Buffers. When a weak acid or weak base is mixed with approximately equal amounts of its own salt (for example HC$_2$H$_3$O$_2$ and NaC$_2$H$_3$O$_2$ or NH$_4$OH and NH$_4$Cl) you get what is called a buffer. A buffer absorbs relatively large amounts of acid or base without changing the pH of the solution. Buffers are important in our body where many life giving reactions depend on a stable pH (7.35 – 7.45). Buffers are useful when strong acids or bases are spilled or need to be cleaned up. Strong acids or bases on the skin can cause painful tissue damage. Application of a suitable buffer can neutralize large amounts of these acids and bases resulting in almost instantaneous relief. If you observe the titration curve you made in Unit 13, you will see relatively flat portions of the curve before and after the end point. These are called the buffer regions. You will recall that you added relatively large amounts of base without the pH changing significantly.

Antacids. The linings of the stomach produce HCl to digest food. When we eat the wrong food, the digestion does not take place and the stomach produces more acid. Eventually we end up with what is called heartburn or excessive stomach acid. This can be very uncomfortable and unhealthy. To neutralize this acid safely, buffers can be used. These buffers are called antacids. They take a variety of forms with varying compositions. They all do the same thing, neutralize acid. And they do so more efficiently and more safely than a strong base. If you ate a strong base, you would neutralize the acid but just a very small amount in excess and you would end up with excessive base in your stomach that would be just as bad or worse than the excess acid.

Some antacids contain flavors, textures, and other components designed to entice the buyer. A common inexpensive antacid is sodium bicarbonate (baking soda). Drinking a small amount dissolved in water will neutralize stomach acid efficiently. If you need more you can safely drink more. Since carbonic acid is a weak acid, there is little concern that too much sodium bicarbonate will hurt your stomach. However, some concern has been expressed about excessive sodium levels in the diet. Some believe that excess sodium levels increase blood pressure. An occasional consumption of sodium bicarbonate to relieve infrequent heartburn will probably not cause any long term health problems.
Frequent use of antacids may warrant the use of non-sodium containing products.

**Back Titrations.** A back titration is where you titrate what has not reacted rather than what has reacted. In this experiment we are going to use an antacid to neutralize some HCl. The we are going to titrate the amount of acid that was not neutralized. Knowing what was not neutralized will enable us to determine the amount of acid that was neutralized.

**Procedure**

1. Measure the mass of an antacid tablet and record on your lab report.

2. Prepare a 0.250 N solution of HCl by adding exactly 2.08 ml of 12 M (concentrated) HCl to exactly 97.92 mL of distilled water.

3. Add 35-40 mL of this solution to a medium sized Erlenmeyer flask and record the exact volume. Add the measured antacid tablet to the acid and boil very gently for about 5 minutes. During the boiling you may want to break up the tablet. Not all the tablet will dissolve. Insoluble materials constitute other substances in the tablet of no concern to our experiment.

4. Cool the flask and add a few drops of phenolphthalein indicator. Titrate with your standardized (approximately) 0.1N NaOH solution to a consistently pink endpoint as before. The pink endpoint should remain for 30 seconds.

5. Repeat with the other two tablets.

6. Calculate the moles of NaOH used in the titration, then the moles of HCl titrated and subtract from the moles of HCl originally used (volume of 0.250 M HCl originally used times the concentration) to get the moles neutralized. Then multiply the moles neutralized by the concentration of the HCl to get the mL neutralized. Divide grams of tablet by the mL neutralized to get
the neutralizing strength of the tablet.
Prelab Exercises for Unit 14

Unit 14 Buffers/Antacids

1. A buffer is defined as a combination of a ___________ acid (or base) and its ______________ base (or acid).

2. You can add relatively large amounts of strong acid or base to a buffer without significantly changing the ____________.

3. If we used a 1.3032 g antacid tablet in a beaker containing 40.2 ml of 0.2500 M solution of HCl and then titrated the neutralized acid with 0.1003 N solution of NaOH and observed an endpoint after titrating 2.33 ml of the NaOH, how many grams of antacid are needed to neutralize 1 ml of HCl? How many tablets are needed to neutralize 100 ml of HCl in your stomach? Be sure to round up the number of tablets to ensure neutralization.
## Lab Report for Unit 14

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<tr>
<th>Name</th>
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### Table 1

<table>
<thead>
<tr>
<th>Mass of Tablet</th>
<th>mL of 0.250 N HCl used</th>
<th>mL NaOH titrated</th>
<th>mL HCl titrated</th>
<th>mL of HCl neutralized by tablet</th>
<th>Mass Tablet per mL HCl</th>
<th># of Tablets to Neutralize 100 mL HCl</th>
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**Show calculations:**