Completely Miscible Liquids. They can be handled by Raoult's Law, i.e.

$$y_i P = x_i P_i^o$$

where P = Total pressure of vapors in equilibrium with the liquid solution, P_i^o = vapor pressure of component i in pure state, y_i= mole fraction of ith component in vapor state, xi= mole fraction of ith component in liquid state.

This most fundamental expression may be arranged in many useful forms. e.g. for binary solutions :

$$P = x_a P_a^0 + (1- x_a) + P_b^0$$

a=toluene, b=xylene   1 atm=760 torr, 0.5 atm =380 torr

$P = x_a P_a^0 + (1- x_a) + P_b^0 = 400x_a + 150(1-x_a) = 400x_a + 150 - 150x_a = 250x_a + 150$

$250x_a = 380 - 150$

$x_a = 230/250 = 0.92$

$x_b = 1 - 0.92 = 0.08$

$P_a = x_a P_a^0 = 0.92*400 = 368$ torr

$P_b = x_b P_b^0 = 0.08*150 = 12$ torr

$y_a = P_a/P = 368/380 = 0.968$ (96.8%)

$y_b = 1 - y_a = 0.032$ (3.2%)