

Worksheet 7.2

pH calculations

NAME:

CLASS:

INTRODUCTION

- The pH scale is used as a measure of the acidity or basicity of a solution. The scale is usually applied over the range 0 to 14 (but does extend beyond these values).
 - $\text{pH} = -\log_{10}[\text{H}_3\text{O}^+]$
 - pH is a logarithmic scale, so a difference of one unit on the pH scale means a ten-fold difference in the hydrogen ion concentration.
 - For dilute solutions at 25°C, $K_w = [\text{H}_3\text{O}^+] \times [\text{OH}^-] = 1 \times 10^{-14}$
 - In acidic solutions $[\text{H}_3\text{O}^+] > [\text{OH}^-]$ hence $[\text{H}_3\text{O}^+] > 1 \times 10^{-7}$ hence $\text{pH} < 7$ (at 25°C)
In neutral solutions $[\text{H}_3\text{O}^+] = [\text{OH}^-]$ hence $[\text{H}_3\text{O}^+] = 1 \times 10^{-7}$ hence $\text{pH} = 7$ (at 25°C)
In basic solutions $[\text{H}_3\text{O}^+] < [\text{OH}^-]$ hence $[\text{H}_3\text{O}^+] < 1 \times 10^{-7}$ hence $\text{pH} > 7$ (at 25°C)
- (Assume all the calculations below are for solutions at 25°C)

No.	Question	Answer
1	Calculate the hydronium ion concentration and the pH of a: a 0.10 mol L ⁻¹ HCl solution b 0.050 mol L ⁻¹ HNO ₃ solution.	
2	Calculate the hydroxide ion concentration and the pH of a: a 0.10 mol L ⁻¹ NaOH solution b 0.50 mol L ⁻¹ Ba(OH) ₂ solution.	
3	Calculate the hydronium ion and hydroxide ion concentrations in: a an ammonia cleaner with a pH of 11.0 b lemon juice with a pH of 2.3.	

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4	<p>Sulfuric acid is a strong diprotic acid. One student calculated the expected pH of a 0.10 mol L^{-1} H_2SO_4 solution to be 0.7, while another calculated it to be 1.0. The actual pH was found to be between these two values.</p> <p>a Show how a pH of 0.7 was calculated.</p> <p>b Show how a pH of 1.0 was calculated.</p> <p>c Explain why the actual pH was between the two calculated values.</p>	
5	<p>20.0 mL of a solution of pH 3.0 is diluted to produce a total volume of 200.0 mL. What is the pH of the resulting solution?</p>	
6	<p>What volume of water must be added to 50.0 mL of a hydrochloric acid solution of pH 2.0 to increase the pH to 2.5?</p>	
7	<p>List the following 1.0 mol L^{-1} solutions in order of decreasing pH. Give reasons for your order.</p> <p>NaOH, H_2O, NH_3, CH_3COOH, H_2SO_4, HNO_3</p>	
8	<p>25.0 mL of a solution of pH 5.0 is added to 25.0 mL of a solution of pH 6.0. What is the pH of the resultant solution?</p>	