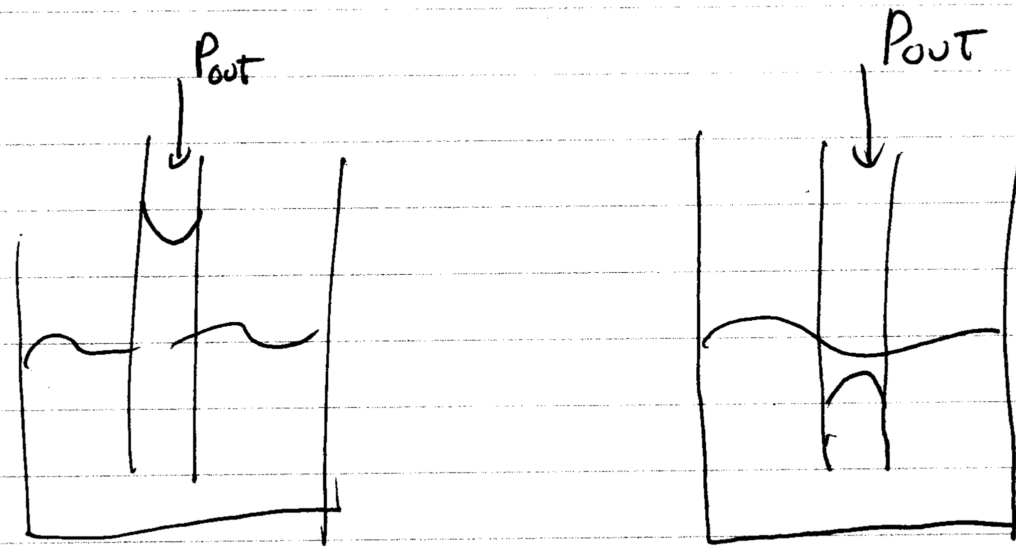
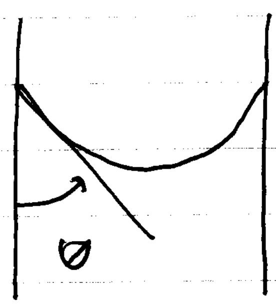
Capillarias





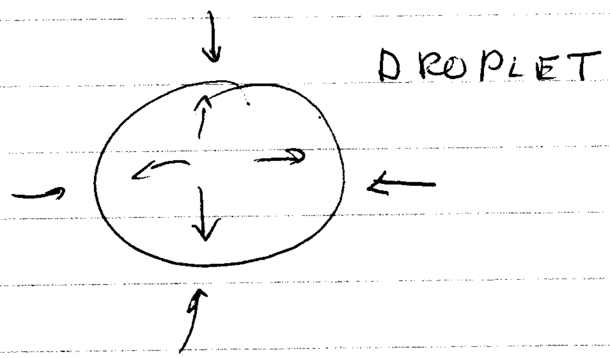
$\theta \equiv$ contact angle

Watting $\Rightarrow \theta = 0°$

Nonwatting $\Rightarrow \theta = 180°$

$$P_{in} = P_{out} + \frac{2\gamma}{r\cos\theta}$$

SURFACE TENSION



$$P_{in} = P_{out} + \frac{2\gamma}{r}$$

r = radius
γ = SURFACE TENSION

FOR A FLAT SURFACE $r \to \infty$

$$P_{in} = P_{OUT}$$

$r \simeq 10^{-7}\,m \quad 10^{-8}\,m$

Smaller droplets evaporate faster than bigger droplets.

IDEAL SOLUTIONS. (BINARY)

Ideal sol. IS SUCH THAT

$$F_{AA} = F_{BB} = F_{AB}.$$

Ideal solutions follow Raoult's Law

$$P_i = X_i P_i^*$$

WHERE P_i IS THE VAPOR PRESSURE ON TOP OF A SOLUTION WITH COMPOSITION X_i.

So GIVEN (X_A, X_B)

$$X_A + X_B = 1$$

VAPOR

$$P_A = X_A P_A^*$$

$$P_B = X_B P_B^*$$

$$P_T = P_A + P_B = X_A P_A^* + X_B P_B^*$$

BINARY SOLUTIONS

$$P_{Total} = P_1 + P_2 = X_1 P_1^* + (1 - X_1) P_2^*$$
$$= P_2^* + (P_1^* - P_2^*) X_1$$

P_{TOTAL} IS THE VAPOR PRESSURE AS A FUNCTION OF SOLUTION COMPOSITION

WE CAN CONSIDER THE VAPOR COMPOSITION AND FROM DALTONS LAW

$$P_1 = y_1 P_{TOTAL}$$
$$P_2 = y_2 P_{TOTAL}$$

OR

$$y_1 = \frac{P_1}{P_{TOTAL}}$$

$$y_1 = \frac{X_1 P_1^*}{P_2^* + (P_1^* - P_2^*) X_1}$$

OR

$$X_1 = \frac{y_1 P_2^*}{P_1^* + (P_2^* - P_1^*) y_1}$$

$$P_{TOTAL} = P_1 + P_2 = P_2^* + (P_1^* - P_2^*) X_1$$

OR

$$P_{TOTAL} = \frac{P_1^* P_2^*}{P_1^* + (P_2^* - P_1^*) y_1}$$

$$y_1 = \frac{P_1^* P_{TOTAL} - P_1^* P_2^*}{P_{TOTAL}(P_1^* - P_2^*)}$$

THERMODYNAMICS

FOR EACH COMPONENT

$$\mu_i^{sol} = \mu_i^{vap}$$

BUT

$$\mu_i^{vap} = \mu_i^{o} + RT \ln\left(\frac{p_i}{p^o}\right)$$

THUS

$$\mu_i^{sol} = \mu_i^{o} + RT \ln\left(\frac{p_i}{p^o}\right)$$

FOR A PURE LIQUID $p_i = p_i^*$

$$\mu_i^{*} = \mu_i^{o} + RT \ln\left(\frac{p_i^*}{p^o}\right)$$

HENCE

$$\boxed{\mu_i^{sol}(T, p_i) = \mu_i^{*}(T, p_i^*) + RT \ln X_i}$$

WHERE WE USE $p_i = X_i p_i^*$

MIXING

$$\Delta G_{mix} = nRT \sum_i x_i \ln x_i$$

$$\Delta S_{mix} = -\left(\frac{\partial}{\partial T} \Delta G_{mix}\right)_p = -nR \sum x_i \ln x_i$$

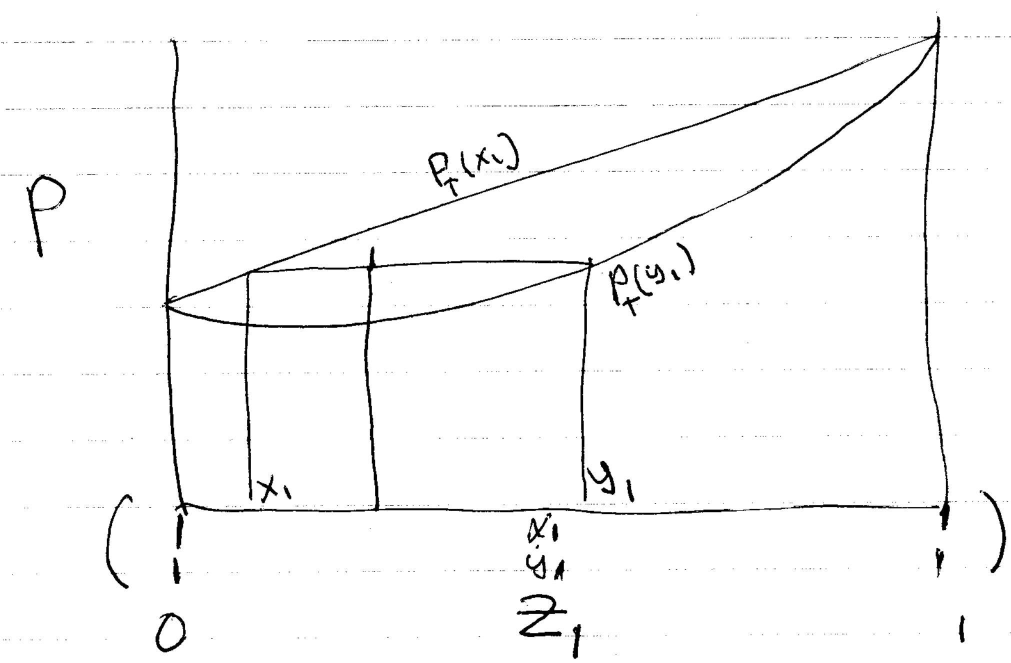
$$\Delta V_{mix} = \left(\frac{\partial}{\partial p} \Delta G_{mix}\right)_T = 0$$

$$\Delta H_{mix} = \Delta G_{mix} + T\Delta S_{mix} = 0$$

$$z_1 \equiv \frac{n_1}{n_{TOTAL}} = \frac{n_1^{liq} + n_1^{vap}}{n_1^{liq} + n_2^{liq} + n_1^{vap} + n_2^{vap}}$$

IN THE LIQUID REGION $z_1 = x_1$

IN THE VAPOR REGION $z_1 = y_1$



$$n_{liq}^{TOT}(z_1 - x_1) = (y_1 - z_1)\, n_{vap}^{TOT}$$

LEVER RULE