

Date \_\_\_\_\_ Name \_\_\_\_\_  
Section \_\_\_\_\_ Team \_\_\_\_\_  
Instructor \_\_\_\_\_

## Pre-Lab Study Questions

1. How is the pH of a solution related to the  $[\text{H}_3\text{O}^+]$ ?
2. Using the equation for  $K_w$ , explain how  $[\text{OH}^-]$  changes when more  $\text{H}_3\text{O}^+$  is added.
3. Is a solution with a pH of 12.0 acidic or basic?
4. Is a solution with a pH of 2.0 acidic or basic?
5. What is a buffer?
6. If you add acid or base to water, how will the pH change?
7. If you add acid or base to a buffer, how will the pH change?

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## REPORT SHEET

# Acids, Bases, pH, and Buffers

## A. Reference Colors for pH Using Red Cabbage Indicator

pH	Colors of Acidic Solutions
1	red
2	light red
3	light pink
4	pink
5	light purple
6	purple

pH	Colors of Basic Solutions
8	light blue
9	dark blue
10	dark blue
11	dark green
12	light green
13	yellow

pH	Color of Neutral Solution
7	violet / blue

## B. Measuring pH

Substance	1. Color with Indicator	2. pH Using Indicator	3. pH Using pH Meter	4. Acidic, Basic, or Neutral?
<b>Household cleaners</b>				
vinegar	light red	2	2	
ammonia	light blue	8	8	
<b>Drinks, juices</b>				
lemon juice	light pink	3	3	
apple juice	light pink	3	3	
<b>Detergents, shampoos</b>				
shampoo	light purple	5		
detergent	light blue	8		
hair conditioner	light blue	8		
<b>Health aids</b>				
mouthwash	violet / blue	7		
antacid	light blue	8		
aspirin	pink	4		

Other items				

## Questions and Problems

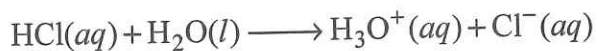
Q1 Complete the following table:

$[\text{H}_3\text{O}^+]$	$[\text{OH}^-]$	pH	Acidic, Basic, or Neutral?
$2.0 \times 10^{-6}$	$5 \times 10^{-9}$	5.70	
$6.6 \times 10^{-10}$	$6.3 \times 10^{-5}$	9.8	
$2.9 \times 10^{-12}$	$3.5 \times 10^{-3}$	11.5	
$10^{-7}$	$10^{-7}$	7	Neutral

Q2 A solution has a  $[\text{OH}^-] = 4.0 \times 10^{-5}$  M. What are the  $[\text{H}_3\text{O}^+]$  and the pH of the solution?

$$\text{H}^+ = \frac{10^{-14}}{4 \times 10^{-5}} = 2.5 \times 10^{-10}$$

$$\text{pH} = 9.60$$

Q3 A sample of 0.0084 mol of HCl is dissolved in water to make a 1500-mL solution. Calculate the molarity of the HCl solution, the  $[\text{H}_3\text{O}^+]$ , and the pH. For a strong acid such as HCl, the  $[\text{H}_3\text{O}^+]$  is the same as the molarity of the HCl solution.

$$\frac{0.0084}{1500} \times 1000 = 5.6 \times 10^{-3} \text{ M}$$

$$\text{pH} = 2.25$$

## C. Effect of Buffers on pH

### C.1 Effect of adding acid

Solution	1. Initial pH	2. pH after 5 drops of HCl	3. pH after 10 drops of HCl	4. pH change	5. Buffer yes or no?
H <sub>2</sub> O	6.5	1.3	1.1	5.4	No
0.1 M NaCl	6.2	1.4	1.1	5.1	No
High pH buffer	10	9.6	9.4	0.6	Yes
Low pH buffer	4	3.8	3.7	0.3	Yes

### C.2 Effect of adding base

Solution	1. Initial pH	2. pH after 5 drops of NaOH	3. pH after 10 drops of NaOH	4. pH change	5. Buffer yes or no?
H <sub>2</sub> O	6.5	12.7	13	6.4	No
0.1 M NaCl	6.2	12.6	13	6.8	No
High pH buffer	10	10.2	10.3	0.3	Yes
Low pH buffer	4	4.3	4.4	0.4	Yes

### Questions and Problems

**Q4** Which solution(s) showed the greatest change in pH? Why?

**Q5** Which solutions(s) showed little or no change in pH? Why?

**Q6** Normally, the pH of the human body is fixed in a very narrow range between 7.35 and 7.45. A patient with an acidotic blood pH of 7.3 may be treated with an alkali such as sodium hydrogen carbonate. Why would this treatment raise the pH of the blood?