High School Science Virtual Learning

Chemistry

Solutions

April 30, 2020

High School Chemistry
Lesson: [4/30/20]

Objective/Learning Target:

Students will be able to calculate molarity of solutions using the molarity equation and the dilution equation.

Let's Get Started:

$$3H_2SO_4 + 2Al(OH)_3 \rightarrow Al_2(SO_4)_3 + 6H_20$$

1. 30.0 g of sulfuric acid react with 25.0 g of aluminum hydroxide in the reaction above. Knowing that sulfuric acid is the limiting reactant, how many grams of each product will be generated?

2. What mass of aluminum hydroxide will remain once the reaction is complete?

Let's Get Started: Answer Key

1. $30.0\text{g } H_2SO_4 \times \frac{1 \text{ mol } H_2SO_4}{98 \text{ g } H_2SO_4} \times \frac{1 \text{ mol } Al_2(SO_4)_3}{3 \text{ mol } H_2SO_4} \times \frac{342 \text{ g } Al_2(SO_4)_3}{1 \text{ mol } Al_2(SO_4)_3} = 34.9 \text{ g } Al_2(SO_4)_3$

$30.0\text{g } H_2SO_4 \times \frac{1 \text{ mol } H_2SO_4}{98 \text{ g } H_2SO_4} \times \frac{6 \text{ mol } H_2O}{3 \text{ mol } H_2SO_4} \times \frac{18 \text{ g } H_2O}{1 \text{ mol } H_2O} = 11.0 \text{ g } H_2O$

2. $30.0\text{g } H_2SO_4 \times \frac{1 \text{ mol } H_2SO_4}{98 \text{ g } H_2SO_4} \times \frac{2 \text{ mol } Al(OH)_3}{3 \text{ mol } H_2SO_4} \times \frac{78 \text{ g } Al(OH)_3}{1 \text{ mol } Al(OH)_3} = 15.9 \text{ g } Al(OH)_3$

So..

$25.0 \text{ g} - 15.9 \text{ g} = 9.1 \text{ g excess } Al(OH)_3$

Lesson Activity:

Directions:

1. Answer the following questions on the handout, as you watch the following video.

Links:

- Video: Molarity and Dilution & Molarity Problems
- Handout: Molarity and Dilution Worksheet & Molarity Problems Worksheet

Lesson Notes:

Directions:

1. Read through the following notes information and write them down. This will help in solving the practice problems.

Notes:

- Molarity: number of moles of solute dissolved in one liter of solution.

$$\text{Molarity } (M) = \frac{\text{moles of solute}}{\text{liters of solution}}$$

Lesson Notes Continued:

- Diluting a solution reduces the number of moles of solute per unit volume, but the total number of moles of solute in solution does not change.

$$\text{Moles of solute before dilution} = \text{Moles of solute after dilution}$$

$$\text{Moles of solute} = M_1 \times V_1 = M_2 \times V_2$$

Practice

Complete the following questions using the information you learned during the lesson activity.

Questions: What is the molarity of the following solutions given that:

1. 1.0 moles of potassium fluoride is dissolved to make 0.10 L of solution.
2. 1.0 g of potassium fluoride is dissolved to make 0.10 L of solution.
3. 1.0 g of potassium fluoride is dissolved to make 0.10 mL of solution.
4. 952 g of ammonium carbonate are dissolved to make 1750 mL of solution.
5. 9.82 g of lead (IV) nitrate are dissolved to make 465 mL of solution.

Once you have completed the practice questions check with the answer key.

1. $\frac{1.0 \text{ mole KF}}{0.10 \text{ L soln}} = 10. \text{ M}$

2. $1.0 \text{ g KF} \times \frac{1 \text{ mole KF}}{58 \text{ g KF}} = 0.0172 \text{ mol KF}$

$\frac{0.0172 \text{ mol KF}}{0.10 \text{ L soln}} = 0.17 \text{ M}$

3. $1.0 \text{ g KF} \times \frac{1 \text{ mole KF}}{58 \text{ g KF}} = 0.0172 \text{ mol KF}$

$\frac{0.0172 \text{ mol KF}}{1 \times 10^{-4} \text{ L soln}} = 170 \text{ M}$

4. $952 \text{ g } (NH_4)_2CO_3 \times \frac{1 \text{ mole } (NH_4)_2CO_3}{96 \text{ g } (NH_4)_2CO_3} = 9.92 \text{ mole } (NH_4)_2CO_3$

$\frac{9.92 \text{ mole } (NH_4)_2CO_3}{1.75 \text{ L soln}} = 5.67 \text{ M}$

5. $9.82 \text{ g } Pb(NO_3)_4 \times \frac{1 \text{ mole } Pb(NO_3)_4}{455.2 \text{ g } Pb(NO_3)_4} = 0.0216 \text{ moles } Pb(NO_3)_4$

$\frac{0.0216 \text{ moles } Pb(NO_3)_4}{0.0465 \text{ L soln}} = 0.0465 \text{ M}$

Questions:

1. If 45 mL of water are added to 250 mL of 0.75 M K_2SO_4 solution, what will the molarity of the diluted solution be?
2. If water is added to 175 mL of a 0.45 M KOH until the volume is 250 mL, what will the molarity of the diluted solution be?
3. How much 0.075 M NaCl solution can be made by diluting 450 mL of 9.0 M NaCl?
4. If 550 mL of a 3.50 M KCl solution are set aside and allowed to evaporate until the volume of the solution is 275 mL, what will the molarity of the solution be?
5. How much water would need to be added to 750 mL of a 2.8 M HCl solution to make a 1.0 M solution?

Once you have completed the practice questions check with the answer key.

1. $(0.75\ M)(250\ mL) = M_2\ (295\ mL)$

$$M_2 = \frac{(0.75\ M)(250\ mL)}{(295\ mL)} = 0.64\ M$$

2. $(0.45\ M)(175\ mL) = M_2\ (250\ mL)$

$$M_2 = \frac{(0.45\ M)(175\ mL)}{(250\ mL)} = 0.32\ M$$

3. $(9.0\ M)(450\ mL) = (0.075\ M)V_2$

$$V_2 = \frac{(9.0\ M)(450\ mL)}{(0.075\ M)} = 54{,}000\ mL = 54\ L$$

4. $(3.50\ M)(550\ mL) = M_2\ (275\ mL)$

$$M_2 = \frac{(3.50\ M)(550\ mL)}{(275\ mL)} = 7.0\ M$$

5. $(2.8\ M)(750\ mL) = (1.0\ M)V_2$

$$V_2 = \frac{(2.8\ M)(750\ mL)}{(1.0\ M)} = 2100\ mL = 2.1\ L$$ (This is the volume of solution)

To find how much H_2O should be added: **2.1L - .750L = 1.35L**

More Practice:

Follow the links below to do more practice.

1. Molarity worksheet
2. Dilution worksheet

Additional Practice:
Click on the link below for additional practice.
Quiz