Acid-Base Lab

Name: _____Pd: ____

Background and Purpose:

Acids and bases are present in a variety of substances in our daily lives. Some of them are necessary and helpful while others are harmful to us and our environment. In this activity, we will determine the pH of a number of household products using a variety of qualitative and quantitative methods.

Safety:

1. Wear safety goggles
2. HCl & NaOH are irritants. If you spill either of these solutions, immediately notify the teacher & flush the area for 2-3 min.
3. NH_3 is an irritant. Do not inhale the fumes and avoid skin contact.
4. pH meters are sensitive instruments, treat them with care, they are easily damaged.

Materials:

- Safety goggles
- 4 small test tubes
- 1 test tube rack
- 1 stirring rod
- 1 plastic wash bottle
- 0.1 M HCl
- 0.1 M CH_3COOH
- 0.1 M NH_3
- 0.1 M NaOH
- Distilled water
- Methyl red solution
- Litmus solution
- Bromthymol blue solution
- Phenolphthalein
- pH meter
- An assortment of household chemicals

LAB PART A: The pH Scale and the Effect of pH on Red Cabbage Dye

Acid						*Neutral*	*Base*						
pH	2	3	4	5	6	7	8	9	10	11	12	13	14
Color	red	red-purple		purple	blue-purple	blue	blue-green		green			yellow	

1. Determine the cabbage indicator color of each household product item provided.
   a. Fill a ***small*** test tube about 1/2 inch high with the product to be tested (use a separate dropper for each substance).
   b. Obtain a small amount of red cabbage dye from your instructor.
   c. Add several drops of the indicator to the product in the test tube with a new pipet (you can use the same pipet for each test tube as long as you don't touch the household substance).
2. Record the colors of the substances after adding the dye in the chart below.
3. Estimate the pH of each product using the above chart as a guide.
4. Decide if each product is an acid, base or neutral.

Product Name	Cabbage Indicator Color	Estimated pH Number	Acid, Base, or Neutral?
Baking soda			
Distilled Water			
Lemon juice			
Milk			
Shampoo			
Soda pop			
Vinegar			

LAB PART B: The pH Scale and the Effect of pH on Acid-base Indicators

Acid-base indicators are weak Bronsted-Lowry acids that change color when the hydrogen ion is lost. The colors for the indicators in acidic and basic solutions are given in the table below:

Indicator	Color in acidic solution	Color in neutral solution	Color in basic solution
Methyl Red	Red	Orange	Yellow
Litmus	Red	Purple	Blue
Bromthymol Blue	Yellow	Green	Blue
Phenolphthalein	Colorless	Colorless	Pink

1. Obtain 4-5 mL of the first household substance and divide between 4 ***small***, clean test tubes.
2. Add 2 drops of **methyl red** to the 1st test tube. Flick to mix the contents. Record the final color in the table.
3. Add 2 drops of **litmus** to the 2nd test tube. Flick to mix the contents. Record the final color in the table.
4. Add 2 drops of **bromthymol blue** to the 3rd test tube. Flick to mix the contents. Record the final color in the table.
5. Add 2 drops of **phenolphthalein** to the 4th test tube. Flick to mix the contents. Record the final color in the table.
6. Empty and rinse the test tubes in the sink.
7. Repeat steps 1-6 for the remaining solutions.
8. When all of the colors have been recorded, use the indicator table from the introduction to determine if the solutions were acidic, basic or neutral.

Solution	Methyl red	Litmus	Bromthymol blue	Phenolphthalein	Acid, Base, or Neutral?
Baking soda					
Distilled Water					
Lemon juice					
Milk					
Shampoo					
Soda pop					
Vinegar					

LAB PART C: Quantitatively Measuring pH using a pH meter

pH meters can be used to give a numerical pH value. You will be using pH meters and calculators to measure the pH of solutions and then calculating the hydrogen and hydroxide concentrations for each.

1. Fill your wash bottle with distilled water.
2. Get a pH meter from your teacher.
3. Rinse the pH meter with distilled water from your wash bottle.
4. Obtain a sample (~10-12 mL) of one of the substances in the table below and place in a ***large*** clean test tube.
5. Carefully place the pH meter into the first sample & gently swirl keeping the end of the meter submerged.
6. Watch the pH reading & when the reading stabilizes record the number in the data table.
7. Remove the pH meter from the sample and rinse well with distilled water.
8. Repeat steps 4-8 for the remaining samples until all have been tested. Rinse the test tube well with distilled water in between samples.
11. When you are done testing pH, rinse the pH meter a final time with distilled water.
12. Return the pH meter to your teacher.
13. Clean up the rest of your lab space.

Substance	pH (from meter)	Acidic, Basic, or Neutral?	Which is greater? $[H^+]$ or $[OH^-]$?
Baking soda			
Lemon juice			
Milk			
Shampoo			
Soda pop			
0.1 M Hydrochloric acid (HCl)			
0.1 M Acetic Acid (CH_3COOH)			
0.1 M ammonia (NH_3)			
0.1 M Sodium Hydroxide (NaOH)			

Summing Up Questions:

1. Calculate the $[H^+]$ and the $[OH^-]$for *<u>each</u>* of the substances you tested in Part C. *Show the equation(s) you used and **<u>all</u** of the calculations.*

Substance	*Work and answer*	*Substance*	*Work and answer*
Baking soda	$[H^+]=$ $[OH^-]=$	**0.1 M HCl**	$[H^+]=$ $[OH^-]=$
Lemon juice	$[H^+]=$ $[OH^-]=$	**0.1 M CH_3COOH**	$[H^+]=$ $[OH^-]=$
Milk	$[H^+]=$ $[OH^-]=$	**0.1 M NH_3**	$[H^+]=$ $[OH^-]=$
Shampoo	$[H^+]=$ $[OH^-]=$	**0.1 M NaOH**	$[H^+]=$ $[OH^-]=$
Soda pop	$[H^+]=$ $[OH^-]=$		

2. How did the measured pH values (part C) for the household substances correspond to the acid/base predictions made using acid-base indicators in parts A and B?

3. Compare the pH of 0.1 M CH_3COOH with that of 0.1 M HCl. Explain any differences.

4. Compare the pH of 0.1 M NH_3 with that of 0.1 M sodium hydroxide. Explain any differences.