EXERCISE 2

pH AND BUFFERS

LEARNING OBJECTIVES:

- Become familiar with the pH scale.
- Determine the pH of different substances using a pH indicator.
- Learn to use the pH meter.
- Determine experimentally which antacid works best at neutralizing excess stomach acid.

Introduction

pH (potential of hydrogen) is a measure of the free hydrogen ions (H+) in a solution. Pure water is called a neutral solution because it has equal numbers of the positively charged H+ ions and the negatively charged hydroxide ions (OH-). An acid has more H+ ions than OH- ions while a base (also called an alkali) has fewer H+ ions than OH- ions. Although most of the areas of our body tend to be in the neutral range e.g. the pH of blood is between 7.3 and 7.5. pH buffers present in our cells keep the pH within the neutral range. However, the pH of the stomach is very low, between pH 1.0 and 3.0. The pH scale is used to measure pH of a solution and ranges from 1 to 14, with a pH of 1 being the most acidic and a pH of 14 the most basic. Refer to the pH scale below.

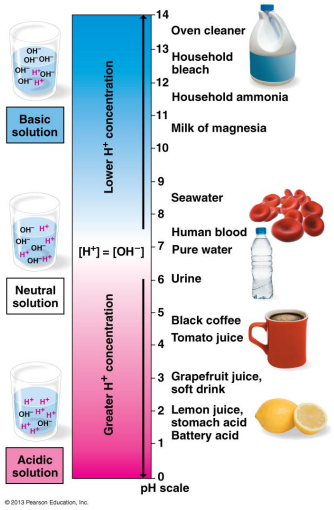

Figure 1 pH scale.

PART A: MEASURING PH

pH Indicators

pH indicators are chemicals, which display characteristic color changes in response to the pH of standard buffer solutions. Some pH indicators used in the lab are: litmus, phenolphthalein, methyl red, and phenol red, to name a few. These are available in liquid form as well as paper strips. Hydrion (a type of so-called universal indicator) is one such paper indicator that will allow you to read from pH 1 to 14. To read the pH, compare the color change to the color chart provided.

Procedure

Using **only the pipette** in the beaker containing the substance to be tested, place a few milliliters of the solution into a watch glass. **(DO NOT SWAP PIPETTES).** Dip a small strip of the pH indicator into it and observe the color change. Match the color of the indicator paper with the color chart and record the pH.

Record your results in the table below.

Table 1: pH of some common substances

Substance	**pH**	**Acidic or Basic?**
Ammonia solution		
Aspirin solution		
Baking soda		
Banana		
Bleach		
Coffee		
Detergent		
Distilled water		
Milk		
Milk of magnesia		
Lemon juice		
Orange juice		
Soda pop		

Vinegar		

pH meters

pH indicator s give us a general idea of the pH of the solution. To get a more accurate reading of the pH, an instrument called a pH meter can be used. It makes use of an electrode, which is immersed into the solution to be measured, and the pH is registered on a monitor.

Use the pH meter to measure the pH of solutions X and Y.

	pH indicator paper	**pH meter**	**Acidic or basic?**
pH of X			
pH of Y			

PART B: EVALUATING SOME ANTACIDS

Introduction

The very acidic condition in the stomach aids in the digestion of food. Sometimes the stomach produces too much acid, which can cause discomfort. A common remedy is to chew an antacid tablet. Antacids work by neutralizing excess hydrogen ions and are thus, considered buffers. A **buffer** is any substance that can remove or accept hydrogen ions in order to stabilize the pH of a solution.

In this experiment you are going to evaluate 4 different antacids is to determine which one works best at neutralizing excess stomach acid. We will use an acid solution of the same pH as stomach acid.

Procedure

1. Use a mortar and pestle and grind up about 3 tablets of antacid.
2. Weigh out 4 grams of antacid powder.
3. Use a measuring cylinder, measure out 200ml of acid solution and pour the acid into a 400ml beaker.
4. Take the beaker containing the acid to the pH meter. Start the magnetic stirrer. You will need a timing device.

5. Immerse the electrode into your acid solution, making sure that it is in the solution and not in the vortex created by the stirrer.
6. Allow the pH meter to read 'stable' then record the pH of the acid solution. This is your initial or starting pH.
7. Pour the antacid powder into the acid solution. ***Start timing as soon as you begin to add the powder.***
8. Record the final pH (when the pH meter reads 'stable' again) and the time taken to get to that pH.
9. Rinse the electrode of the pH meter thoroughly with distilled water. (Handle with care!). Leave the electrode immersed in the storage solution.
10. Wash the mortar and pestle and dry well.
11. Repeat the experiment for the other antacids.
12. Record your results in the table below.

Antacid	**Initial pH**	**Final pH**	**Difference in pH units**	**Time elapsed (minutes)**

Lab Report

pH AND BUFFERS

1. From your results, what is the difference in the H+ content between lemon juice and household ammonia?

   _____

   From your results in Table 1, rank the following in order of their H+ content (from the one with the **most** H+ ions to the one with the **least**).

   Lemon juice, orange juice, milk, distilled water, coffee, baking soda, ammonia.

	Most H+ ions
	Least H+ ions

2. Use your results from the antacid experiment to answer the following questions.

Antacid	**Initial pH**	**Final pH**	**Difference in pH units**	**Time elapsed**	**Rate of acid neutralization/ pH units per minute**

a. Calculate the rate of acid reduction by each of the antacids and record your results in the table above.

b. At the end of the experiment which antacid solution still had the highest number of H+ ions? _____

c. At the end of the experiment which antacid solution had the lowest number of H+ ions? _____

d. Which antacid neutralized the acid slowest? (rate!) _____

e. Which antacid neutralization the acid fastest? (rate!) _____

3. Suggest one reason why this method may not be ideal for comparing **all** antacids.

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4. State five variables that must be kept constant (the same) in this experiment.

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