



SCIENCE DISSECTED

Making Solutions: Mass Percent

Mass percent solutions are used commonly in science, especially in biology. The concentration is given in percent solute per one hundred grams solution. This means

$$\% \text{ solute} = \frac{\text{grams solute}}{\text{grams solute} + \text{grams solvent}}$$

To make up a mass percent solution, mass out the grams of solute you wish to have and then dissolve this solute in enough grams of solvent to make 100. grams solution in total. For example, to make a solution that is 0.90 % NaCl, mass out 0.90 g NaCl and dissolve the NaCl in enough water to make 100 grams solution. The amount of water needed is 99.10 g H₂O. If you want 200 g solution, simply double the amount of NaCl and the amount of water.

Water is assumed to be the solvent unless another solvent is specifically indicated. One convenience here is that 99.10 g H₂O has a volume of 99.10 mL because the density of H₂O is 1.0 g/mL. So, you could simply add the correct amount of water measured in a graduated cylinder. Another common solvent is ethyl alcohol (ethanol). However, you would need to either mass out the amount of ethanol or calculate its volume using the density formula and the density of ethyl alcohol, which is 0.789 g/mL.

For example, if you wanted to obtain 85.0 g ethanol, the volume would be calculated as shown to the right

$$V = 85.0 \text{ g ethanol} \times \frac{\text{mL}}{0.789 \text{ g}} = 108 \text{ mL ethanol}$$

If you want students to test several solutions of vinegar to determine which meet the standard for at least 5% acetic acid, you could make up solutions that are 2.0%, 4.0%, and 6.0% acetic acid. Here's how you can do this. For every 100 g solution, mass out 2.0 g, 4.0 g, and 6.0 g glacial acetic acid (concentrated HC₂H₃O₂) into 3 labeled containers. Add 98.0, 96.0, and 94.0 g H₂O to each container and mix. Remember to double, triple, half, etc solute and solvent to make the amount of solution needed.

Indicators are often made in % solutions. The appropriate amount of solid indicator is massed, dissolved in alcohol, and then diluted to get the correct total mass of solution. Take special care when massing and transferring indicators since their color is quite intense and often difficult to remove from skin and clothing.

Many of the chemical suppliers offer directions and explanations about making solutions in their catalogs. Consult them to find which will be most helpful to you.

Determine the mass % of a solution made by dissolving 30 grams of NaOH in 300 mL of water (assume the density of water is 1 g/mL)

#1 Convert 300 mL water to grams of water using density

$$\text{Mass} = \text{Density} \times \text{Volume} = (1 \text{ g / mL})(300 \text{ mL}) = 300 \text{ grams water}$$

#2 Determine mass of solution

$$\text{Mass of solution} = \text{mass solute} + \text{mass solvent} = 30 \text{ g} + 300 \text{ g} = 330 \text{ grams solution}$$

Answer = 9 %

#3 Apply definition for mass percent and solve for mass percent

$$\% \text{ solute} = \frac{\text{grams solute}}{\text{grams solute} + \text{grams solvent}} = \frac{30 \text{ g}}{330 \text{ g}} = 0.09 \text{ (change to percent by multiplying by 100)}$$

General Chemistry Online!, <http://antoine.frostburg.edu/chem/senese/101/index.shtml>

Archived Issues of Science Dissected, <http://www.rpdp.net/link.news.php?type=sciencedis>

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