

4. Dissociation constant (acidity constant) of formic acid

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Date of report submission (yyyy/mm/dd):_____

Dates of experiment (yyyy/mm/dd) 1st day: _____; 2nd day: _____

Write concisely (in the space provided)

【Summary of Experiment】

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There is a vertical margin line on the left side, creating a narrow left margin. The paper appears to be from a notebook or a standard ruled document.

【Results】

1. Preparation and standardisation of aqueous sodium hydroxide solution (Solution A)

NaCl / g			
No.	Potassium hydrogen phthalate / g	NaOH titre / cm ³	NaOH concentration / mol dm ⁻³
1			
2			
3			
		Mean	
		Ionic strength / mol dm ⁻³	

2. 0.5 mol L⁻¹ sodium chloride solution preparation

NaCl / g	NaCl concentration / mol

3. Preparation and standardization of dilute HCl solutions (B₁ ~ B₄)

NaCl / g			
No.	NaOH titre / cm ³	HCl concentration / mol	Ionic strength / mol dm ⁻³
B ₁			
B ₂			
B ₃			
B ₄			

4. pH meter calibration and construction of calibration curve for *h*

Note: The graph showing the calibration curve should be included as a separate sheet
(horizontal axis: *h*; vertical axis: pH)

	Standard pH buffer solution	Solution temperature / °C	pH value from the table
	Neutral phosphate		
	Phthalate		
No.	<i>h</i>	Solution temperature / °C	pH calculated from concentration
B ₁			
B ₂			
B ₃			
B ₄			

5. Titration curve

Note: The graph showing the titration curve should be included as a separate sheet
(horizontal axis: cumulative titre; vertical axis: pH)

No.	Titre / cm ³	<i>h</i>	Cumulative titre / cm ³	Temperature / °C	pH
1					
2					
3					
4					

5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
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39					
40					

6. Molar concentration of formic acid

	h	pH
Point A		
Point B		
Midpoint AB		
HCOOH conc. / mol dm ⁻³		
Ionic strength / mol dm ⁻³		

7. Dissociation constant of formic acid

No.	Cumulative titre / cm ³	pH	$-\alpha$	β
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
K_a / mol dm ⁻³				

【Questions】

1. Verify the extent to which ionic strength is maintained at 0.5 mol dm⁻³ for solutions A, B₁ ~ B₄, C.
2. Based on the calibration chart, comment on the relationship between h and pH at an ionic strength of 0.5 mol dm⁻³.
3. In equation 11, can the third terms in both the denominator and numerator, on the right hand-side, be ignored?
4. Does the measured K_a value agree with the literature value (3.28×10⁻⁴ mol dm⁻³ at 25 °C and an ionic strength of 0.5 mol dm⁻³)? If the value of $pK_a = -\log_{10}(K_a / \text{mol dm}^{-3})$ is within 0.1, it is quite good.
5. For Solution C, compare the H⁺ ion concentration calculated from K_a with that measured with the pH meter.
6. Look up the dissociation constant of formic acid in a data book (thermodynamic dissociation constant, 25 °C, ionic strength = 0) and explain any difference with the value observed in this experiment.
7. Explain why the H⁺ concentration at the half-equivalence point (half of the titre required to reach the equivalence point) is approximately equal to K_a . Compare the pK_a value with the pH value at the half-equivalence point to assess to what extent this relationship applies in the current experiment.