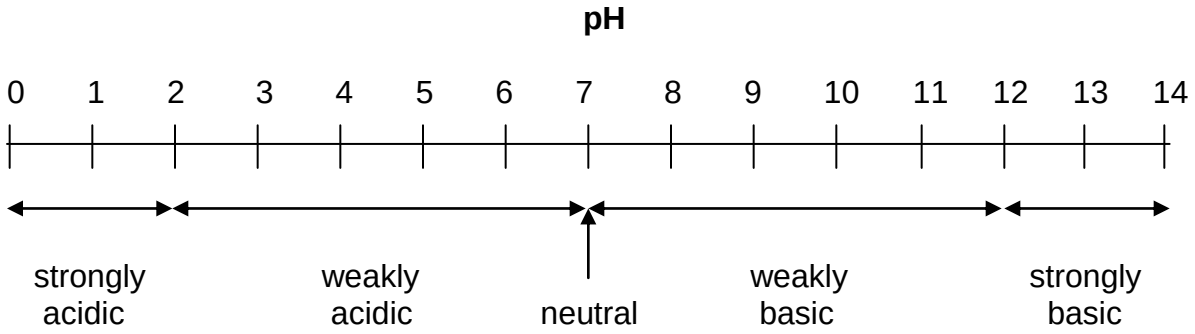
GCC CHM 107LL
pH of Household Products

Introduction

The pH scale runs from 0 to 14, and indicates the relative acidity (or basicity) of a solution. Low pHs indicate acidic solutions and high pHs indicate basic solutions, with the neutral point being pH = 7. Acidic solutions contain H^+ ions (hydronium ions) and basic solutions contain OH^- ions (hydroxide ions). **The higher the concentration of H^+ ions, the lower the pH**. **The higher the concentration of OH^- ions, the higher the pH**. The pH scale is shown below.



pH values can be approximated through the use of substances called indicators. These substances change color at certain pH values. In this experiment a natural indicator is used, red cabbage. Knowing the color of the indicator at various pH values, you will then use the indicator to determine the pH of some household materials.

Procedure:

A. Red Cabbage Indicator

1. Cut about 8 g of small pieces from a head of red cabbage. Put the pieces in a 250-mL beaker. Add 35-40 mL of deionized water. Place the beaker on the hotplate, and heat at setting 4-5 to a gentle boil. Stir often, until the liquid is dark purple (~10 minutes). Note: If your solution is blue, you used tap water instead of deionized water. Start over. Prepare test tubes for step 3 and answer the follow up question in the lab report while you are waiting
2. Turn off the heat and allow the mixture to stand for a few minutes. Pour the colored liquid into a 150-mL beaker to use as the indicator. Waste disposal: Throw the boiled cabbage in the regular trash.
3. Arrange 7 small test tubes in a test tube rack. Number them consecutively to correspond to the pH values of 2, 4, 6, 7, 8, 10 and 12.
4. The pH solutions are located on the carts on either side of the lab. Use dropper bottles to add about 20 drops of each pH solution into the corresponding test tubes.
5. Use a disposable pipet to add 8 drops of the cabbage indicator to each test tube. Tap the tubes gently to mix the contents. Record the colors you observe for each pH value. Save these test tubes for comparison to complete Part B.

B. pH of Household Materials

1. If possible, bring from home at least 3 small colorless samples of liquids (3-4 mL) and/or solids (size of a pea). Check to make sure that the substances will mix with or dissolve (are soluble) in water. Do NOT bring flammables or alcoholic beverages. (Juices, vinegar, household cleaners, detergents, aspirin are some possibilities.) We will provide some products for you if you did not bring your own.
2. If your sample is solid, crush it with the mortar and pestle, then dissolve a **pea sized amount** in 3-4 mL of deionized water in a separate clean test tube. If your samples are liquids, put 15 drops of

them to be tested into **separate** labeled clean empty test tubes. **You must do at least 6 samples, but do not do bleach, that comes later.**

3. Add 8 drops of cabbage indicator to each test tube from step 2. Record the colors and the pH for each product. If you have a color intermediate between two standard buffer solutions, you can estimate the pH value such as 3.5 or 9.5. Classify each substance as strongly acidic, weakly acidic, neutral, weakly basic, or strongly basic on your lab report.
4. Add 15 drops of cabbage indicator into a clean test tube. Add 5 drops of bleach solution into the test tube and shake to mix the contents. Record the color results AFTER mixing.

Clear vs Colorless – Clear simply means you can see through something. It is transparent. Colorless means no color like water. Something can be pink and clear. So if you observe something today that looks like water it is clear AND colorless.

CAUTION: Bleach can easily damage eyes. It is corrosive and can cause chemical burns. Check to see that safety goggles fit close to your face and do not rub or touch your eyes until you finish this part of the experiment. Any bleach splashed into eyes or spilled on skin must be rinsed immediately with water for 15 minutes. Any bleach spilled on your work area must be neutralized, then the entire area should be washed and dried. **Wash your hands.**

Waste disposal: Dispose of the contents of the test tubes down the drain. Rinse the test tubes and put upside down in your test tube rack to dry.

TRUE STORY - Dr. Smith has been drinking a diet soda that will remain nameless since 4th grade – about 2 to 3 cans a day. As a child her parents thought since it was "diet" it would not hurt her teeth: no sugar, no decay. As a teenager her teeth showed unusual wear and the dentist decided she must really grind her teeth at night. In her twenties her teeth were really worn down, several no longer touched, and they were extremely sensitive. Dentists were confused and still thought she must grind her teeth at night and brush them too hard because the wear was on the sides of her teeth as well as the top. In 2005 a dentist said acid wear was the reason her teeth were seemingly dissolving away. Seven specialists confirmed it was the acidic beverages causing the damange, not grinding. As the enamal was already gone from her teeth, the damange was irreversible, and the erosion process had picked up considerable speed. In 3-4 years her teeth would be too worn and small to even crown – they were literally dissolving away now without the protective enamel layer. So in the summer of 2007, Dr. Smith had all her teeth crowned. 18 dentist visits, about 60 hours in the chair, about 100 mouth injections, and $30,000 spent. **What are YOU drinking???**

Table I. pH values of Common Sodas

Product	**pH**	**Product**	**pH**
Pure Water	7.00 (neutral)	Tap water	7.67
Barq's	4.61	Mug root beer	4.038
Diet Coke	3.289	Lemon Nestea	2.969
Mountain Dew	3.229	Lemon Brisk	2.868
Diet Mountain Dew	3.365	Gatorade (pink)	2.95
Coke Classic	2.525	Diet Dr. Pepper	3.169
Pepsi	2.49	Dr. Pepper	2.899
Sprite	3.202	Hawaiian Fruit Punch	2.82
Diet 7-Up	3.67	Squirt	2.898
7 Up	3.202	Slice Orange	3.059
Surge	3.02	RC Cola	2.387
Gatorade	2.95	Cherry Coke	2.522
Surge	3.004	Diet Pepsi	3.031
Orange Minute Maid	2.80		
Mr. Pibb	2.902	Source: Minnesota Dental Association *	**The threshold pH for enamel dissolving is 5.5.**
BATTERY ACID	1.00		

GCC CHM 107LL Report: Name: _____

pH of Household Products Partner: _____

A. Cabbage Indicator

pH	Color – be descriptive
2	
4	
6	
7	
8	
10	
12	

B. Household Materials

Substance	Color	pH	S Acid, W Acid, N, W Base, S Base

Questions:

1. Which of the household chemicals you tested was most acidic? _____
2. Which of the household chemicals you tested was most basic? _____
3. Acidic solutions contain _____ ions.
4. Basic solutions contain _____ ions.

5. The color of the bleach solution with indicator is _____.

6. Can this method be used to determine the pH of a bleach solution? Explain why or why not. (Hint: Why don't we use bleach with colored fabrics?)

7. As concentration of H^+ increases, the pH: increases decreases stays the same

8. As concentration of OH^- increases, the pH: increases decreases stays the same

9. As pH decreases, the solution is getting more: acidic basic neutral

Follow up Question:

Refer to the pH table on page 1 and Table I on page 2. Categorize each of the following substances as strongly acidic, weakly acidic, neutral, weakly basic, or strongly basic. Fill in pH if missing.

Substance	pH	Category
Carbonated water	3.9	
Stomach acid	1.3	
Saline solution	7.0	
Tears	7.4	
Saliva	6.8	
Codeine	10.3	
Carrots	5.1	
Drain cleaner	13	
Maple syrup	6.0	
Battery Acid		
Pepsi		
Gatorade		

According to Table I, which soda is the most acidic? _____

According to Table I, which soda is the least acidic? _____