Stoichiometric Relationships – Limiting Reagents

Balance the following neutralization reaction:

_____ $H_2SO_{4(aq)}$ + _____ $NaOH_{(aq)}$ → ________________ + ___________________

For the procedure today, both reactants are used as aqueous solutions. One of the reactants will be a “limiting reagent”, and therefore will be consumed completely, stopping the reaction at that point. The other reagent will be in “excess”, meaning some amount of it will still be remaining in the reaction vessel when the reaction stops. In other words, when the reaction above ceases, the reaction vessel will contain the products (unless they are gases and bubbled out) as well as the remaining excess reagent.

***Cautions**:* H_2SO_4 *is a strong acid; NaOH is a strong base. Handle with care. Rinse exposed skin immediately upon exposure*.

Part 1 Procedure:

1) Using the bottles on the lab table as the source of the chemicals, carefully fill each burette to the 0.0mL mark.
2) Dispense 15mL of each burette solution into a separate clean, empty beaker.
3) Add 5 – 10 drops of phenolphthalein indicator to each beaker. Carefully swirl the beakers to mix the contents.
4) To carry out the reaction, carefully pour each beaker into the same empty 125mL Erlenmeyer flask. Record your observations.

At this point, note the color of the solution in the flask. Phenolphthalein is pink in a basic solution, and colorless in an acidic solution. Because the ***products*** of the reaction are ***neutral*** (it is called, after all, a neutralization reaction), the acidity or basicity of the solution is due to the presence of the excess reagent.

Based on the color of the contents of the flask with the indicator added, the excess reagent is ________________.

Part 2 Procedure: Titrate the contents of the 125mL Erlenmeyer flask with the burette containing the limiting reagent.

1) Place the flask under the burette containing the limiting reagent.
2) Add the limiting reagent solution to the flask from the burette a few drops at a time, swirling the flask throughout the process to insure proper mixing of the reagents. If the flask starts out pink, titrate until it becomes colorless. If the flask starts out colorless, titrate until it becomes pink.

Be careful not to overshoot the color change that indicates the reaction has reached completion.

3) Record the volume of limiting reagent added to achieve the color change.

Balance the following neutralization reaction:

_____ $H_2SO_{4(aq)}$ + _____ $NaOH_{(aq)}$ → ________________ + ____________________

Observations:

Data Part 1

Volume of H_2SO_4 solution used:	mL		Volume of NaOH solution used:	mL

Color of flask contents + indicator = ___________________

Based on the color of the contents of the flask with the indicator added…

the *excess reagent* is: ________________ **and the *limiting reagent* is:** ________________

Data Part 2

Volume of limiting reagent used to reach reaction completion:	mL

Calculations

1. Calculate the total volume of limiting reagent solution used from part 1 and part 2.

Answer ____________

2. Knowing the answer to calculation 1 and that the molarity of the NaOH was 0.1M, calculate the molarity of the H_2SO_4 solution used.

Answer ____________

3. Calculate the number of milliliters of H_2O produced in the reaction. (The density of $H_2O_{(l)}$ is 1.0g/mL.)

Answer ____________

4. Using the total volumes of H_2SO_4 used, NaOH used, and H_2O produced, calculate the total volume in the flask at the end of part 2.

Answer ____________

5. Using the result from above, calculate the molarity of the Na_2SO_4 solution produced by the end of part 2.

Answer ____________