Solutions Concentration/Practice **Name:** Key

1) How will you make a 2.30 kg of a solution that is 4.85% $NaNO_3$ by mass? (ans: 112g $NaNO_3$+2.19 kg water)

$2.30\text{kg} \times \frac{1000\text{g soln}}{1\text{kg soln}} \times \frac{4.85\text{g NaNO}_3}{100\text{g soln}} = 112\text{g NaNO}_3$

$2.3 \times 10^3\text{g} - 112.5\text{g NaNO}_3 = 2188\text{g} = 2.19\text{kg H}_2\text{O}$

2) What is the mass percent of solute in each of the following solutions?

a) 175 mg NaCl/g solution (ans: 17.5%)

$175 \times 10^{-3}\text{g} \times 100\%\text{soln} = 17.5\%$

b) 0.275 L methanol (d=0.791 g/mL)/Kg water. (ans:17.9%)

$0.275\text{L} \equiv 275\text{mL} \times 0.791\text{g/mL} = 218\text{g methanol.}$

$\frac{218\text{g}}{(218+1000\text{g})\text{soln}} \times 100\% = 17.9\%$

3) What is the mass percent of solute in each of the following solutions?

a) 4.12 g NaOH in 100.0 g water. (ans: 3.96%)

$\frac{4.12\text{g NaOH}}{4.12\text{g} + 100\text{g}} \times 100\% = 3.96\%$

b) 5.00 mL ethanol (d = 0.789g/mL) in 50.0 g water. (ans:7.31%)

$5.00\text{mL} \times 0.789\text{g/mL} = 3.95\text{g ethanol.}$

$\frac{3.95\text{g}}{(3.95+50)\text{g}} \times 100\% = 7.31\%$

4) What is the volume percent of the following solutions? Assume the volumes are additive.

a) 58.0 mL water in 625 mL of ethanol-water solution. (ans: 9.28%)

$\frac{58.0\text{mL}}{625\text{mL}} \times 100\% = 9.28\%$

b) 10.00 g methanol (d = 0.791 g/mL) in 75.00 g ethanol (d = 0.789g/mL). (ans: 11.7%)

$10.00\text{g} \times \frac{1\text{mL}}{0.791\text{g}} = 12.64\text{mL meth.}$ $\quad 75.00\text{g} \times \frac{1\text{mL}}{0.789\text{g}} = 95.06\text{mL eth.}$

$\frac{12.64\text{mL}}{(12.64+95.06)\text{mL}} \times 100\% = 11.7\%$

5) Express the following solutions in the units indicated:
   a) 1 μg benzene/L water as ppb benzene. (ans: 1ppb)

ppb = 10^{-9}

$$\frac{1\ \mu g\ benz}{1\ L\ H_2O} \times \frac{1\ L\ H_2O}{1000\ g\ H_2O} \times \frac{1\ g}{10^6\ \mu g} = \boxed{1\ ppb}$$

($1000\ g\ H_2O = 10^3$)

   b) 0.0035% NaCl by mass as ppm NaCl. (ans: 35ppm)

ppm = 10^{-6}.

$$\frac{0.0035\ g\ NaCl}{100\ g\ soln} \times \frac{10^4}{10^4} = \frac{35\ g}{10^6\ g} = \boxed{35\ ppm}$$

6) Calculate the molality of a solution that has 1.02 Kg sucrose ($C_{12}H_{22}O_{12}$ MW = 342.3 g/mol) in 554 g water. (ans: 5.38*m*)

$$1.02 \times 10^3\ g\ suc \times 1\ mol / 342.3\ g = 2.9798\ mol\ suc.$$

$$\frac{2.9798\ mol}{0.554\ kg} = \boxed{5.38\ m}$$

7) An aqueous solution is prepared by diluting 3.30 mL acetone (CH_3COCH_3; d = 0.789 g/mL, MW = 58.08g/mol) with water to a final volume of 75.0 mL. The density of the solution is 0.993 g/mL. What are the molarity and molality of the solution? (ans: 0.598M, 0.624*m*)

a) Molarity: $3.30\ mL \times 0.789\ g/mL \times 1\ mol / 58.0\ g = 0.04483\ mol\ acetone$

$$\frac{0.04483\ mol}{75 \times 10^{-3}\ L} = \boxed{0.598\ M}$$

b) molality: $3.30\ mL \times 0.789\ g/mL = 2.60\ g\ acetone$ ($0.04483\ mol$ as above)

$75\ mL \times 0.993\ g/mL = 74.5\ g\ soln$

$74.5 - 2.60\ g\ acetone = 71.9\ g\ H_2O$.

$$0.04483\ mol\ acetone / 71.9 \times 10^{-3}\ kg\ H_2O = \boxed{0.624\ m}$$

8) What is the mol fraction of naphthalene ($C_{10}H_8$, MW 128.16g/mol) in a solution of:
   a) 23.5 g naphthalene in 315 g benzene (C_6H_6, MW 78.11 g/mol)? (ans: 0.0434)

$23.5\ g\ naph \times 1\ mol / 128.16\ g = 0.183\ mol\ naph.$

$315\ g \times 1\ mol / 78.11\ g = 4.03\ mol\ benz.$

$$\chi_{naph} = \frac{0.183\ mol}{(0.183 + 4.03)\ mol} = \boxed{0.0434}$$

   b) A 0.25 *m* solution of naphthalene in benzene. (ans: 0.0192)

$0.25\ mol\ naph.$

$1000\ g\ benz \times 1\ mol / 78.11\ g = 12.80\ mol\ benz.$

$$\frac{0.25\ mol}{(0.25\ mol + 12.80)\ mol} = \boxed{0.0192\ \chi_{naph}}$$