(1) How many pounds in a cup of mercury?

DATA: Density of mercury @ 25°C = 13.5 g/cm³

4 cups = 1 qt ; 16 cups = 1 gal (REF: Merck Index v. 11)

$$1\,\text{cup} \times \frac{13.5\,\text{g}}{\text{cm}^3} \times \frac{\text{cm}^3}{\text{mL}} \times \frac{1000\,\text{mL}}{\text{L}} \times \frac{\text{L}}{0.2642\,\text{gal}} \times \frac{\text{gal}}{16\,\text{cups}} \times \frac{1\,\text{lb}}{453.29\,\text{g}}$$

$$= \underline{7.05\,\text{lbs}}$$

Note: The common saying "A pint's a pound the world around" applies to water at around room temperature...

$$1\,\text{pt} \times \frac{1.0\,\text{g}}{\text{cm}^3} \times \frac{\text{cm}^3}{\text{mL}} \times \frac{1000\,\text{mL}}{\text{L}} \times \frac{\text{L}}{0.2642\,\text{gal}} \times \frac{\text{gal}}{8\,\text{pints}} \times \frac{1\,\text{lb}}{453.29\,\text{g}}$$

$$= \underline{1.04\,\text{lbs}}$$

(2) FIND THE MASS FRACTION OF NaOH IN AN 8M NaOH SOLUTION.

DATA: DENSITY OF 8M NaOH @ 20°C = 1.275 g/cm^3

(REF: HANDBOOK OF CHEMISTRY & PHYSICS)

IF WE SELECT 1 LITER AS A BASIS FOR CALCULATIONS:

$$m_{NaOH} = 1.0\,L \times \frac{8\,mol}{L} \times \frac{40.0\,g\ NaOH}{mol} = 320.0\,g\ NaOH$$

$$m_{TOTAL} = 1.0\,L \times \frac{1.275\,g}{mL} \times \frac{1000\,mL}{L} = 1275\,g\ SOLN$$

$$w_{NaOH} = \frac{320.0\,g\ NaOH}{1275\,g\ SOLN} = \underline{0.251}$$

(3) WHAT ARE THE MOLE FRACTION AND MASS FRACTION OF CARBON IN ACETIC ACID?

ACETIC ACID = CH_3COOH $\quad M_{AA} = 60.0\ g/mol$

IF WE SELECT 1.0 mol OF ACETIC ACID AS A BASIS FOR OUR CALCULATIONS:

moles of atoms = 8

moles of C = 2

$$x_C = \frac{\text{moles C}}{\text{moles total}} = \frac{2}{8} = \underline{0.25}$$

$$m_{TOT} = 1.0\ mol\ AA \times \frac{60.0\ g\ AA}{mol\ AA} = 60.0\ g\ AA$$

$$m_C = 1.0\ mol\ AA \times \frac{2\ mol\ C}{mol\ AA} \times \frac{12.0\ g\ C}{mol\ C} = 24.0\ g\ C$$

$$w_C = \frac{24.0\ g\ C}{60.0\ g\ AA} = \underline{0.40}$$

(4) IF EXHALED BREATH IS 5.0% BY MASS CO_2, WHAT IS PARTIAL PRESSURE OF CO_2 IN 16.1 psi BALLOON?

MOLECULAR WEIGHTS: $M_{AIR} = 29.0\ g/mol$

$M_{CO_2} = 44.0\ g/mol$

IN BALLOON: $w_{AIR} = 0.95$ $w_{CO_2} = 0.05$

$$y_{CO_2} = \frac{w_{CO_2}/M_{CO_2}}{\frac{w_{CO_2}}{M_{CO_2}} + \frac{w_{AIR}}{M_{AIR}}} = \frac{0.05/44}{\frac{0.05}{44} + \frac{0.95}{29}} = 0.0335$$

$$P_{CO_2} = y_{CO_2} P = (0.0335)(16.1\ psi)$$

$$= \underline{0.540\ psi}$$

(5) WHAT IS THE MAXIMUM MASS FRACTION OF ETHANOL THAT CAN EXIST AS VAPOR AT 35°C AND 775 mm Hg?

CONCEPT: THE MAXIMUM MASS FRACTION OCCURS WHEN THE AIR IS SATURATED WITH ETHANOL.

FIRST, FIND VAPOR PRESSURE OF ETHANOL @ 35°C

$$\log p_E^* = 8.32109 - \frac{1718.10}{35 + 237.52} \qquad \text{(TABLE 1.7 p 21)}$$

$$p_E^* = 103.9 \text{ mm Hg}$$

IF AIR IS SATURATED WITH ETHANOL, THEN $p_E = p_E^* = 103.9$ mm Hg

$$y_E = \frac{p_E}{P} = \frac{103.9 \text{ mm Hg}}{775 \text{ mm Hg}} = 0.134$$

$$\omega_E = \frac{x_E M_E}{x_E M_E + x_{AIR} M_{AIR}} = \frac{(0.134)(46.1)}{(0.134)(46.1) + (0.866)(29)} = \underline{0.197}$$