CONCENTRATION

- When you discuss a solution, you need to be aware of:
  - what materials are in the solution
  - how much of each material is in the solution

- CONCENTRATION is the amount of one substance compared to the others in a solution. This sounds vague, but that's because there are many different ways to specify concentration!

- We will discuss three different concentration units in CHM 111:

(1) MOLARITY

$$= \frac{\text{moles solute}}{\text{L solution}} \qquad M \text{ or } \underline{M}$$

(2) MOLALITY

$$= \frac{\text{moles solute}}{\text{kg solvent}} \qquad m$$

(3) MOLE FRACTION

$$= \frac{\text{moles component A}}{\text{moles solution}} \qquad X_A$$

What's the MOLALITY and MOLE FRACTION OF SOLUTE of a solution that contains 29.6 grams of sodium sulfate dissolved in 425.4 grams of distillied water?

$$m = \frac{\text{moles } Na_2SO_4}{Kg\ H_2O}$$ ① / ②

Definition of molality

1) Convert 29.6 grams sodium sulfate to moles. Use FORMULA WEIGHT.
2) Convert 425.4 grams of water to kg.

① Na_2SO_4: $Na: 2 \times 22.99$
$S: 1 \times 32.07$
$O: 4 \times 16.00$
$142.05\ g\ Na_2SO_4 = mol\ Na_2SO_4$

$$29.6\ g\ Na_2SO_4 \times \frac{mol\ Na_2SO_4}{142.05\ g\ Na_2SO_4} = 0.208377331 9\ mol\ Na_2SO_4$$

② $Kg = 10^3\ g$

$$425.4\ g\ H_2O \times \frac{Kg}{10^3\ g} = 0.4254\ Kg\ H_2O$$

$$m = \frac{\text{moles } Na_2SO_4}{Kg\ H_2O} = \frac{0.208377331 9\ mol\ Na_2SO_4}{0.4254\ Kg\ H_2O} = \boxed{0.490\ m\ Na_2SO_4}$$

29.6 g Na_2SO_4, 425.4 g water ← previous solution

$$X_{Na_2SO_4} = \frac{\text{mol } Na_2SO_4 \ ①}{\text{mol Solution} \ ②}$$

Definition of mole fraction

1) Convert 29.6 grams sodium sulfate to moles. Use FORMULA WEIGHT. (Already done ... just use previous calculation.)
2) We need to add moles sodium sulfate (from (1)) to moles water. Get moles water by converting 425.4 grams of water to moles with FORMULA WEIGHT.

① 0.208377331 9 mol Na_2SO_4 (prev. page)

② $425.4\ g\ H_2O \times \frac{\text{mol } H_2O}{18.016\ g\ H_2O} = 23.612344588\ \text{mol } H_2O$

H_2O: H: 2 x 1.008
O: 1 x 16.00
18.016 g H_2O = mol H_2O

mol solution = mol Na_2SO_4 + mol H_2O

$= 23.820721911$ mol solution

$$X_{Na_2SO_4} = \frac{0.208377331 9\ \text{mol } Na_2SO_4}{23.820721911\ \text{mol solution}} = \boxed{0.00875}$$