

## Chapter 10 — Problem Set

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1. A solution is made by dissolving 1.25[g] of  $\text{C}_2\text{H}_5\text{OH}$  in 11.6[g] of water ( $\rho = 1.38 \left[ \frac{\text{g}}{\text{mL}} \right]$ ). Calculate the molality of the solution.

$$\begin{aligned}\frac{1.25}{46} &= .0272[\text{mol}] \\ \frac{.0272}{.0116} &= 2.34[\text{M}] \\ \frac{12.85}{1.38} &= 9.31[\text{mL}] \\ \frac{.0272}{.00931} &= 2.92[\text{M}]\end{aligned}\tag{1}$$

2. A solution contains 50[g] of  $\text{CS}_2$  and 50[g] of  $\text{CHCl}_3$ . Calculate the mole fraction of each.

$$\begin{aligned}\frac{50}{76} &= .658[\text{mol}] \\ \frac{50}{119} &= .42[\text{mol}] \\ \frac{.658}{.42 + .658} &= .39_{\text{CHCl}_3} \\ 1 - .39 &= .61_{\text{CS}_2}\end{aligned}\tag{2}$$

3. The molality of a solution of  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$  is 1.62[M]. Calculate the mass percent.

$$\begin{aligned}\text{C}_{12}\text{H}_{22}\text{O}_{11} &\rightarrow 342 \left[ \frac{\text{g}}{\text{mol}} \right] \\ 1.62 \cdot 342 &= 554[\text{g}] \\ \frac{554}{1000 + 554} &= 36\%\end{aligned}\tag{3}$$

4. The mole fraction of a solution of  $\text{C}_2\text{H}_5\text{OH}$  is 0.0532. Calculate the molality.

$$\begin{aligned}
 1[\text{mol}_{total}] &\rightarrow .0532[\text{mol}_{\text{C}_2\text{H}_5\text{OH}}] \\
 1 - .0532 &= .9468[\text{mol}_{\text{H}_2\text{O}}] \\
 .9468 \cdot 18 &= 17.04[\text{g}] \\
 \frac{.0532}{.01704} &= 3.12[\text{M}]
 \end{aligned}
 \tag{4}$$

5. Complete the following table for three different solutions of NaOH:

	Density ( $\frac{\text{g}}{\text{mL}}$ )	Molarity (M)	Molality (M)	Mass (%)
Solution 1	1.05	1.32	1.32	5
Solution 2	1.22	6.1	6.25	20.0
Solution 3	1.35	10.8	11.8	32

Solution 1:

$$\begin{aligned}
 1.32[\text{mol}_{\text{NaOH}}] &\rightarrow 1000[\text{mL}] \\
 1000 \cdot 1.05 &= 1050[\text{g}] \\
 1.32 \cdot 40 &= 52.8[\text{g}] \\
 1050 - 52.8 &= 997.2[\text{g}] \\
 \frac{1.32}{.9972} &= 1.32[\text{M}] \\
 \frac{52.8}{1050} &= 5\%
 \end{aligned}
 \tag{5}$$

Solution 2:

$$\begin{aligned}
 1220[\text{g}] &\rightarrow 1000[\text{mL}] \\
 1220 \cdot .2 &= 244[\text{g}_{\text{NaOH}}] \\
 \frac{244}{40} &= 6.1[\text{mol}] \\
 \frac{6.1}{1} &= 6.1[\text{M}] \\
 \frac{6.1}{.976} &= 6.25[\text{M}]
 \end{aligned}
 \tag{6}$$

Solution 3:

$$11.8[\text{mol}] \rightarrow 1000[\text{g}]$$

$$40 \cdot 11.8 = 472[\text{g}]$$

$$1000 + 472 = 1472[\text{g}]$$

$$\frac{1472}{1.35} = 1090[\text{mL}] \tag{7}$$

$$\frac{11.8}{1.09} = 10.8[\text{M}]$$

$$\frac{472}{1472} \cdot 100\% = 32\%$$