Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Period: \_\_\_\_\_\_\_\_\_\_\_

KEEP BUFFERED AND CARRY ON



Your body’s pH should be around 7 (7.2 – 7.4, depending on who you ask). Interestingly, cancer cells have a much lower pH (around 6.5).

Our blood cannot tolerate a drastic shift in pH. It’s a good thing, then, that human blood contains a ***buffer*** of carbonic acid (H2CO3) and sodium bicarbonate (NaHCO3). This buffer regulates drastic shifts in the pH of our blood. Becoming too basic (a condition called alkalosis = high pH) or too acidic (acidosis = low pH) can be deadly. Symptoms of alkalosis can include any of the following: confusion (can progress to stupor or coma), hand tremor, lightheadedness, muscle twitching, nausea, vomiting, numbness or tingling in the face, hands, or feet, prolonged muscle spasms (tetany). Some of the common symptoms of metabolic acidosis include the following: rapid and shallow breathing, confusion, fatigue, headache, sleepiness, lack of appetite, jaundice, and increased heart rate.

How does this work? Remember: A proton is a hydrogen atom that has lost its single electron; it is a naked proton. The bicarbonate buffer system works by donating protons (H +) if the substances carried in the blood stream are too basic and accepting protons (H +) if the substances are too acidic. In essence, the buffer is pulling the system back from extremes. You could compare it to our political system – centrists pull far-right conservatives and far-left liberals toward the middle.

**Pre-lab Questions:**

1. What is a buffer (see your text for a definition)? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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2. Buffers maintain a balance inside you; this balance is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

3. Read through the procedure. Which setup is the control – beaker #1 or #2? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Materials:**

goggles lab apron 2 beakers micropipette graduated cylinder

**Procedure:**

*Beaker #1: Unbuffered Solution*

1. Place 50 mL of deionized water in a beaker and add 6 drops of universal pH indicator. Swirl gently to mix. Note the color of the solution and pH. Record.

2. Add 3 drops of 1.0 M HCl (this means “1 molar hydrochloric acid”; molarity is a measure of concentration).

Swirl gently to mix. Note the new color and record the pH.

3. Save this beaker and solution for comparison to what happens in beaker #2.

*Beaker #2: Buffered System*

1. Make a buffer solution in a new beaker. Do this by putting 50 mL of 0.1 M NaHCO3 (0.1 molar sodium bicarbonate) solution in the beaker and GENTLY blowing exhaled breath into the solution for at least 2 minutes. Do NOT blow hard or some might splash in your face. It won’t kill you – sodium bicarbonate is in AlkaSeltzer and baking soda. Once you begin blowing, you will realize that 2 minutes is a

lonnngggg… time. No whining.

2. Add 6 drops of universal pH indicator. Swirl gently to mix. Note the color and record the pH.

3. Add 3 drops of 1.0 M HCl as you did above and note the color and record the pH.

4. Continue to add acid drop by drop, counting the drops (swirl to mix) until the color matches the unbuffered solution from step 2 when you were working with beaker #1. How many drops did you use? Record.

Number of drops of HCl added to beaker #2 - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Data:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Beaker | Initial color | Initial pH | Final color | Final pH |
| 1 |  |  |  |  |
| 2 |  |  |  |  |

**Post-lab Questions:**

1. Up to a point, did the buffer system work? \_\_\_\_\_\_\_\_\_\_\_ What happened when the system no longer could

maintain its pH? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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2. There was water (H2O) in beaker #2. What gas did you (and your lungs) add to the water?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Those 2 things combined to form carbonic acid (H2CO3). Write the chemical equation to show what

happened (A + B 🡪 C).

3. What do you call an atom if it has lost or gained an electron? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. HCl (hydrochloric acid) splits into 2 ions. How do you represent a ……………….

Hydrogen ion - \_\_\_\_\_\_\_ Chloride ion - \_\_\_\_\_\_\_

Which of these gained an electron? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. If pH is high, is the solution acidic or basic? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Does this mean there

are lots or just a few hydrogen ions? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6. What do we call a hydrogen atom that has been stripped of its one electron? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_