

4. Introduction to Acids and Bases

pH Factor

Driving Question

What is the pH of some common household chemicals?

Materials and Equipment

For each student or group:

- | | |
|--|---|
| <input type="checkbox"/> Data collection system | <input type="checkbox"/> Beakers, 250-mL (5) |
| <input type="checkbox"/> pH sensor | <input type="checkbox"/> Distilled water, 200 mL, in wash bottle |
| <input type="checkbox"/> Red cabbage indicator, 100 mL | <input type="checkbox"/> Household chemical samples, 50 mL each (4) |
| <input type="checkbox"/> Pipet | |

Safety

Add this important safety precaution to your normal laboratory procedures:

- Wear goggles and an apron when working with glassware and chemicals.

Thinking about the Question

Manufacturers of beauty products such as cleansers, soaps, and shampoo, often advertize that their products are "pH balanced," or made for the pH of one gender while still being effective for the other gender. You have probably heard of the pH scale before, and you may even know that it is used to classify substances by how acidic or how basic they are. You may have already learned that pure water is considered neutral on the pH scale, with a pH of 7.

Discuss with your lab group members what types of products are commonly found around the home that may be classified as acids or bases. Do any of the substances feel slippery or soapy or taste bitter? Do any taste any sour? Categorize each of the products you list according to how they are used — for example, are they household cleaners, cosmetics, medicine, or food?

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In humans, the blood typically has a pH of about 7.4, while saliva normally has a pH of between 6.0 and 7.4. Like most living organisms, our bodies are able to stay healthy only when their pH remains within a narrow range. Discuss with your lab group members why some household chemicals may be dangerous to humans and pets. Be prepared to share your ideas with the class.

Sequencing Challenge

The steps below are part of the Procedure for this lab activity. They are not in the right order. Determine the proper order and write numbers in the circles that put the steps in the correct sequence.

				
Obtain and label four samples of household chemicals.	Make certain that each member of your lab group is familiar with the safety rules and procedures for this activity.	Remove the pH sensor electrode from the storage bottle of buffer solution, setting the bottle safely aside.	Using the wash bottle and empty beaker, rinse the electrode of the pH sensor after measuring the pH of a sample.	Record pH data for one of the samples of household chemicals.

Investigating the Question

Note: When you see the symbol "♦" with a superscripted number following a step, refer to the numbered Tech Tips listed in the Tech Tips appendix that corresponds to your PASCO data collection system. There you will find detailed technical instructions for performing that step. Your teacher will provide you with a copy of the instructions for these operations.

Part 1 – Making predictions

1. Observe each of your samples of household chemicals. Check with your teacher to see if you may safely smell any of the chemicals, and if so, carefully waft the sample toward your nose to check for odors. Note your observations in the space below:

2. Based on your observations of your chemical samples, predict which are acids and which are bases.

Part 2 – Measuring the pH of household chemicals

3. Start a new experiment on the data collection system. ♦^(1.2)
4. Connect the pH sensor to the data collection system. ♦^(2.2)
5. Display pH data in a digits display. ♦^(7.3.1)
6. Remove the storage bottle from the pH sensor tip, and set the bottle aside.
7. Rinse the pH sensor with distilled water, over the empty beaker. This beaker will hold waste rinse-water.
8. Place the pH sensor into the first sample of household chemical.
9. Use the pipet to add several drops of red cabbage indicator solution to the sample. Record the color change, if any, in the data table at the end of this section.
10. Start data recording. ♦^(6.2)
11. Wait until the reading has stabilized and then stop recording. ♦^(6.2) Write the pH of this chemical sample in the data table at the end of this section.
12. Rinse the pH sensor with distilled water.

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13. Place the pH sensor into the second sample of household chemical.
14. Use the pipet to add several drops of red cabbage indicator solution to the sample. Record the color change, if any, in the data table at the end of this section.
15. Start data recording. ♦^(6.2)
16. Wait until the reading has stabilized and then stop recording. ♦^(6.2) Write the pH of this chemical sample in the data table at the end of this section.
17. Rinse the pH sensor with distilled water.
18. Place the pH sensor into the third sample of household chemical.
19. Use the pipet to add several drops of red cabbage indicator solution to the sample. Record the color change, if any, in the data table at the end of this section.
20. Start data recording. ♦^(6.2)
21. Wait until the reading has stabilized and then stop recording. ♦^(6.2) Write the pH of this chemical sample in the data table at the end of this section.
22. Rinse the pH sensor with distilled water.
23. Place the pH sensor into the fourth sample of household chemical.
24. Use the pipet to add several drops of red cabbage indicator solution to the sample. Record the color change, if any, in the data table at the end of this section.
25. Start data recording. ♦^(6.2)
26. Wait until the reading has stabilized and then stop recording. ♦^(6.2) Write the pH of this chemical sample in the data table at the end of this section.
27. Put the pH sensor tip back into the storage bottle.
28. Dispose of your chemical samples and rinse water according to your teacher's instructions.

Table 1: pH measurements

Sample	pH	Indicator Color
1		
2		
3		
4		

Answering the Question

Analysis

1. How do your results compare to your prediction? Are your results close to what you expected? Why or why not?

2. Review your pH data. What was the range between the highest and lowest pH factors of your household chemical samples? How did you calculate this range?

3. Which household chemical substance tested had a pH closest to that of your skin (remember that human blood typically has a pH of about 7.4)? What was the pH of this sample? If you do not already know, ask what this household chemical is and include this information in your answer.

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4. The pH scale is organized by powers of ten. This means that a substance with a pH factor of 8 is ten times more basic than a neutral substance with a pH of 7. Likewise, a substance with a pH of 6 is ten times more acidic than the neutral substance. Did you test any samples that were more than 1000 times as acidic or as basic as distilled water? If so, which substances were they?

Key Term Challenge

Fill in the blanks from the randomly ordered words below. Not all words may be used; some words may be used more than once:

acids	bases	neutral	10
100	1000	distilled water	red cabbage
factor	sour	soap	7
5	Indicator solution	14	lemon juice

1. The pH scale goes from zero to 14, with a pH of _____ indicating that a substance is neither an acid nor a base.
2. A substance is considered _____ if it is neither acidic nor basic.
3. Rinsing the pH sensor with _____ between measurements helps prevent contamination of a sample with substances from previous measurements.
4. Foods such as vinegar and citrus that have a _____ taste are often classified as _____ because they have pH numbers below _____.
5. A chemical sample with a pH of 2 is _____ times more acidic than a substance with a pH of 4.
6. Each pH number is larger than the previous pH number by a _____ of ten.
7. A/an _____ changes color in the presence of acids or bases.

8. A mixture made of distilled water and _____ may have a pH factor of 4.5.
9. _____ turns magenta in the presence of _____ and turns green in the presence of _____.
10. A substance with a pH of _____ would be unsafe for humans or animals to get on their skin.

