



QUESTION OF THE DAY

Problem: A closed container contains liquid benzene and toluene in the mole fractions of 0.4 and 0.6, respectively. The temperature is 298K. Calculate the pressure inside the container.

Solution:

We may use Raoult's Law, which states that $P = x_b P_b^* + x_T P_T^*$

We will use Antoine's Equation for to find P^* , which is $\log_{10} P^* = A - \frac{B}{T + C}$ in units of mm Hg and temperature in C.

A, B, and C are species-dependant constants

| | Benzene | Toluene |
|---|---------|---------|
| A | 6.893 | 6.958 |
| B | 1204 | 1347 |
| C | 220 | 220 |

Converting 298 K to C (25 C), plugging these values into Antoine's Equation and solving for P^* gives 95.217 mm Hg for benzene and 28.84 mm Hg for toluene

Plugging this into Raoult's Law gives

$$P = (0.4)(95.217) + (0.6)(28.84) = 55.39 \text{ mm Hg}$$

The pressure in the container must equal 55.39 mm Hg for the liquid mole fraction to match the specified conditions.

Note, the vapor mole fraction can be calculated from using the equation $y_b P = x_b P_b^$