****Concentration and Molarity II: *Dilution* and *Evaporation* PhET-Chemistry Labs**

**Introduction:** In the first part of this lab, you learned about the actions of solid salts added to water to form solutions of various concentrations. In this exercise, you will use a powerful and simple formula to determine the concentration of a solution when it has been diluted with additional water or made more concentrated due to evaporation of water.

**Some handy vocabulary for you to define:**

Molarity \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Dilution \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Evaporaton\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Procedure:** *PhET*🡪*Play with the Sims 🡪 Chemistry 🡪 Concentration* 

***Part 1: Dilution***

At this point you should be familiar with the *Concentration* simulation. Because some time may have passed, take a few minutes to re-learn the simulations. Pay particular attention to the effect of evaporation and addition of water to the solution’s concentration

How does the concentration change as additional water is added? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Why? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

How does the concentration change as evaporation occurs? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Why is this? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Does evaporation change the concentration of a saturated solution? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Why is this? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Using the concentrated solution spigot, add a ½ Liter of Drink Mix to an empty beaker. What is the concentration?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Is this solution saturated? \_\_\_\_\_\_\_\_\_\_\_\_ How do you know? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Fill the beaker with another ½ Liter of water. What is the new concentration? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Complete the table below, using in an empty beaker, writing the concentration in the boxes provided.

|  |  |  |  |
| --- | --- | --- | --- |
| Only .25L of spigot solution  | .25L spigot+.25L water | .25L spigot + .50 L water | .25L spigot + .75 L water |
|  |  |  |  |

Repeat the exercise, using in an empty beaker.

|  |  |  |  |
| --- | --- | --- | --- |
| Only .25L of spigot solution  | .25L spigot+.25L water | .25L spigot + .50 L water | .25L spigot + .75 L water |
|  |  |  |  |

What do you notice about the concentration change as each addition of .25L of water is added to the concentrated spigot solution? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The formula  is a great way to calculate the concentration of a solution that undergoes dilution or concentration.  Refer to the concentration and volume of the original solution, and  refer to that solution after it has been diluted or concentrated.

0.20 L of has a concentration of 5.0 M. (M1 = 5.0 M and V1 = 0.20 L) If the solution’s volume, V2 is increased with water to .50 L, calculate the new concentration, M2. **Check your work in the sim AFTER your calculation.**

Your Calculated M2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ . New concentration shown in the simulation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Complete the table below using . R**emember to calculate first, and then check in the sim.**

|  |  |  |  |
| --- | --- | --- | --- |
| M1 | V1 | M2 | V2 |
| .40 M | .20 L |  | .80 L |
| .40 M | .50 L |  | .90 L |
| .40 M | .30 L | .15 M |  |

***Part 2: Evaporation: Making Solutions MORE concentrated***  

Create a solution of with a concentration 1.0 M of and a volume of .50 L . If evaporation reduces the volume to .40 L without changing the dissolved solute, calculate the new concentration of the solution. **Check your work in the sim AFTER your calculation.**

Your Calculated M2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ . New concentration shown in the simulation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Complete the table below using . **Remember to calculate first, and then check in the sim.**

|  |  |  |  |
| --- | --- | --- | --- |
| M1 | V1 | M2 | V2 |
| .40 M | .80 L |  | .40 L |
| .40 M | .90 L |  | .25 L |
| .40 M | .90 L | 1.1 M |  |

***Conclusion Questions and Calculations*** *SHOW WORK*

1. Dilution causes the concentration of an unsaturated solution to *increases / decreases / remains the same.*
2. Evaporation causes the concentration of an unsaturated solution to *increases / decreases / remains the same.*
3. As a saturated solution (with no solids) is diluted, its concentration *increases / decreases / remains the same.*
4. As a saturated solution (with no solids) is evaporated, its concentration *increases / decreases / remains the same.*
5. 1.8 L of a 2.4 M solution of NiCl2 is diluted to 4.5 L. What is the resulting concentration of the diluted solution?
6. .60 L of a .95 M solution of NaCl is allowed to evaporate until it has a volume of .25 L. What is the concentration of the new solution?
7. 350 mL of a 1.0 M CuSO4 solution is left on the counter and allowed to evaporate. CuSO4’s saturation solubility point is 1.4 M. At what volume will the solution begin to show solid crystals?
8. 3.4 moles of solid CuSO4 is added to 1.8 L of water and allowed to dissolve. Will all the solid dissolve? \_\_\_\_\_\_\_\_\_ If so, how much water was needed? If not, how much more water is needed to allow all the solid to dissolve?