### Dilution Notes : Definition and Calculations

To dilute a solution means to add more solvent without the addition of more solute. Of course, the resulting solution is thoroughly mixed so as to ensure that all parts of the solution are identical.

The fact that the solute amount stays constant allows us to develop calculation techniques.

First, we write:

moles before dilution = moles after dilution

From the definition of molarity, we know that the moles of solute equals the molarity times the volume.

So we can substitute MV (molarity times volume) into the above equation, like this:

M1V1 = M2V2

The "sub one" refers to the situation before dilution and the "sub two" refers to after dilution.

This equation does not have an official name like Boyle's Law, so we will just call it the dilution equation.

**Example #1** - 53.4 mL of a 1.50 M solution of NaCl is on hand, but you need some 0.800 M solution. How many mL of 0.800 M can you make?

Using the dilution equation, we write:

(1.50 mol/L) (53.4 mL) = (0.800 mol/L) (x)

Solving the equation gives an answer of 100. mL.

Notice that the volumes need not be converted to liters. Any old volume measurement is fine, just so long as the same one is used on each side.

Example #2 - 100.0 mL of 2.500 M KBr solution is on hand. You need 0.5500 M. What is the final volume of solution which results?

Placing the proper values into the dilution equation gives:

(2.500 mol/L) (100.0 mL) = (0.5500 mol/L) (x)

x = 454.5454545 mL (oops, my fingers got stuck typing.) (Bad attempt at humor, really bad!)

Sometimes the problem might ask how much more water must be added. In this last case, the answer is 454.5 - 100.0 = 354.5 mL.

### Chemistry B Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

### Dilutions Practice Period\_\_\_\_\_

### Practice Problems

1. A stock solution of 1.00 M NaCl is available. How many milliliters are needed to make 100.0 mL of 0.750 M

2. What volume of 0.250 M KCl is needed to make 100.0 mL of 0.100 M solution?

3. Concentrated H2SO4 is 18.0 M. What volume is needed to make 2.00 L of 1.00 M solution?

4. Concentrated HCl is 12.0 M. What volume is needed to make 2.00 L of 1.00 M solution?

5. A 0.500 M solution is to be diluted to 500.0 mL of a 0.150 M solution. How many mL of the 0.500 M solution are required?

6. A stock solution of 10.0 M NaOH is prepared. From this solution, you need to make 250.0 mL of 0.375 M solution. How many mL will be required?

7. 2.00 L of 0.800 M NaNO3 must be prepared from a solution known to be 1.50 M in concentration. How many mL are required?

### Dilution: Practice Problem Answers

1. (0.750 mol/L) (100.0 mL) = 1.00 mol/L) (x)

2. (0.100 mol/L) (100.0 mL) = (0.250 mol/L) (x)

3. (18.0 mol/L) (x) = (1.00 mol/L) (2.00 L)

4. (12.0 mol/L) (x) = (1.00 mol/L) (2.00 L)

5. (0.500 mol/L) (x) = (0.150 mol/L) (500.0 mL)

The answer to this problem will be in mL, not liters.

6. (10.0 mol/L) (x) = (0.375 mol/L) (250.0 mL)

7. (1.50 mol/L) (x) = (0.800 mol/L) (2.00 L)

In both 6 & 7, multiply by 1000 to get the mL asked for in the problem.

These next two are a bit harder and involve slightly more calculation than the discussion above.

8. Calculate the final concentration if 2.00 L of 3.00 M NaCl and 4.00 L of 1.50 M NaCl are mixed. Assume there is no volume contraction upon mixing.

9. Calculate the final concentration if 2.00 L of 3.00 M NaCl, 4.00 L of 1.50 M NaCl and 4.00 L of water are mixed. Assume there is no volume contraction upon mixing.

8. The approach here can be summarized in three steps: 1) calculate total moles, 2) calculate total volume, 3) divide moles by volume to get molarity.

Here are the two mole calculations:

x = (3.00 mol/L) (2.00 L)
x = (1.50 mol/L) (4.00 L)

I hope it is obvious that you add the two answers to get the total moles.

The total volume calculation is 2.00 + 4.00 = 6.00 L.

I will leave you to divide total moles by total volume to get the final answer.

9. The solution to this problem is exactly the same. The only problem child appears to be the 4.00 L of water. Hint: the water contributes to the final volume, but NOT to the total moles. The ChemTeam gets a final answer of 1.20 M in this problem.