Chemistry 30

Laboratory Storage: Lab Recipes

Common Dilutions

Safety Precautions:

When diluting acids, always add the acid to the water, never add water to acid.

Hydrochloric Acid, HCl (concentrated hydrochloric acid is 12 M)

To Make	Concentrated acid needed for 1 L solution.
0.1 M	8.21 mL
1 M	82.1 mL
3 M	246 mL
6 M	500 mL

Sodium hydroxide, NaOH (molar mass NaOH = 40.0 $g \cdot mol^{-1}$)

To Make	Mass NaOH needed for 1 L solution.
0.1 M	4.00 g
1 M	40.0 g
2 M	80.0 g
3 M	120 g
6 M	240 g

Sulfuric Acid, H_2SO_4 (concentrated sulfuric acid is 18 M)

To Make	Concentrated acid needed for 1 L solution.
0.1 M	5.6 mL
1 M	55.6 mL
3 M	167 mL
6 M	333 mL

Solution Preparation

Although there are several ways to measure solution concentration, molarity (M) is most commonly used. Molarity is measured as the number of moles of solute per liter of solution.

To prepare a 1M solution of a solute you would add 1 mole of the substance to a clean 1-L volumetric flask, partially filled with distilled or deionized water. Allow the solute to dissolve completely. Then add enough water to fill the flask to the mark on the flask.

To prepare a diluted solution, add the required volume of the concentrated solution to a volumetric flask (of the appropriate size), then fill to the mark on the flask

Calculating Dilutions

To prepare a dilution, determine the volume and concentration (molarity) of solution that will be required. Use the following equation to determine how much of the concentrated solution will be required:

$M_1V_1 = M_2V_2$

where:

M_1 and M_2 are the concentrations of the original and diluted solutions and

V_1 and V_2 are the volumes of the original and diluted solutions

Example:

What volume of concentrated hydrochloric acid, 12.0 M, is required to prepare 500 mL of 0.150 M solution by dilution with water?

Solution:

In a dilution question there are 4 variables - M1, V1, M2 and V2. You will know three of these values and have to calculate the fourth.

$M_1 = 12.0$ M $\quad M_2 = 0.150$ M

$V_1 = ?$ $\quad V_2 = 500$ mL

Set up the formula and rearrange to solve for the unknown:

$M_1V_1 = M_2V_2$

$(12.0)(V_1) = (0.150)(500)$

$V_1 = 6.25$ mL

To make the required diluted solution, add 6.25 mL of concentrated hydrochloric acid to a 500 mL volumetric flask (or other volume measuring device). Fill to the mark on the flask with water.

Assorted Solution Recipes

Calcium hydroxide, $Ca(OH)_2$	
saturated	see Limewater
Cobalt(II) chloride hexahydrate, $CoCl_2 \cdot 6H_2O$ (acidified)	
0.2 M	2.6 g $CoCl_2 \cdot 6H_2O$ to total solution volume of 100 mL. This produces the pink hydrated form of the equilibrium system. To form the blue chloro-complex side of this equilibrium, add concentrated 12M HCl (as much as 100 mL) until the solution turns blue.
Copper(II) nitrate, $Cu(NO_3)_2$	
0.5M	93.8 g; add distilled water for a total volume of 1 L
Copper(II) sulfate, $CuSO_4$	
1 M	160 g; add distilled water for a total volume of 1 L
Copper(II) sulfate, $CuSO_4 \cdot 5H_2O$	
0.1 M	25.0 g ; add distilled water for a total volume of 1 L
1M	250 g; add distilled water for a total volume of 1 L
Iron(III) chloride, $FeCl_3$	
0.1 M	16 g $FeCl_3$ in 50 mL 6M HCl. add distilled water for a total volume of 1 L
Lead(II) nitrate, $Pb(NO_3)_2$ 0.5 M	
0.5 M	165.6 g; add distilled water for a total volume of 1 L
Limewater, $Ca(OH)_2$ saturated	
saturated	1.5 g per liter of water. Stir or shake vigorously for a minute or two. Let stand overnight; filter off the clear solution and store. Limewater is often used to test for the presence of carbon dioxide. For example, have a student use a straw and blow into a solution of clear limewater. The solution will turn cloudy. The reactions: Step 1: $CO_2 + H_2O \rightarrow H_2CO_3$ Step 2: $Ca(OH)_2 + H_2CO_3 \rightarrow CaCO_3 + 2H_2O$

Assorted Solution Recipes

Potassium chloride, KCl 0.1 M	
0.1 M	7 g KCl; add distilled water for a total volume of 1 L
Potassium chromate, K_2CrO_4 0.1 M	
0.1 M	19 g K_2CrO_4, add distilled water for a total volume of 1 L
Potassium dichromate, $K_2Cr_2O_7$	
0.1 M	29 g $K_2Cr_2O_7$; add distilled water for a total volume of 1 L
Potassium nitrate, KNO_3	
0.5 M	50.6 g; add distilled water for a total volume of 1 L
Potassium thiocyanate, KSCN	
0.1 M	10 g KSCN; add distilled water for a total volume of 1 L
Zinc nitrate, $Zn(NO_3)_2$	
0.5 M	94.7 g; add distilled water for a total volume of 1 L