Acid - Base Titration Lab (80/1200) Name: _____

Objective: to determine Molarity of a base _____$_{(AQ)}$ by titrating with an acid _____$_{(AQ)}$ of known Molarity
Acids are aqueous solutions with excess H^{+1} ions, bases are aqueous solutions with excess OH^{-1} ions.

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 old solutions, they ARE an acid and base, AND we don't get a precipitate either, but it is NOT a double replacement.

The process of using the burets in the lab to cause this acid base neutralization is called titration, or titrating an acid with a base to neutral. Titration is the lab activity that lets you control an acid base neutralization reaction. They are related but are NOT the exact same thing. (think: buying a new bow tie for a dance is not the same thing as dancing)

We will use an 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. <u>All of the math is to be done alone</u>.

PROCEDURE: The LEFT burette has your acid. The RIGHT burette contains the base of <u>unknown concentration</u>. Record the initial (start) readings of both of the burets into the data table. Obtain a small clean reaction beaker.

Mark down how many mL of acid and how many mL of base (to the nearest 10th mL) there is in each buret, in the data table. Put ~5.0 mL of acid into the beaker (approximately). Go slowly. Next, add 1 drop of the indicator phenolphthalein into the acid (<u>not down the side of the beaker!</u> Put it directly into the acid). Add about 1 squirt of deionized water, just to swirl. Swirl without spilling.

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 DATA in data table on next page. The END POINT of each titration is the New Starting Point for the acid and the base. When you are done with each titration you may discard the solution down the sink with plenty of water. Rinse well, 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 about 6.0 so rinse with deionized water before starting over. You will repeat this procedure 5 more times.

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

My class used _____ acid

and _____ base of unknown molarity

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						

1. Write the BALANCED chemical equation, <u>with phases</u>, for the acid + base you used. Use PHASES TOO.

2. What type of chemical reaction occurs in this lab? (see paragraph 2 of the 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 (over and over)?

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.

14. A truck carrying 22,500 L of 6.83 M $HCl_{(AQ)}$ which is used as a masonry + brick cleaner crashed and dumped its contents in your town. As the fire chief you are called to deal with this disaster. <u>How many moles</u> of $HCl_{(AQ)}$ actually spilled will you have to neutralize?

15. If you use 4.00 M $Mg(OH)_{2(AQ)}$ as a neutralizing agent, how much of it will you need to neutralize this hydrochloric acid spilled in question #14? Write a formula, do the math.

16. Write a balanced chemical reaction <u>with phases</u> for the acid base neutralization in problem #15.

17. It's a bad week for the fire department in your town and you get a call at 3:30 am 2 days later! A trucker with not enough sleep decided to nap on Route 17 while driving his rig filled with 2.51×10^3 L of 5.50 M $NaOH_{(AQ)}$. It's hanging and looks like it will spill over at any moment. How much of your 2.95 M sulfurous acid neutralizing agent do you tell the team to bring to the scene of the accident to completely neutralize this base?

18. Write a balanced chemical reaction <u>with phases</u> for 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 really very neutral at all!). 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.

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 enough (AP Chem?) or college chem, you will open more doors, push aside more curtains. There is enough chemistry for your whole life, more really. There is no simple way to show you this, so please, trust me on this, it's real, true, okay, and it's 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 <u>molecule is clear in color</u> while the <u>anion is pink</u>, the acids and bases we add will shift the dynamic equilibrium of the indicator, making it change colors!

$$HC_{20}H_{13}O_{4(AQ)} \rightleftharpoons H^{+1}_{(AQ)} + C_{20}H_{13}O_4^{-1}{}_{(AQ)}$$

COLORLESS MOLECULE ACID CATION + PINK ANION

ADD OH^{-1} (base) →

← ADD H^{+1} (acid)

Think about the arrows showing the proper shift, then copy something like this into your conclusion! It's important to grasp that ADDING BASE really means removing H^{+1} ions, as the hydroxide ions combine with the acid ions, forming water. This might help understanding the shift.

This lab report is worth 80 Lab Minutes towards the regents requirement, and it must include:	
Page 1 Cover: Start with a formal Title, add a fun title and/or drawing (optional) + a one sentence introduction	1 point
Completely filled in Data table	1 point
The Lab Questions 1 through 18, NEAT, with all units, all SF, and IN ORDER. Try using pencil!	17 points
The Lab Conclusion, which must include ALL of these parts. Write neatly! ● Explain what an Arrhenius acid and an Arrhenius base is. Tell what happens when you mix them together. ● Explain how $NH_{3(AQ)}$ can be a base with no apparent OH^{-1} ions using the alternate theory. Write an equation with arrows, and the 2 sentences explaining this acid and base idea. ● Explain what acid base indicators are, and <u>how</u> they operate using LeChatleier's Principle, use the phenolphthalein equation from above, which you will rewrite (with arrows!) into your conclusion! ● Give an example from table M, show how a solution changes colors when stressed with added acid or base. ● Create a word problem for the titration of a volume of nitric acid combining with calcium hydroxide. <u>Solve</u> this problem. Watch SF. Use units! ● Tell the world: Who was Svante?	6 points 25 total