
EXPERIMENT 7
pH OF ACID, BASE AND SALT SOLUTIONS
PART II

PURPOSE:

To identify three unknown acid, base or salt solutions from the pH values of their solutions, obtained by the use of indicators and/or a pH meter.

PRINCIPLES:

Distinguishing between an acidic or basic solution is often easily achieved by the use of common indicators, such as litmus paper and phenolphthalein, if the pH of the solution range is between specific pH values.

The main use of these indicators is to test whether a solution is acidic or basic. However these indicators do not distinguish between strong and weak acids or bases. Furthermore, often they are not useful in distinguishing between acidic or basic solutions of salt solutions.

For an accurate identification of unknown solutions based on pH values, a pH measurement with a correctly calibrated pH meter is required. The rationale is as follows:

1. If the indicators identified the unknown(s) as being acidic, the pH meter needs to be calibrated for the acidic range:
First: calibration with a pH= 7.01 buffer Next: calibration with a pH = 4.01 buffer
2. If the indicators identified the unknown(s) as being basic, the pH meter needs to be calibrated for the basic range:
First: calibration with a pH= 7.01 buffer Next: calibration with a pH = 10.01 buffer
3. If the indicators did not identify the unknown(s) as either being acidic, or basic the type of pH calibration needs to be determined by the use of a Universal Indicator.
A Universal Indicator is a pH indicator composed of a solution of several compounds that exhibits several smooth color changes over a range of pH values (from 1-14).

PROCEDURE:

Your unknowns will be issued to you only after you have turned in to your laboratory instructor the Report Form for Experiment 7, PART I

You may work with your lab partner on the tests performed on the known solutions, but you are required to do the testing and the identification of the three unknown solutions individually.

PART A: CHECK OUT YOUR THREE UNKNOWN SOLUTIONS

Record the numbers of your unknowns on the check-out sheet and in your laboratory notebook. Your unknowns are randomly assigned from the following choices:

1.	Hydrochloric acid	HCl(aq)	0.10 M
2.	Acetic acid	HC₂H₃O₂(aq)	0.10 M
3.	Ammonium chloride	NH₄Cl(aq)	0.10 M
4.	Sodium acetate	NaC₂H₃O₂(aq)	0.10 M
5.	Aqueous ammonia	NH₃(aq)	0.10 M
6.	Sodium hydroxide	NaOH(aq)	0.10 M

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PART B: TESTING WITH INDICATORS

1. Determining Acidity/Basicity with Blue/Red litmus paper and Phenolphthalein.

- **Prepare your Chemplate for the Indicator Testing of twelve solutions (six known solutions and six unknown solutions/two students).**
 - Dispense the six known solutions into six depressions of the Chemplate. The known solutions are available in dispenser bottles.
 - Dispense the six unknown solutions (three unknown solutions/student) into the remaining depressions of the Chemplate. The unknown solutions are provided in vials. To dispense the unknown solutions from the vials, onto the depressions of the Chemplate, you may use disposable plastic droppers (if available), or a hollow glass tube.
Be aware that contamination of the solutions in the depressions of the Chemplate or the contents of the vials will compromise your observations and the correct identification of your unknowns.

- **Blue and Red Litmus Test.**
 - Lay twelve pieces of both red and blue strips of litmus paper on a piece of clean dry paper towel. Using the dispenser bottles and/or disposable plastic droppers (if available), or a hollow glass tube, or a glass rod, transfer one or several drops of each solution on both kinds of litmus paper. You may not use the same disposable plastic dropper when switching from one solution to another. If you use a hollow glass tube or a glass rod for transfer, make sure you wash them very well before switching from one solution to another.
 - Observe the color changes (if any) and record them it in your Laboratory Notebook.

- **Phenolphthalein Test.**
 - Add two to three drops of phenolphthalein solution to each of the twelve solutions to be tested.
 - Observe the color changes (if any) and record them it in your Laboratory Notebook.

- **Wrapping up Part B.1 of the experiment.**
 - Discard the solutions from the Chemplate.
 - Wash the Chemplate and put it away in your locker.
 - Make sure you keep your three unknown solutions in the vials. You will need these solutions for PART B.2 and Part C of the experiment..

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2. pH determination with Universal pH Indicator Paper.

- You will need twelve strips of Universal pH Indicator Paper for a team of two students (six known solutions and six unknown solutions/two students).

This test should not be performed on paper towel since the chemicals used in the manufacturing of paper used for paper towels react with the Universal Indicator and give false results.

- Prepare a glass or plastic surface that you will use to perform pH tests using the Universal pH Indicator Paper
 - You may use watch glasses or the bottom of inverted beakers
 - Your instructor may be able to provide you with a convenient surface for this test.
- Lay twelve strips of Universal pH Indicator paper on a clean and dry glass or plastic surface.

A color change will occur upon the addition of each solution to the Universal pH Indicator paper. Since this color is unstable and changes in time, it is advisable to test, observe and record the findings, one solution at a time.

- Using disposable plastic droppers (if available) or a hollow glass tube sweep, one by one, all areas of the Universal pH Indicator Paper strip with the twelve solutions. A color change will immediately be noticed.
- The colors on all areas of the test strip will match one of the color set corresponding to a specific reference pH on the box of the Universal pH Indicator Paper box (see below)



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- Observe and record the pH values obtained by matching the color on the strip of the Universal pH Indicator Paper with the reference colors (see previous page)
 - Normally the pH values obtained by this test are recorded as integers.
 - However, if the color on the test strip appears to be between two reference colors, you may wish to record a half-way value (such as 3.5 or 5.5 or 8.5)

PART C: pH MEASUREMENTS with pH meter.

1. Buffers

You will use the three buffer solutions (pH = 4.01, pH = 7.01 and pH = 10.01), stored in your locker in plastic test tubes.

2. pH measurements of the Known Solutions:

You may do this part with your partner.

- **Prepare six shell vials to measure the pH of the six known solutions.**
 - Wash, rinse with D.I. water and drain off the D.I water from the vials.
 - Label the six vials.
 - Deliver about 10 mL of the known solutions into each of the six labeled shell vials.
- **Taking the pH measurements.**

Recall that, prior to taking a pH measurement, you need to calibrate the pH meter by using the buffer solutions whose pH values are in close range with the pH (acidic or basic) of the solution, whose pH is to be measured.

 - Calibrate first your pH meter for acidic range (7.01 followed by 4.01).
Measure and record the pH of all known acidic solutions
 - Calibrate next your pH meter for basic range. (7.01 followed by 10.01)
Measure and record the pH of all known basic solutions.

3. pH measurements of the assigned Unknown Solutions:

You are required to do this part individually

- Calibrate first your pH meter for acidic range (7.01 followed by 4.01).
Measure the pH of the unknown acidic solutions (if any), by immersing the pH electrode into the vial(s) containing the unknown acidic solutions (if any).
Record the pH
- Calibrate next your pH meter for basic range (7.01 followed by 10.01).
Measure the pH of the unknown basic solutions (if any), by immersing the pH electrode into the vial(s) containing the unknown basic solutions (if any)
Record the pH.
- **IDENTIFY YOUR UNKNOWNNS.**

4. Wrapping up PART C of the experiment.

- Keep your buffer solutions in your locker in tightly capped plastic test tubes.
The buffer solutions will be used for the next experiment.
- Your laboratory instructor will instruct you how to store the pH meters.

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REPORT FORM

NAME: _____ PARTNER: _____ Date: _____

	Color with Blue Litmus paper (RED or N.C)	Color with Red Litmus paper (BUE or N.C.	Color with phenolphthalein solution (COLORLESS or PINK)	pH Universal Indicator Paper	Calibration of pH meter 7/4 or 7/10	pH Experimental Value (measured with pH meter)	pH Calculated (Theoretical) Value
HC₂H₃O₂(aq) 0.10 M							
NaC₂H₃O₂(aq) 0.10 M							
HCl(aq) 0.10 M							
NH₃(aq) 0.10 M							
NaOH(aq) 0.10 M							
NH₄Cl(aq) 0.10 M							
Unknown # 761 0.10 M							
Unknown # 738 0.10 M							
Unknown # 728 0.10 M							

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UNKNOWN # _____ is _____ (formula)

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