Concentration Units

1. If 2.65 g of Na_2CO_3 is dissolved in 825.22 g of water, what is the molality?

$2.65\ g\ Na_2CO_3 = \frac{1\ mol}{105.9888\ g} = 0.0250\ mol\ Na_2CO_3$ 825.22 g = 0.82522 kg

$m = \frac{0.0250\ mol}{0.82522\ kg} = \mathbf{0.0303\ m}$

2. A solution contains 26.45 g of $K_2Cr_2O_7$ and 25.24 g of Na_2SO_4 dissolved in 300.00 g of water. What is the mole fraction of $K_2Cr_2O_7$, Na_2SO_4, and H_2O?

$26.45\ g\ K_2Cr_2O_7 \times \frac{1\ mol}{294.185\ g} = 0.0899\ mol$

25.24 g Na_2SO_4 = 0.178 mol 300.00 g H_2O = 16.65 mol

$\chi_{K_2Cr_2O_7} = \frac{0.0899\ mol}{0.0899\ mol + 0.178\ mol + 16.65\ mol} = \mathbf{0.00531}$

$\chi_{Na_2SO_4} = \frac{0.178\ mol}{0.0899\ mol + 0.178\ mol + 16.65\ mol} = \mathbf{0.0105}$

$\chi_{H_2O} = \frac{16.65\ mol}{0.0899\ mol + 0.178\ mol + 16.65\ mol} = \mathbf{0.9998}$

3. How many grams of HNO_3 is required to prepare 50.00 g of a 2.54% by mass aqueous solution?

$50.00\ g\ soltn \times \frac{2.54\ g\ HNO_3}{100.0\ g\ soltn.} = \mathbf{1.27\ g}$

4. An aqueous solution of 2.45 M H_2SO_4 has a density of 1.79 g/mL. Calculate the percent by mass, the molality, and the mole fraction of H_2SO_4. 2.45 mol = 240.29 g H_2SO_4 Convert L soltn. to grams

1000 mL soltn. $\times \frac{1.79\ g}{mL} = 1790\ g\ solution$

$\%\left(\frac{w}{w}\right) = \frac{mass\ solute,\ g}{mass\ solution,g} \times 100 = \frac{240.29\ g}{1790\ g} \times 100 = \mathbf{13.4\%}$

$m = \frac{mol\ solute}{kg\ solvent}$ mass H_2O = 1790 g – 240.29 g = 1549.71 g H_2O

$\boldsymbol{m = \frac{2.45\ mol}{1.54971\ kg} = 1.58\ m}$

$\boldsymbol{\chi_{H_2SO_4} = \frac{2.45\ mol}{2.45\ mol + 85.999\ mol} = 0.0285}$

5. The concentration of Cl^- ion in water is 18.0 ppm. How many grams of chloride ion are in 275.00 mL of water? The density is 1.00 g/mL. 275.00 mL x $\frac{1.00\ g}{mL} = 275.00\ g$ solution

$18.0\ ppm = \frac{mass\ of\ solute}{mass\ of\ solution} \times 10^6$ solve for mass of solute

$mass\ of\ solute = \frac{18.0\ ppm\ \times\ 275.00\ g\ solution}{10^6} = \mathbf{0.00495\ g}$