

Exercise 12.3d

Solution Dilution

Name: _____

Date: _____ Per: _____

While solutions are often made by dissolving a calculated mass (representing a certain number of moles) of solute in a solvent to create a desired volume of solution, another technique for making a solution involves taking a stock solution of higher concentration and diluting it to the desired concentration. The diluted solution is made by adding additional solvent to a measured amount of stock solution. This retains the original amount of solute but increases the solvent to create a concentration less than that of the original stock solution. *For example, 1 liter of 2 M solution contains 2 moles of solute in 1 L of solution. Adding an additional liter of solvent creates a solution where there are still 2 moles of solute, but there are now 2 L of solution creating a ratio of 2mol/ 2liter (reducing the fraction: 1mol/ 1liter or 1M).*

The calculation necessary to find the amount of stock solution needed for dilution is represented by:

$$\text{molarity}_1 \times \text{volume}_1 = \text{molarity}_2 \times \text{volume}_2 \quad \text{or} \quad M_1V_1 = M_2V_2$$

Example: 560. mL of water is added to 340. mL of 0.500 M NaBr solution. What is the new concentration of the solution?

$$M_1 = 0.500 \text{ mol/liter}$$

$$V_1 = 340. \text{ mL}$$

$$M_2 = ?$$

$$V_2 = 900. \text{ mL} = (560. \text{ mL} + 340. \text{ mL})$$

$$M_1V_1 = M_2V_2$$

$$M_2 = \frac{M_1V_1}{V_2} = \frac{0.500 \text{ M} \cdot 340. \text{ mL}}{900. \text{ mL}} = 0.1888 \text{ M} \quad \boxed{0.0189\text{M}}$$

DIRECTIONS: Answer the following in the space provided.

1. A stock solution of sodium sulfate, Na_2SO_4 has a concentration of 1.00 M. The volume of this solution is 50.0 mL. What volume of a 0.250 M solution could be made from the stock solution?
2. 2.00 mL of a 0.75 M solution of potassium permanganate, K_2MnO_4 solution is used to make a 500.00 mL solution. What is the concentration of the new solution?
3. A hydrochloric acid solution, HCl has a concentration of 12.1 M. A 41.2 mL sample is used to make a more dilute solution. If the new solution has a concentration of 0.5 M, determine the volume of the solution.
4. 250. mL of 0.10 M lithium acetate solution is diluted to a volume of 750 mL. What is the concentration of the diluted solution?
5. 750. mL of 0.50 M sodium chloride solution is left uncovered on a windowsill and 150. mL of the solvent evaporates, what will the new concentration of the sodium chloride solution be?

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- How much water would have to be added to the concentrated solution in Problem 5 to produce a solution with a concentration of 0.25 M ?
- A 0.50 M solution of sodium thiosulfate, $\text{Na}_2\text{S}_2\text{O}_3$ is used to create a more dilute solution. If 250 mL of the concentrated solution is diluted to a volume of 2.5 L , determine the concentration of the new solution.
- What volume of concentrated nitric acid, HNO_3 (15.8 M) should be added to water to form 500.0 mL of a 3.0 M nitric acid solution?
- A sample of 7.0 mL of concentrated sulfuric acid, H_2SO_4 is used to make $250.\text{ mL}$ of a 0.50 M sulfuric acid solution. What was the initial concentration of the sulfuric acid?
- An instructor needs to make $500.\text{ mL}$ of a silver nitrate solution that has a concentration of 0.010 M using a 0.80 M stock solution. (*Available equipment includes the stock bottle of AgNO_3 , a 10 mL graduated pipet, a 500 mL volumetric flask and a wash bottle filled with distilled water.*) Perform the calculations required and draw a diagram representing the steps required to make this solution.