

Ph and buffer solutions



**ASSIGN
BUSTER**

Saint Louis University Madrid Campus Introduction to Chemistry II Laboratory
Session Report Spring 2010 Yolatl Ruiz de Gordo Ph. D.

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Solutions ! Ruiz de Gordo, Yolatl Abstract: This lab session objectives were
to learn how to measure the pH of a solution and to understand the operation
of buffer systems. The measurements of pH were correctly performed and
the experimental values achieved agreed with the expected by the theory,
therefore, the speed reducing effect of buffer solutions was proven.

Introduction: The experiment was based upon the Bronsted-Lowry theory,
which is an acid-base theory, proposed independently by Johannes Nicolaus
Bronsted and Thomas Martin Lowry in 1923. In this system, Bronsted acids
and Bronsted bases are defined, by which an acid is a molecule or ion that is
able to lose, or " donate" a hydrogen cation (proton, H⁺), and a base is a
species with the ability to gain or " accept" a hydrogen cation (proton). Thus,
the general formula for acid-base reactions according to the Bronsted-Lowry
definition is: $AH + B \rightleftharpoons BH^+ + A^-$ Applying this, to the element HCl used in
the experiment: HCl (acid) + H_2O (base) H_3O^+ (acid) + Cl^- (base) This can
be described by an acid dissociation constant, pK_a : Which plays an essential
role in the Henderson-Hasselbalch equation used to know the pH of the
solution: "Experiment No. 10! ! Ruiz de Gordo, Yolatl Buffer solutions are
aqueous solutions consisting of a mixture of a weak acid and its conjugate
base or a weak base and its conjugate acid.

They have the property that the pH of the solution changes very little when a
small amount of strong acid or base is added to it. Buffer solutions are used
as a means of keeping pH at a nearly constant value in a wide variety of

chemical applications. Many life forms thrive only in a relatively small pH range; an example of a buffer solution is blood. pH meters are electronic instruments used to measure the pH (acidity or alkalinity) of a liquid. To perform a precise work the pH meter should be calibrated before and after each measurement. For normal use calibration should be performed at the beginning of each day. Calibration should be performed with at least two standard buffer solutions that span the range of pH values to be measured.

For general purposes buffers at pH 4 and pH 10 are acceptable. The pH meter has one control (calibrate) to set the meter reading equal to the value of the first standard buffer and a second control (slope) which is used to adjust the meter reading to the value of the second buffer. The calibration process correlates the voltage produced by the probe (approximately 0.06 volts per pH unit) with the pH scale. After each single measurement, the probe is rinsed with distilled or deionized water to remove any traces of the solution being measured, blotted with a clean tissue to absorb any remaining water which could dilute the sample and thus alter the reading, and then quickly immersed in another solution. When not in use, the probe tip must be kept wet at all times.

It is typically kept immersed in an acidic solution of around pH 3.0. In an emergency, acidified tap water can be used, but distilled or deionized water must never be used for longer-term probe storage as the relatively ionless water “sucks” ions out of the probe through diffusion, which degrades it. Experiment No. 10! Experimental: ! Ruiz de Gordo, Yolal! The pH of solutions 1 M HCl, 0.

1 M acetic acid, 0.1 M sodium acetate, 0.1 M sodium bicarbonate, 0.

1 M ammonia and 0.1 M NaOH were measured. Then, using the pH meter as instructed, 0.1 M sodium bicarbonate, 0.1 M sodium acetate and 0.

1 M ammonia were measured. Afterwards, two solutions of 5 ml 0.1 M acetic acid and 5 ml 0.

1 M sodium acetate and two solutions of 1 ml 0.1 M acetic acid and 10 ml 0.1 M sodium acetate were prepared and its pH recorded. Finally, one of each kind and a 5 ml distilled water solution were added each 0.5 ml 0.1 M HCl, measuring the pH afterwards.

The same was performed with the remaining solutions plus 5 ml distilled water solution adding them 0.5 ml of 0.1 M NaOH. Further detail is available on the lab manual.

Results: pH of solutions 0.1 M HCl 0.1 M acetic acid 0.1 M sodium acetate 0.1 M sodium bicarbonate 0.1 M ammonia 0.

1 M NaOH Buffer system A 5 ml 0.1 M acetic acid + 5 ml 0.1 M sodium acetate 0.5 ml 0.

1 M HCl addition 0.5 ml 0.1 M NaOH addition by pH paper 0-1 4-5 7 8-9 11 13 by pH meter not done 3 9.2 8.

4 9.8 11.3 pH 4.

7 4.5 4.8"Experiment No. 10! Ruiz de Gordo, YolatlBuffer system B 1 ml 0.1 M acetic acid + 10 ml 0.1 M sodium acetate 0.

5 ml 0.1 M HCl addition 0.5 ml 0.1 M NaOH addition No buffer system

Distilled water 0.5 ml 0.1 M HCl addition 0.5 ml 0.

1 M NaOH addition Discussion: ! pH 6.6 1.1 11.2 pH 5.

3 3.2 7.1 The data seems to conclude that the best buffer system in resisting a change in the pH is the 5 ml 0.1 M acetic acid + 5 ml 0.1 M sodium acetate. It varied less than system B. Also, it can be concluded that pH measuring is more accurate with the pH meter instead of the pH paper, which in many occasions had a middle color, and the team was unable to decide where in the scale it stood. This did not affect the experiment since only in the first part was pH paper used.

Water proved to be quite a bad buffer system and from the data it does not seem to fit the definition of buffer system. Since it did not slow the change in acidity or alkaline conditions. The expected values can be seen in the following table: Buffer System A B 4.75 5.75 Normal HCl Addition 3.86 4.5 NaOH addition 4.8 5