Solving Percentage Problems by Dimensional Analysis

Once one understands problem solving by dimensional analysis (factor label) it is straightforward to solve percentage problems using conversion factors.

1. To calculate a percentage use the equation $\% = \frac{\text{part}}{\text{whole}} \times 100\%$

   80.0 g of solution contains 20.0 g of salt. What is the percentage (by mass) of salt in the solution?

   $$\% = \frac{\text{part}}{\text{whole}} \times 100\% = \frac{20.0 \text{ g salt}}{80.0 \text{ g solution}} \times 100\% = 25.0 \text{ \% salt}$$

2. To use percentage as a conversion factor.

   a. Notice in the problem above that 25.0 % salt is an intensive property. Any amount of this solution contains 25.0 % salt.

   b. %, per cent, means "per hundred". Any amount of 25.0 % solution can be pictured as being divided into 100 parts. Of those hundred parts, 25 parts will be salt and the remainder (75 parts) will be something else (in this case water).

   c. 100 parts of solution contains 25 parts salt. So 100. g solution contains 25.0 g. salt. To have 100. g solution is to have 25.0 g salt. And to have 25.0 g of salt in the form of solution (25 % solution) is to have 100. g of solution. Therefore, as far as the salt is concerned:
   100. g solution = 25.0 g salt

   d. In general one can make a conversion factor of any percentage by the following steps. 25 % $\Rightarrow$ 25 per cent $\Rightarrow$ 25 per 100 $\Rightarrow$ 25 units part **per** 100 units whole $\Rightarrow$ 25 units part **=** 100 units whole. So 25. g part = 100. g whole OR 25. kg part = 100. kg whole OR 25. lb part = 100 lb. whole, etc. Once there is an equality, it is possible to make conversion factors.

   Consider the problem: How many grams of salt are in 45.0 g of 35.0 % salt solution?

   The 35.0 % can be made into a conversion factor using 35.0 g salt = 100. g solution.

   The question can be rewritten: 45.0 g solution = ? g salt

   So: $$45.0 \text{ g soln} = 45.0 \text{ g soln} \times \frac{35.0 \text{ g salt}}{100. \text{ g soln}} = 15.8 \text{ g salt}$$

   Notice that each number must be labeled carefully with not only "g", but also "salt" and "soln".