



Virtual Lab Manual

Solution Preparation: From Salt to Solution

Synopsis

Prepare to become a solution champion! In this simulation, you will complete all the steps involved in preparing an aqueous solution of a given molarity from ammonium chloride – a water-soluble salt, from start to storage.

Broken table

Your first mission will be to determine the exact amount of ammonium chloride needed for your solution. When the calculations are sorted, you will move to your first workbench, where you'll find an analytical balance. You will use this instrument of high precision to obtain just the right amount of the substance. It's a tricky procedure, but you'll have unlimited time and attempts to get it right.

Glassware and quantitative transfer

Moving on to the second workbench, you will explore and determine what glassware will be appropriate for you to use. Your lab guide and mentor, Dr. One, will walk you through the process of preparing the solution. You will have the freedom to use the equipment as you like, but only by following Dr. One's instructions will you be successful in making the right solution. To make sure you can always redo essential steps of the process, Dr. One will provide you with a fantastic reset button, so you can try again if you make a mistake.

Solve the preparation

In the end, only by carefully ensuring that the right amount of water and ammonium chloride is used can you make the correct solution. Are you prepared for solving how to perform a Solution Preparation?

Learning Objectives

At the end of this simulation, you will be able to...

- Prepare an aqueous solution of a specific concentration from a pure salt
- Correctly use an analytical balance, a volumetric pipette, a volumetric flask, and a measuring cylinder
- Explain the relationship between molarity and mass concentration

Techniques in Lab

- Correct use of analytical balance

Theory

Mass and moles conversions

The relationship between mass and amount in mol for any chemical substance is governed by its molar mass, which is defined as the mass of 1 mol of a pure substance expressed in grams.

Symbols and units

Oftentimes, the following notation is used:

mass [g] = m

amount [mol] = n

molar mass [g/mol] = M

Example 1:

NaCl (table salt) has a molar mass of 58.44 g/mol. What is the mass of 2.10 mol NaCl?

$$m(\text{NaCl}) = n(\text{NaCl}) * M(\text{NaCl}) = 2.10 \text{ mol} * 58.44 \text{ g/mol} = 122.7 \text{ g}$$

Example 2:

H₂O (water) has a molar mass of 18.02 g/mol. What is the amount of water (in mol) equivalent to 4.3 g?

$$n(\text{H}_2\text{O}) = m(\text{H}_2\text{O}) / M(\text{H}_2\text{O}) = 4.3 \text{ g} / 18.02 \text{ g/mol} = 0.239 \text{ mol.}$$

Molar concentration

The concentration of a chemical substance or compound in a solution is often given in moles per liter, or mol/L. This is also called the molarity, and you will therefore often see M used instead of mol/L.

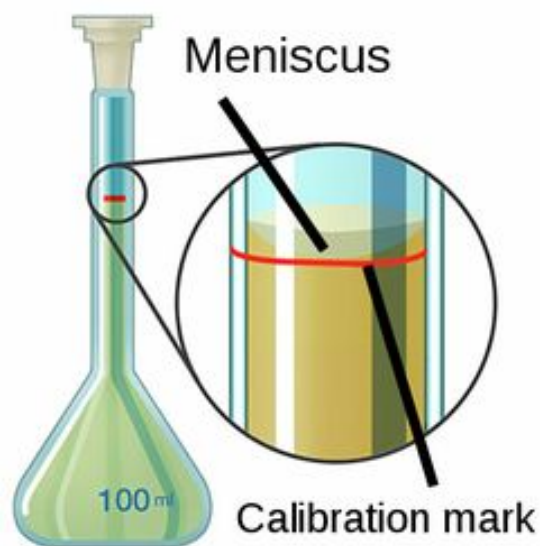
The molarity is found by dividing the amount in moles with the volume in a liter of the solution:

$$C = n / V$$

where C is the molarity or molar concentration, n is the amount in moles, and V is the volume in liter.

Volumetric flask

A volumetric flask is a standard piece of glassware in a chemistry lab. Its main purpose is to be used for creating solutions with a high accuracy of the concentration.

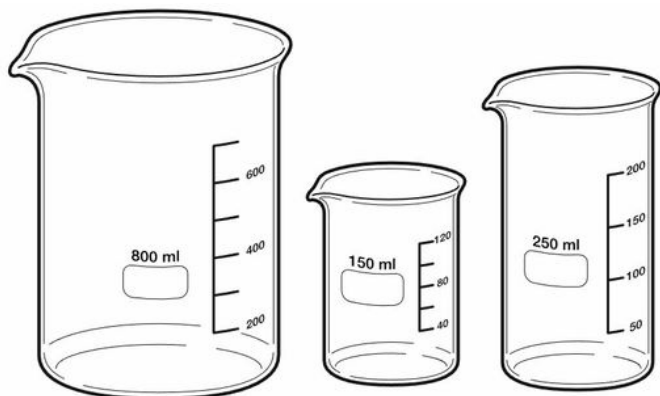


It often comes with a stopper for the top, which can be used to completely seal off the flask in connection with mixing the content.

As there's only a single calibration mark on the flask, you can't determine the volume of its content with any reasonable accuracy before it's filled to the mark.

Beaker

A beaker can be good for temporarily storing solutions or solvents when you're working in a lab. It's easy to add and transfer liquids to, but you can't tell the volume very accurately.



Blue-capped bottle

A blue-capped bottle is often used to store liquid solvents or solutions in. They come with different kinds of caps, dependent on what you are using them for.



Bulb pipette

The main purpose of a bulb pipette, also called a *volumetric pipette*, is to transfer very precise volumes from one container to another. Typical sizes range from 1-100 mL. You will commonly use a pipette bulb or a so-called pipette helper for filling and dispensing liquid from a volumetric pipette.

Measuring cylinder

A measuring cylinder is also called a graduated cylinder. It's great for measuring out volumes of liquids relatively accurately, usually with less than 1% error, and is very commonly used in the lab.

Steps to use the Analytical balance

- 1) Remove any item from the analytical balance
- 2) Put an empty weighing dish on the balance, close it, and click Tare to reset it.
- 3) Open the balance, take that weighing dish and put it on the workbench.
- 4) With the spatula, add your solid substance from its container to the weighing dish.
- 5) Put the weighing dish with your substance on the balance, and close it to make an accurate reading.