2
4	1.0 moles NaCl dissolved in 1.00 L of water at 298 K	1.0 moles Na_2SO_4 dissolved in 1.00 L of water at 298 K
5	0.5 moles benzene dissolved in 1.0 L of n-decane	0.5 moles n-decane dissolved in 1.0 L of benzene

Exercise B For pure water, P^* = 23.75 Torr at 298 K. For compartment 1 in condition 4, above, calculate:

- the vapor pressure of H_2O in equilibrium with each solution at 298 K
- $\mu(H_2O, \text{aqueous}) - \mu^*(H_2O, \text{aqueous})$ at 298 K
- the boiling point of the solution, given $\Delta H_{vap,molar}$ = 40. kJ/mole
- the freezing point of the solution, given $\Delta H_{melt,molar}$ = 6.0 kJ/mole
- the osmotic pressure of the solution

Problem 2 As Exercise B, but for 1.0 moles $Ca_3(PO_4)_2$ dissolved in 2.00 L of water at 298 K.

Exercise C. For n-pentane, P^*(298 K) = 0.68 bar. For n-hexane, P^*(298 K) = 0.20 bar. Assume the solution is ideal. What is the total pressure of vapor in equilibrium with a solution of n-hexane and n-pentane for which $x_{n\text{-hexane}}$ = 0.25?

Problem 4. At what solution composition do n-pentane and n-hexane have the same partial pressures?

Exercise D Consider an ideal dilute solution with x_{water} = 0.980 and x_{CH3OH} = 0.020 at 298 K. The Henry's Law constant (k_{CH3OH}) for CH_3OH in water is 3.3 Torr at 298 K.

Exercise D.1 Compute the vapor pressure of CH_3OH at equilibrium

Exercise D.2 Calculate μ(aqueous) – μ* for CH_3OH, given P*(CH_3OH) = 126 Torr at 298 K.

Problem 5 What do the values of P*(CH_3OH) and k_{CH3OH} indicate about the relative strength of H_2O-CH_3OH attractive forces versus CH_3OH-CH_3OH attractive forces.

Problem 6 Consider an ideal dilute solution with x_{water} = 0.9990 and $x_{benzene}$ = 0.0010 at 298 K. Assume the solution is ideal dilute and the Henry's Law constant for benzene in water is 69 bar.

Problem 6.1 Compute the vapor pressure of each component at equilibrium.

Problem 6.2 Calculate μ – μ* for benzene and H_2O.

Variations for your consideration:

1) For Conditions 1 in Exercise A and Conditions 3-4 in Problem 1, calculate:

μ(H_2O, compartment 1) - μ(H_2O, compartment 2)

2) Can the same solution of B in water have a boiling point of 374.15 K and a melting point of 272.15 K?

3) If a solution of B in water has a boiling point of 374.15 K, what is its osmotic pressure?

4) Given the data in Exercise D, what is the mole fraction of CH_3OH in an aqueous solution for which P(CH_3OH) = 0.10 Torr?

5) For an ideal solution at 298 K, μ(A) – μ*(A) = -1200 J/mole. What is the mole fraction of A in solution?