
EXPERIMENT 8
pH of Acid, Base and Salt Solutions
PART I

PURPOSE:

To determine experimentally the pH of several acids, base and salt solutions with the aid of a pH meter and to compare the experimentally determined values with the theoretical, calculated pH values.

PROCEDURE:**I. Determining the required calibration of the pH meter.**

Measure and record the pH of each of the following solutions, by using Universal Indicator Paper.

1.	Hydrochloric acid	HCl(aq)	0.010 M
2.	Acetic acid	HC ₂ H ₃ O ₂ (aq)	0.010 M
3.	Ammonium chloride	NH ₄ Cl(aq)	0.010 M
4.	Sodium acetate	NaC ₂ H ₃ O ₂ (aq)	0.010 M
5.	Aqueous ammonia	NH ₃ (aq)	0.010 M
6.	Sodium hydroxide	NaOH(aq)	0.010 M

II. Experimental determination the pH of the solutions by using a pH meter.

- Make sure you have properly calibrated your pH meter before taking the measurements.
- Use clean and carefully rinsed large test tubes (18 mm x 150 mm) for each measurement
- You will need 15 mL of each solution for a pH measurement.
- Measure the pH of the six solutions and record your data

III. Calculation of the theoretical values of the pH values for each solution

- Calculate and record the expected pH of each of these solutions by using appropriate equilibrium constants, where appropriate.

IV. Error Analysis

- Compare your measured, experimentally determined pH values with those calculated.

Calculate the Percent Error in each case and express it to the appropriate number of significant figures.

Recall:

$$\% \text{ Error} = \frac{\text{Experimental Value} - \text{Theoretical Value}}{\text{Theoretical Value}} \times 100$$

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REPORT FORM

NAME: _____ Date: _____ Partner: _____

	Solution tested	CONC.	pH Theoretical (Calculated)	Calibration of pH meter 7/4 OR 7/10	pH Experimental (Measured) Record readings to the nearest 0.01 value.
1	HCl(aq)	0.010 M			
2	HC ₂ H ₃ O ₂ (aq)	0.010 M			
3	NH ₄ Cl(aq)	0.010 M			
4	NaC ₂ H ₃ O ₂ (aq)	0.010 M			
5	NH ₃ (aq)	0.010 M			
6	NaOH(aq)	0.010 M			

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Note: 1. All measured pH values should be recorded to the nearest ± 0.01 pH unit.
2. Use $K_w = 1.00 \times 10^{-14}$

1. 0.010 M HCl

Measured Value: pH =

Calculated Value: pH =

% Error:

Show calculations below:

2. 0.010 M HC₂H₃O₂ ($K_a = 1.75 \times 10^{-5}$)

Measured Value: pH =

Calculated Value: pH =

% Error:

Include Equilibrium Table and show ALL calculations below:

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3. 0.010 M NH₄Cl (K_b of NH₃ = 1.77×10^{-5})

Measured Value: pH =

Calculated Value: pH =

% Error:

Include Equilibrium Table and show ALL calculations below:

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4. **0.010 M NaC₂H₃O₂** (K_a of HC₂H₃O₂ = 1.75 x 10⁻⁵)

Measured Value: pH =

Calculated Value: pH =

% Error:

Include Equilibrium Table and show ALL calculations below:

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5. **0.010 M NH₃ (K_b = 1.77 x 10⁻⁵)**

Measured Value:

pH =

Calculated Value:

pH =

% Error:

Include Equilibrium Table and show ALL calculations below:

:

6. **0.010 M NaOH**

Measured Value:

pH =

Calculated Value:

pH =

% Error:

Show calculations below:

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PART II

PURPOSE:

To identify three unknown acid, base or salt solutions from their electrolyte character and the experimentally determined pH measurements.

PROCEDURE:**NOTE:**

Your unknowns will be issued to you only after you have turned in to your laboratory instructor the Report Form for Experiment 8, PART I

I. Check out your three unknowns.

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)	0.010 M
2.	Acetic acid	HC ₂ H ₃ O ₂ (aq)	0.010 M
3.	Ammonium chloride	NH ₄ Cl(aq)	0.010 M
4.	Sodium acetate	NaC ₂ H ₃ O ₂ (aq)	0.010 M
5.	Aqueous ammonia	NH ₃ (aq)	0.010 M
6.	Sodium hydroxide	NaOH(aq)	0.010 M

The random assignment of your unknowns implies that:

- the three unknowns may be different from each other, OR
- two unknowns may be identical and different from the third one OR
- the three unknowns may be identical.

II. Perform the tests indicated below, in the order listed, for the known solutions and for your three unknowns and enter

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your observations and measurements in the table provided.

1. Electrolyte Character

Use a spot plate and a conductivity tester to determine the electrolyte character of the solution.

2. Phenolphthalein Test

Use the same depressions of the spot plate to perform the phenolphthalein test

3. pH measurements

- For the known solutions:
Immerse the pH electrode in a 18 mm x 150 mm test tube or a vial containing sufficient solution for a pH measurement.
- For the unknown solutions:
Immerse the pH electrode directly in the vial in which the unknown is provided

III. Identify your three unknowns

See Report Form on page 3

REPORT FORM

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PART II

NAME: _____ Date: _____

Note: This experiment is performed individually

Conc.	Electrical Conductance (+) or (+/-) or (-)	Electrolyte Character SE or WE or NE	Color with phenolphthalein solution CLEAR OR PINK	pH Calculated Value	Acid/Base Character of Solution. ACIDIC OR BASIC OR NEUTRAL	Calibration of pH meter 7/4 OR 7/10	pH Experimental Value
HCl(aq)	0.010 M						
HC ₂ H ₃ O ₂ (aq)	0.010 M						
NH ₄ Cl(aq)	0.010 M						
NaC ₂ H ₃ O ₂ (aq)	0.010 M						
NH ₃ (aq)	0.010 M						
NaOH(aq)	0.010 M						
Unknown # _____	0.010 M						
Unknown # _____	0.010 M						
Unknown # _____	0.010 M						

CONCLUSIONS:

Unknown # _____ is _____

Unknown # _____ is _____

Unknown # _____ is _____