

UNIT 5 Virtual Lab

VIRTUAL LAB: Determination of the pH Scale by the Method of Successive Dilutions

We are pleased to announce a new HTML5 based version of the virtual lab. Please use Firefox or Chrome web browser to access this page, errors have been reported when using Internet Explorer.

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EN Method of Successive Dilutions

Stockroom

Solutions Glassware Tools

Distilled H₂O
Distilled Water
3.0 L

1M NaOH
1M Sodium Hydroxide
0.1 L

1M HCl
1 Molar Hydrochloric Acid
0.1 L

Workbench 1

Activate Windows
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11/4/2021

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Objective: It is common knowledge that neutral water has a pH of 7, acids have a pH less than 7 and bases have a pH greater than 7, but few people understand this in terms of the actual hydronium ion concentration. Our objective is to develop an understanding of logarithmic scales by developing a pH scale.

Background: The pH scale describes the hydronium ion concentration in aqueous systems:

$$\text{pH} = -\log[\text{H}_3\text{O}^+]$$
$$[\text{H}_3\text{O}^+] = 10^{-\text{pH}} = 1/10^{\text{pH}}$$

The Method of Successive Dilutions is an experimental technique for preparing a series of solutions of different concentrations from one volume of stock solution.

Procedure: Lets look at a series of half dilutions. With the virtual lab, fill 5 flasks with a constant amount of water (less than half the volume of the flask). For simplicity, we will use 20 ml, but any amount will do.

Virtual Lab Tip: You can right click on each flask and label it using the Rename menu item.

Now add the same amount of stock 1M HCl to the first flask (20 mL), and note that the concentration of [H₃O⁺] has been diluted in half with a value of 0.500M or 1/2 (1/2¹) the original molarity.

From this flask transfer 20 mL to the second flask and note the it has been diluted in half again; [H₃O⁺] = 0.250M or one fourth (1/2²) the concentration of the original stock solution.

Repeating this procedure with the remaining 3 flasks gives:

3rd dilution: [H₃O⁺] = 0.12500 or 1/8 (1/2³) the original stock molarity.

4th dilution: [H₃O⁺] = 0.06250 or 1/16 (1/2⁴) the original stock molarity.

5th dilution: [H₃O⁺] = 0.03125 or 1/32 (1/2⁵) the original stock solution.

In general: [H₃O⁺] = 1/2ⁿ where n is the number of successive dilutions.