Honors Chemistry
Ms. Ye

Name _____
Date _____Block_____

Solutions and Dilutions

Part 1: **A Molecular View of Solutions**

The images show an initial solution of oxygen (O_2) (the solute) in water (the solvent) and that same solution after adding more water to the beaker.

Initial	After Adding Water
	

1. Has the number of molecules of *solute* increased, decreased, or stayed the same?

2. Has the amount of *solvent* increased, decreased, or stayed the same?

3. Has the volume of the *solution* increased, decreased, or stayed the same?

4. Do you think the solution on the right is more or less concentrated than the initial solution? Justify your answer.

Part 2: Diluting a Solution

1. Place 2-3 drops of food coloring into a beaker with 200. mL of water. Stir until the food coloring is evenly dissolved in the water. Assume this makes a 3.0 M solution (your "stock solution").

2. Measure out 50.0 mL of your stock solution and pour it into a separate beaker. Does this 50.0 mL solution have the same molarity (concentration) as your stock solution? Explain.

3. Measure out 50.0 mL of water and add it to your 50.0 mL stock solution (from #2).

A. Has the *amount of food coloring* increased, decreased, or stayed the same?

B. Has the *volume of solution* increased, decreased, or stayed the same?

C. Has the *concentration* of the solution increased, decreased, or stayed the same?

4. This process is known as a dilution. Explain what it means to dilute a solution.

Part 3: Mathematics of Dilution

Consider the solutions below and answer the following questions.

Solution A	Solution B
2.00 mol NaCl dissolved in 5.00 L of water	2.00 mol NaCl dissolved in 10.0 L of water.
$M = \frac{2.00\ mol\ NaCl}{5.00\ L\ solution}$= 0.400 M	$M = \frac{2.00\ mol\ NaCl}{10.0\ L\ solution}$= 0.200 M

1. What happens to the concentration as the volume of a solution increases (while moles of solute remains constant)?

Solution C	Solution D
4.00 mol NaCl dissolved in 3.00 L of water	4.00 mol NaCl dissolved in 9.00 L of water.
$M = \frac{4.00\ mol\ NaCl}{3.00\ L\ solution}$= 1.33 M	$M = \frac{4.00\ mol\ NaCl}{9.00\ L\ solution}$= 0.444 M

2. What specifically happens to the concentration of a solution when the volume is doubled (while moles of solute remains constant)?

3. What specifically happens to the concentration of a solution when the volume is tripled (while moles of solute remain constant)?

4. What do you think would happen to the concentration of a solution if the volume was quadrupled?

Part 4: Making Dilutions

Making Dilutions: **M = Molarity of Solution** **V = volume of solution**

$$M_1V_1 = M_2V_2$$

*since volume (V) is on both sides of the equation, you need to make sure they are both in the same units! They can both be in L or both in mL...just as long as V_1 and V_2 are in the same unit!

M_1 and V_1 are the *initial* molarity and volume before dilution. M_2 and V_2 are the *final* values (what you are trying to make).

Consider your stock solution from above (concentration of 3.0 M). You need to take your stock solution and dilute it to make 50.00 mL of a 1.2 M solution.

1. Using the dilution formula above, calculate the volume of your stock solution that you would need to make the diluted solution.

M_1 =

V_1 =

M_2 =

V_2 =

2. Measure out the volume of stock solution needed to make your diluted solution, and pour it into the 50.00 mL volumetric flask.

A. Do you have 50.00 mL of solution?

B. How much more water do you need to add to make a 50.00 mL solution?

3. Add the amount of water you calculated in 2B above. (This should fill the flask to the faint line on the neck.) You now have 50.00 mL of 1.2M solution. Good job!

4. Clean up by dumping and rinsing out the volumetric flask and beakers in the sink. Return the glassware to your station for the next class to use.

Part 5: Practice

Complete the following problems using the dilution equation. Show all work.

Remember that your V_1 and V_2 units must match, as must your M_1 and M_2 units. Also remember that 1 L = 1000 mL

1. What concentration can be made when 50.0 mL of 4.6 M carbonic acid is diluted to 350.0 mL?

2. 52.5 mL of a 0.500 M solution was used to make 0.50 L of a diluted solution. What is the new concentration of this solution?

3. 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 of stock solution will be required?

4. 1567 mL of 0.800 M $NaNO_3$ must be prepared from a solution known to be 1.50 M in concentration. How many Liters of stock solution are required?

5. How much 0.075 M NaCl solution can be made by diluting 450 mL of 9.00 M NaCl solution?

6. If 45 mL of water are added to 250 mL of a 0.75 M K_2SO_4 solution, what will the new molarity be?