Acid - Base Titration Lab

(80/1200) Name

Objective: to determine Molarity of a base by titrating with an acid of known Molarity

An acid plus a base always makes a salt and water. Putting an acid and base together like this to react is called an **ACID BASE NEUTRALIZATON REACTION**. It starts out looking a little like a double replacement reaction because there are 2 aqueous solutions, but since they are not "just" any two solutions, they ARE an acid and base, AND we don't get a precipitate, this is NOT a double replacement. The process of using the burets in the lab to cause this acid base neutralization is called **TITRATION.** Titration is the lab activity that lets you control an acid base neutralization reaction.

We will use an acid-base indicator called phenolphthalein. The burets are difficult to read, go slowly. Each team will titrate six times. Each person will do it three times, while the other does the data collection.
All of the math is to be done alone.

PROCEDURE: The LEFT burette is acid. The RIGHT burette is the base of unknown concentration.
Record the initial (start) readings of the burets into the data table. Obtain a small clean reaction beaker.

Mark down in the data table how many mL of acid and how many mL of base to the nearest 10th mL there is in each buret. USE PENCILS. Put ~5.0 mL of acid into the beaker. Go slowly. Next, add 1 drop of the indicator phenolphthalein into the acid—not down the side of the beaker! Put it directly into the acid.

Place beaker over a sheet of white paper under the right burette. NO SPLASHING THE BASE! The burette must empty directly into the acid not down the side of the beaker. Add base slowly with constant swirling. Continue until a pink color remains. Once pink, you have obviously gone too far (you added too much base, which is ok). Move the beaker back to the acid side, add one drop at a time until the pink disappears. When one final drop brings you from pink to clear, you are done with that trial. Carefully measure the final volumes of the acid and base NOW.

RECORD your data on page 2. The END POINT of each titration is the New Starting Point for the next trial. When you are done with each titration you may discard the solution down the sink with plenty of water. Rinse with tap water, no soap. Then rinse beaker with a splash of deionized water. Tap water in Vestal is a weak acid, it has a pH here of ~ 6.0 so rinse with deionized water before starting over. Repeat this procedure 5 X.

For each trial, use ~ 5, 6, 7, 8, 9, and 10 mL acid, but do not use the same acid volume twice.

Acid Molarity in this lab is	M
The base we are using is…	

Trial	Acid Start mL	Acid End mL	Acid Used mL	Base Start mL	Base End mL	Base Used mL
1						
2						
3						
4						
5						
6						

17 Lab Report Questions

1. Write the BALANCED chemical equation, with phases, for the acid + base you used.

2. What type of chemical reaction occurs in this lab? (see paragraph 2 on front page)

3. List the OTHER FIVE kinds of reactions that you already know.

4. What is the fixed Titration Formula you will use to calculate molarity of the base ?

5 - 10 Calculate the Molarity of the base in trial 1, trial 2, trial 3, trial 4, trial 5, and trial 6.

11. What is the AVERAGE molarity of the base in all six trials?

~~~~ The actual Molarity of the base is: _____ (get from teacher)

12. Calculate your percent error for molarity of the base.

13. Time out, deep breaths.

14. A truck carrying 22,500 Liters of 6.83 M $HCl_{(AQ)}$ which is used as a masonry cleaner, crashed and dumped its contents in Vestal. As the fire chief you are called to deal with this disaster. How many moles of acid spilled from the truck that you have to neutralize?

15. If your fire house has a large supply of 4.00 M $Mg(OH)_{2(AQ)}$ as a neutralizing agent, how much of this base is needed to neutralize this 22,5000 liters of acid that spilled? Write a formula, do the math.

16. Write a balanced chemical reaction with phases for the reaction in problem #15.

17. It's a bad week for the fire department in Vestal and you get a call at 3:30 AM the very next night and hear that a sleepy trucker took a nap while driving on Route 17. His truck contains 2.51×10^3 L of 5.50 M $NaOH_{(AQ)}$, and it's hanging on the edge of a small cliff. It could spill over at any moment! The fire house has a large tank of 2.95 M sulfurous acid on hand. How much will be needed to neutralize this base?

18. Write a balanced chemical reaction with phases for the reaction in problem #17.
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Special Notes

Many of you might already realize that phenolphthalein is an acid base indicator that only starts to change from colorless to pink at a pH of 8.0 (not quite neutral). You might even be wondering about this.

The actual chemistry that would show you that this is still fine (a very small percent error) requires a fair amount of math that is not inside the scope of this course. Trust me, it's okay. Although I do grasp why, I don't teach this. I'd be hard pressed to explain it to you in simple terms.

Chemistry is a big topic, and there are lots of things going on at the same time. Sometimes we can see them while they happen, sometimes they happen behind the curtain.

If you study chem in college, you will push aside these curtains. There is enough chemistry for your whole life. There's just no simple way to show you this; trust me, it's real, true, and a little complex.

Phenolphthalein is a weak organic acid. It's chemical Formula: $HC_{20}H_{13}O_4$
Phenolphthalein is a weak acid, meaning that some of the molecules will dissociate into H^{+1} and $C_{20}H_{13}O_4^{-1}$ anions. Since the molecule is clear in color while the anion is pink, the acids and bases we add will shift the dynamic equilibrium of the indicator, making it change colors!

$$\underset{\text{colorless molecules}}{HC_{20}H_{13}O_{4(AQ)}} \leftrightharpoons H^{+1}_{(AQ)} + \underset{\text{pink anions}}{C_{20}H_{13}O_4^{-1}{}_{(AQ)}}$$

ADD OH^{-1} (base) $\rightarrow\rightarrow\rightarrow\rightarrow$
$\leftarrow\leftarrow\leftarrow\leftarrow$ ADD H^{+1} (acid)

Think about the arrows showing the proper shift, then copy something like this into your conclusion!
This is important - ADDING BASE really means removing H^{+1} ions, because the hydroxide ions combine with the acid ions, forming water. The more hydroxide ions, the less acid H^{+1} cations.

When this dynamic equilibrium shifts forward, the solution gets PINK.
When this equilibrium shifts to the reverse, it gets less pink, and more COLORLESS.
It is possible to "balance" this and get light pink or super pale pink. This is a qualitative measurement.

This lab report must include:

Page 1 Cover: A formal Title, a fun title and/or drawing (optional) + a one sentence introduction	1 point
Completely filled in Data table	1 point
The 17 Lab Questions on separate paper, in order, all units, all SF, and IN ORDER.	17 points
The Lab Conclusion, which must include ALL SIX parts. 1 Explain what an Arrhenius acid and an Arrhenius base is. Tell what happens when you mix them together. 2 Explain how $NH_{3(AQ)}$ can be a base with no apparent OH^{-1} ions using the alternate theory. Copy the details from the cardstock handout to explain this all. 3 Explain what acid base indicators are, and how they operate using LeChatleier's Principle, use the phenolphthalein equation from above, which you will rewrite (with double arrows!) into your conclusion! 4 Give an example from table M, show how a solution changes colors when stressed with added acid or base. 5 Create a word problem for the titration of $HNO_{2(AQ)}$ and $Ca(OH)_{2(AQ)}$ Solve this problem. SF & units! 6 Who was Svante?	6 points 25 points