A Content Secondary Science Newsletter from the Southern Nevada Regional Professional Development Program

Science Dissected

Diluting Solutions

Solutions can be made to the correct molarity by diluting concentrated stock solutions to the molarity needed. Many of the chemicals used for laboratory activities are sold in concentrated solutions. Common acids (hydrochloric acid, sulfuric acid, nitric acid, and acetic acid) and some bases (ammonia) are ordered as concentrated solutions of these reagents. The table below shows the concentrated molarities of many of these.

Name	Formula	Molarity (Concentrated)
acetic acid	CH_3COOH	17.4 M
hydrochloric acid	HCl	12 M
nitric acid	HNO_3	15.8 M
phosphoric acid	H_3PO_4	14.8 M
sulfuric acid	H_2SO_4	18.0 M
ammonia*	NH_3	14.8 M

*Ammonia is often sold as ammonium hydroxide (NH OH), but it is correctly named ammonia because it is a weak base, $K = 1.8 \times 10^{-5}$

In an earlier edition of Science Dissected, molarity was defined to be,

$$M = \frac{moles\ solute}{L\ solution} = \frac{moles\ solute}{dm^3\ solution}$$

Thus, moles solute = (M) x (L solution). When a solution is diluted, the moles of the concentrated solution will equal the moles of the diluted solution. Algebraically,

$$moles_{concentrated} = moles_{dilute}$$

$$L_{conc}\ x\ M_{conc} = L_{dilute}\ x\ M_{dilute}$$

LAB SAFETY TIP:

When diluting acids, ALWAYS pour acid into water SLOWLY. Be certain to perform the dilution in a fume hood, keeping the area well ventilated.

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

Written by: Joan Taylor

Diluting Solutions continued...

Thus, to calculate what volume (in liters) of the concentrated solution must be obtained and diluted, solve for this quantity. Realizing that the units of the volume can be either liters or milliliters because the units will cancel, the volume can be measured in liters or milliliters for laboratory work. Milliliters are much more frequently used in the chemistry laboratory. Rearranging the equation from page one and using the same units of volume for concentrated and dilute solutions, the following relationship is established:

$$V_{conc} = \frac{V_{dilute}\, x\, M_{dilute}}{M_{conc}}$$

The table summarizes the amount of concentrated solution that must be obtained to make one liter of common dilute solution.

Name, Formula	Diluted Concentration	Volume Diluted/liter
Acetic Acid, CH_3COOH	6 M	345 mL
	3 M	172 mL
	1 M	58 mL
Hydrochloric Acid, HCl	6 M	500 mL
	3 M	250 mL
	1 M	83 mL
Nitric Acid, HNO_3	6 M	380 mL
	3 M	190 mL
	1 M	63 mL
Sulfuric Acid, H_2SO_4	6 M	333 mL
	3 M	167 mL
	1 M	56 mL
Ammonia, NH_3	6 M	405 mL
	3 M	203 mL
	1 M	68 mL

Sample Problem: How much concentrated acetic acid is needed to make one liter of 6 M, 3 M, and 1 M dilute solution?

$6\,M$

$$V_{conc} = \frac{V_{dilute}\, x\, M_{dilute}}{M_{conc}}$$

$$V_{conc} = \frac{1\,L\, x\, 6\,M}{17.4\,M}$$

$$V_{conc} = 0.345\,L\ or\ 345\,mL$$

To make one liter of 6M Acetic Acid, take 345 mL and add that to 655 mL of water to create one liter

$3M$

$$V_{conc} = \frac{V_{dilute}\, x\, M_{dilute}}{M_{conc}}$$

$$V_{conc} = \frac{1\,L\, x\, 3\,M}{17.4\,M}$$

$$V_{conc} = 0.172\,L\ or\ 172\,mL$$

To make one liter of 3M Acetic Acid, take 172 mL and add that to 828 mL of water to create one liter

$1M$

$$V_{conc} = \frac{V_{dilute}\, x\, M_{dilute}}{M_{conc}}$$

$$V_{conc} = \frac{1\,L\, x\, 1\,M}{17.4\,M}$$

$$V_{conc} = 0.058\,L\ or\ 58\,mL$$

To make one liter of 1M Acetic Acid, take 58 mL and add that to 942 mL of water to create one liter