Notes for PS#5 CHM 225 / 2008

1. $x_{benzene} \equiv x_b = 1/2$

(i) $P = P_{benzene} + P_{toluene} = \frac{1}{2} P^*_{benzene} + \frac{1}{2} P^*_{toluene} = 5516.8$ Pa

(ii) benzene $\equiv b$, toluene $\equiv t$

$$y_b = \frac{P^*_b x_b}{P^*_t + (P^*_b - P^*_t) x_b} = 0.61 \quad , \; y_t = 0.39$$

(iii) $$P = \frac{P^*_t P^*_b}{\frac{1}{2}(P^*_t + P^*_b)} = 5238.1 \text{ Pa}$$

(iv) $$x_b = \frac{P^*_t \frac{1}{2}}{\frac{1}{2}(P^*_t + P^*_b)} = 0.39$$

(v) $n_{liq} = n_{gas} = 1 \Rightarrow \overline{al} = \overline{av}$

$$X_b - x_b = y_b - X_b \Rightarrow y_b = 1 - x_b$$

so

$$x_b = \frac{P^*_t y_b}{P^*_b + (P^*_t - P^*_b) y_b} \Rightarrow (P^*_t - P^*_b) x_b^2 - 2P^*_t x_b + P^*_t = 0$$

$$\Rightarrow x_b = \frac{P^*_t \pm (P^*_b P^*_t)^{1/2}}{(P^*_t - P^*_b)} = 0.44 \quad (\text{keep physical root})$$

$$\Rightarrow y_b = 0.56$$

$$P = \frac{P^*_b P^*_t}{P^*_b + (P^*_t - P^*_b) y_b} = 5383.5 \text{ Pa}$$

2. $\pi = m \tilde{g} h / V$ ← volume of soln.
↑ mass of solute
← accel. due to gravity

also $\pi = \frac{RT n_B}{V}$ so $\rho \tilde{g} h = \frac{RT n_B}{V}$; $\rho = \frac{m}{V}$

$V = 1\,cm^2 \times h$, $\rho = 1\,g/cm^3$, $MW = 180\,g/mol$
$\tilde{g} = 980.67\,cm/s^2$

so $h^2 = \frac{RT n_B}{\rho \tilde{g} (1 cm^2)} = 1.404 \times 10^5\,cm^2$

(i) $\Rightarrow h = 374.6\,cm$

(ii) $\pi = \frac{RT n_B}{V}$; $V = (1\,cm^2) \times (374.6\,cm)$
$= 374.6\,cm^3$

$\Rightarrow \pi = 36.7\,kPa$