

	Application Note	No.TIQ-12348
Others	Acid dissociation constant of Sodium carbonate	Acid-Base titration

1. Abstract

The acid dissociation constant is defined as:

$$pK_a = pH - \log \frac{[B]}{[BH^+]}$$

$BH^+ \rightleftharpoons B + H^+$

[B]: Base (Brönsted's definition)
[BH⁺]: Acid

From this equation, it is known that pKa equals pH when [B] equals [BH⁺]. More precisely, [B] nearly equals [BH⁺] at this half-equivalence point, but the error is small in the range of pKa=3 to 11. Therefore, KEM regards the value of pH at this point as pKa.

pKa = The value of pH at the half-equivalence point on the titer to the endpoint

In this application note, the acid dissociation constant of the prepared 0.5mol/L Sodium carbonate sample was determined by titrating it with 1mol/L Hydrochloric acid by potentiometric titration method. (The endpoint of the titration is the maximal inflection point on the titration curve.)

2. Reference

"Progress of Organic Chemistry" Vol. 9, Kyoritsu Publishing Co., Ltd., Japan.

3. Equipment

Main unit : Automatic potentiometric titrator	AT-510
Detector : Standard preamplifier	STD-510
Combination glass electrode	C-173+ Cable #429-0012
Temperature compensation electrode	T-111

4. Reagent

Titration solution : 1mol/L Hydrochloric acid

5. Analysis Procedure

- 1) Place 5mL of sample in 200mL beaker.
- 2) Add pure water to make a total of 100mL solution.
- 3) Titrate with 1mol/L Hydrochloric acid to determine the acid dissociation constant.

6. Calculation

Acid dissociation constant (pKa) : CO1=PK1, CO2=PK2

7. Example of Measurement

–Ambient condition–

Room temperature: 22.5°C	Humidity: 47%	Weather: Cloudy
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–Titration parameter–

[Titration Parameter]	<Control>
Date : 2012/07/09 16:14	End Point No. : 2
Method No. : 14	End Sense : Auto
<Auto Titration>	End Point Area : Off
Method Name:	Separation : Off
Na2CO3	Over Titr.Vol. : 0.0mL
	Gain : 1
Method Type : Titration	Data Samp.Pot. : 4.0 mV
	Data Samp.Vol. : 0.5 mL
	Control Speed : Medium
<Titration>	<Calculation>
Form : EP STOP	Calc. Type : Sample
APB No. : 1	Conc.1 : Set
Unit No. : 1	CO1=PK1
Detector No. : 1	
Unit : pH	Unit : pKa
Max Volume : 20.00 mL	EP No. : 1
Wait Time : 0 s	Conc.2 : Set
Direction : Auto	CO2=PK2
[Control Parameter]	Unit : pKa
Date : 2012/07/09 16:14	EP No. : 2
Method No. : 14	Conc.3 : Off
<Auto Titration>	Conc.4 : Off
Method Name:	Conc.5 : Off
Na2CO3	Temp. Comp : Off
Titration Form : EP STOP	

–Titration curve–

** Result ***		
Sample No.	42-01	
Date :	2012/07/09 16:37	
Sample ID	: Na2CO3	
Method No.	: 14	
	<Auto Titration>	
Method Name :	Na2CO3	
Titration Time	: 00:05:41	
Size	:	5.0mL
CO1=	9.9360pKa	
CO2=	6.1244pKa	
End Point-1		
Volume	:	2.7115mL
Potential	:	7.91pH
pKa	:	9.93
End Point-1		
Volume	:	5.1689mL
Potential	:	3.97pH
pKa	:	6.12

–Results–

Run	Size (mL)	Vol. (mL)		pKa	
		EP1	EP2	0-EP1	EP1-EP2
1	5.0	2.7115	5.1689	9.9360	6.1244
2	5.0	2.6837	5.1683	9.9179	6.1043
3	5.0	2.6811	5.0597	9.9255	6.1641

Statistics		
	pK1	pK2
Mean	9.9265pKa	6.1309pKa
SD	0.0091pKa	0.0304pKa
RSD	0.0916%	0.4963%