



### Determine Mass of a Solute in a Solution

Solution chemistry is arguably the most important aspect of chemistry students will face. As such, students need to know how to make their own solutions. While many situations do not call for a precisely concentrated solution, others (such as titrations), require an extremely precise solution. Though making the solution itself can be time consuming due to the care needed to make precise solutions, the mathematics behind its creation are much easier.

The concentration of a solution is generally identified by molarity, which is defined as the number of moles of solute per liters of solution. In mathematical terms, this is

$$M = \frac{n}{V}$$

In most applications, any practical volume can be made. In other words, the volume is arbitrary and known before the solution is made. In addition, the molarity of the solution is generally specified for the specific application. Therefore, we have one equation with unknown (the moles in solution). This gives

$$n = MV$$

After making sure the volume is in liters, the above calculation will give the moles of solute required to make the solution at the given molarity. From here, all that needs to be done is convert moles of solute into mass (generally grams) of solute. This is done by multiplying the number of moles by the molecular weight.

To come up with a general equation for the desired result, multiply both sides of the equation by the molecular weight of the solute.

$$(n = MV)M_w$$

$$nM_w = MVM_w$$

$$m = MVM_w$$

where

$m$  = mass of solute

$M$  = molarity

$V$  = volume of solution

$M_w$  = Molecular Mass of Solute

With the above equation, finding the mass of the solute needed for a given volume and molarity is easy.

# WHO LIKES HOMEWORK



To demonstrate the ease, let's make a solution of 150 mL NaCl with a molarity of 1.25M.  
We know that

$$M = 1.25 \text{ molar}$$
$$V = 150 \text{ mL} = 0.150 \text{ L}$$

The only other parameter required is the molecular mass of NaCl, which is 58.44 g / mol.

So we have

$$m = MV M_w$$
$$= (1.25 \text{ M})(0.150 \text{ L})\left(58.44 \frac{\text{g}}{\text{mol}}\right)$$
$$= 10.958 \text{ g}$$

Thus, if we wanted to make a 1.25M solution of NaCl with a volume of 150 mL, we would have to use 10.958 g NaCl.