

User's Manual

WTTR

Chemical Software

Win Titration

Acid-base Titrations Calculator for Windows



www.vaxasoftware.com

Ref.: WTTR

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Introduction

Win Titration is a Windows application for acid-base titration calculation.

We can perform strong/weak acid/base titrations choosing the appropriate pH indicator to obtain the table of results and the titration curve.

Note 1:

The shown indicator color is approximate.

Note 2:

Design and specifications are subject to changes without notice.

Terms of use

Vaxa Software will not be responsible for the direct or indirect damages or damages caused by the use or impossibility of use of this application, nor by the effects in the operation of other applications or the operating system.

Before the installation we recommended to make backup of your data and create a restoration point.

You will be able freely to evaluate the application shareware during the time that considers necessary. Passed this period of evaluation you would have or to register it or uninstall it.

To register the application, please see the option "REGISTER APPLICATION" in the help menu of the application.

After paying the registry rights you will receive by email the REGISTRATION KEY of the application. Once registered the application, it will be able to use the options that were disabled until that moment.

The REGISTRATION KEY is UNIQUE for EACH COMPUTER.

You can not use the same REGISTRATION KEY for multiple computers.

You can freely distribute unaltered copies of the installation system of the application to other users.

You cannot decompile the application nor use no type of reverse engineer for its analysis or modification.

You cannot use part or the totality of the application to create a new application.

CONFLICTS OF SHARED FILES:

VaxaSoftware not responsible for conflicts due to the incompatibility of shared files (*.dll, *.ocx and other files).

VaxaSoftware applications use shared files (*.dll, *.ocx and other files).

It is possible that the shared file exists and whether or not previously replaced by a different version during the installation of the VaxaSoftware application.

This can cause the VaxaSoftware application not work and/or a third party application that shares the same file does not.

Also the installation of a third party application can cause the application of VaxaSoftware or third party application does not work.

VaxaSoftware will try to resolve these conflicts in a reasonable manner, despite its satisfactory resolution is not guaranteed and in many cases may be impossible.

Description of parts

This application has three windows:

(1) **Input data** window.

Here we can:

Choose the titration type.

Enter the volume and concentration of titrant and analyte

Choose the indicator.

This window is shown when the application starts.

(2) **Table and results** window.

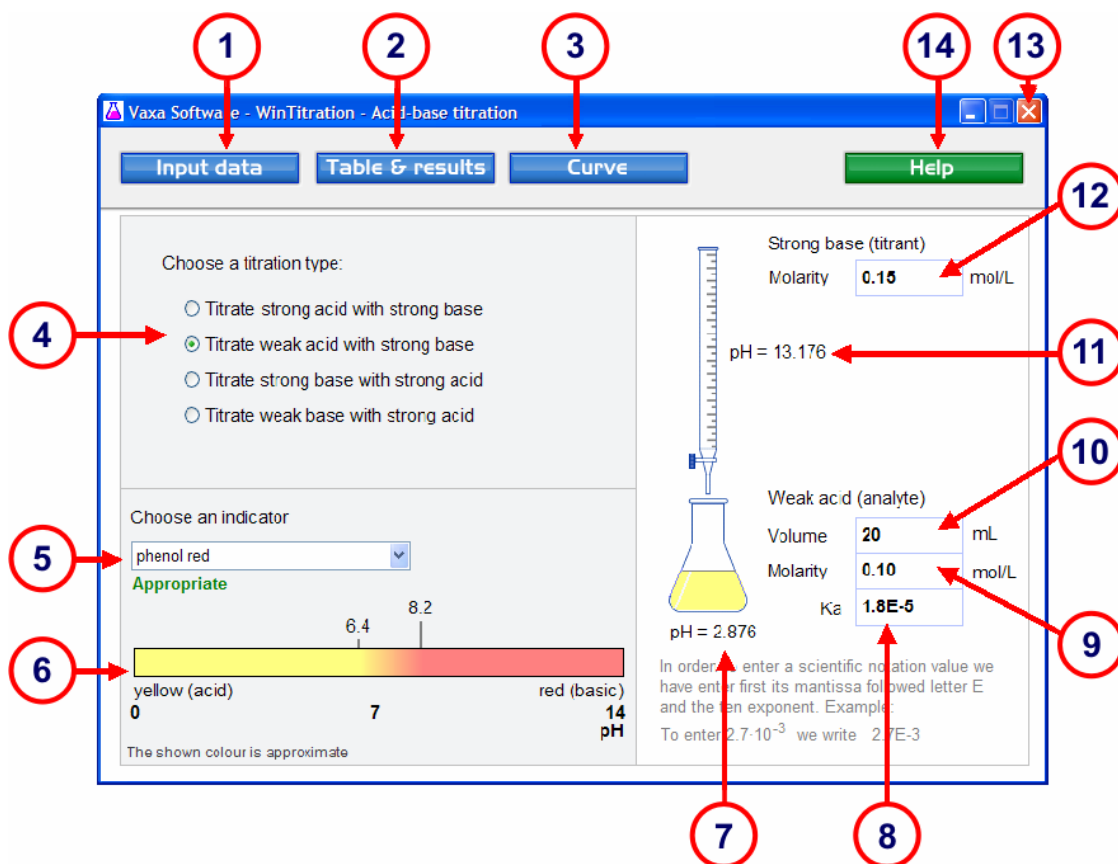
Shows the pH and volume of the equivalence point, range of pH and range of titrant volume when titration error < 1%.

$$\text{Titration Error} = \frac{|\text{current volume added} - \text{volume added at the equivalence point}|}{\text{volume added at the equivalence point}}$$

(3) **pH curve** window

Shows the graphic of pH versus titrant volume added, equivalence point and color indicator.

Input data window



(1) Input data button.

Shows the *Input data* window.

(2) Table and results button.

Shows the *Table and results* window.

(3) Curve button.

Shows the *titration curve* window.

(4) Titration type.

Allows us to choose the titration type:

- Titrant strong acid with strong base
- Titrant weak acid with strong base
- Titrant strong base with strong acid
- Titrant weak base with strong acid

(5) Indicator.

Allows us to choose the indicator

Indicators show change its color when pH changes.

(6) Indicator color.

Shows the indicator color in acid and basic environment.

(7) Initial analyte pH.

Shows us the initial pH of the analyte. The analyte is contained in an Erlenmeyer flask.

(8) Acidity/basicity constant of analyte.

Here we enter the acidity/basicity constant of the analyte (K_a / K_b).
This textbox is shown only if analyte is a weak acid/base.

(9) Molarity of analyte.

Here we enter the molarity of the analyte in mol/L.

(10) Volume of analyte.

Here we enter the volume of the analyte in mL contained in the Erlenmeyer flask.

(11) Titrant pH.

Shows us the pH of the titrant contained in the burette.

(12) Molarity of titrant.

Here we enter the molarity of the titrant in mol/L.

(13) Minimize and Close buttons.

Allow us to minimize and to close the application.

(14) Help button.

Shows us the following menus:

User's manual (PDF document)... menu

Shows this manual.

Application registration menu

Shows the registration form window to register the application.

Disabled functions in the unregistered version menu

Shows the list of disabled functions when the application is not registered.

Home page (www.vaxasoftware.com)... menu

Connects to VaxaSoftware home page.

An active Internet connection and a browser are required.

Make a donation... menu

Connects to VaxaSoftware donations page.

An active Internet connection and a browser are required.

About... menu

Shows the *Splash* window with the version and description of the application.

Table and results window

The screenshot shows the 'Table & results' window of the WinTitration software. The window title is 'Vaxa Software - WinTitration - Acid-base titration'. It has four buttons at the top: 'Input data', 'Table & results', 'Curve', and 'Help'. The main content is divided into two columns. The left column contains titration parameters, and the right column contains a table of values.

Titration of weak acid with strong base

Titrant (burette):
Strong base concentration 0.15 mol/L. pH = 13.18

Analyte (erlenmeyer flask):
20 ml of weak acid Concentration 0.1 mol/l pH = 2.88
Acidity constant $K_a = 1.8E-5$

Equivalence point:
Volume added 13.33 mL, pH = 6.762

Range of added titrant volume when error < 1%
[13.2 , 13.47] mL

Range of pH when error < 1%
[10.70 , 6.74]

Indicator:
phenol red [appropriate]
Colour change: yellow (acid) - red (basic)
pH range: [6.4 , 8.2]

Table of values (added Vol. [mL] and pH)

Vol.	pH
0.00	2.88
2.00	4.00
4.00	4.38
6.00	4.66
8.00	4.92
10.00	5.22
11.00	5.42
12.00	5.70
13.00	6.34
13.10	6.49
13.15	6.60
13.20	6.74
13.25	6.95
13.30	7.35
13.35	9.88
13.40	10.48
13.45	10.72
13.50	10.87
13.55	10.99
14.00	11.47
15.00	11.85

At the bottom of the table, there are two buttons: 'Copy' and 'Print'.

(15) Titration results.

- **Titration type.**
- **Titrant:** Concentration and pH of titrant acid/base contained in the burette.
- **Analyte:** Volume, molarity, initial pH, acidity/basicity constant.
- **Equivalence point:** Titrant volume added and pH
- **Range of added titrant volume when titration error < 1%**
- **Range of pH when titration error < 1%**
- **Indicator.** Indicator name, Color change acid/basic, pH range.

(16) Copy button.

Copies the results and table to the clipboard (text format).

(17) Print button.

Prints the results and table to the default printer.

When the mouse pointer is over the button, the default printer name is shown.

Note:

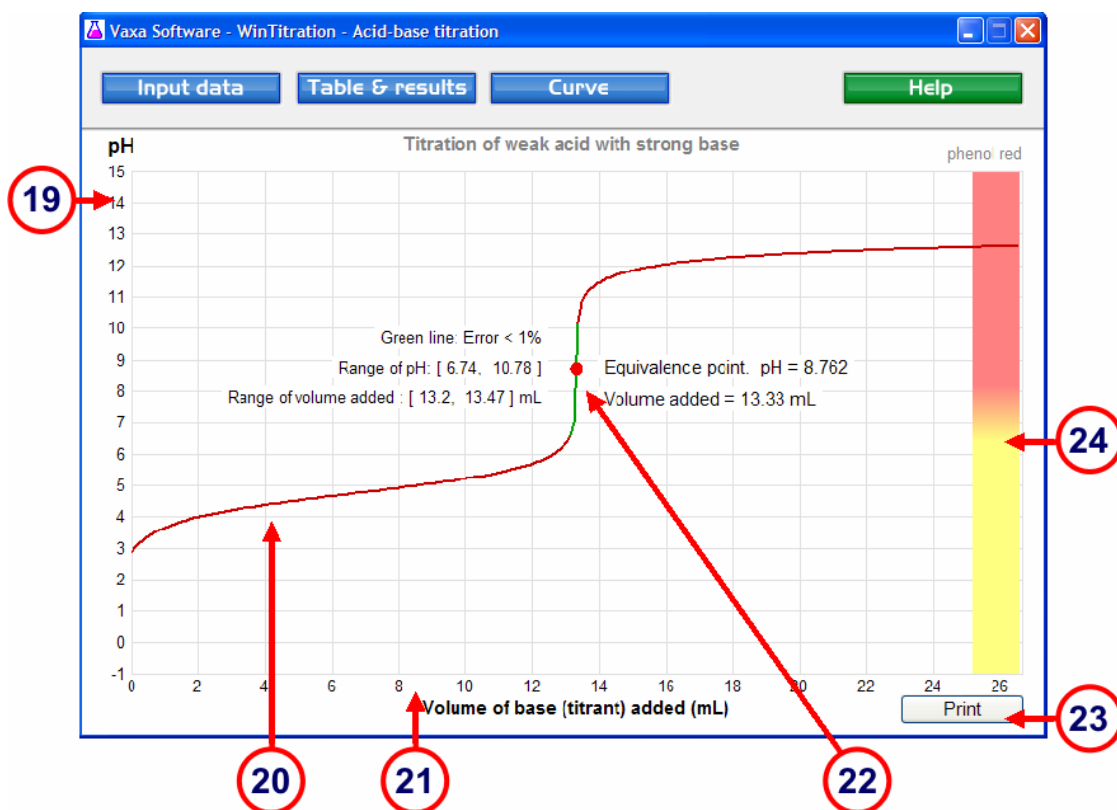
To change the default printer we can do it in the *Printers and Faxes* utility in the *Control Panel*.

(18) Volume versus pH table.

Shows us the titrant volume added in mL versus the pH.

The values are more abundant around the equivalence point (steps of 0.05 mL).

pH curve window



(19) pH scale.

Shows us the pH scale in the interval -1 ... 15.

(20) Titration curve.

Shows the curve of pH vs. titration volume added.

(21) Titrant volume added scale (mL).

(22) Curve when titration error < 1%.

This curve is shown in green color.

Here titration error < 1%

The equivalence point is shown as a red circle.

(23) Print button.

Prints the titration curve to the default printer.

When the mouse pointer is over the button, the default printer name is shown.

Note:

To change the default printer we can do it in the *Printers and Faxes* utility in the *Control Panel*.

(24) Change of the indicator color.

For each pH value the indicator color is shown.

Titration examples

Example 1: Titration of strong acid with strong base.

Calculate the table of results and the titration curve when we titrate 25 mL of hydrochloric acid (HCl) (analyte) of concentration 0.09 mol/L with sodium hydroxide (NaOH) (titrant) of concentration 0.10 mol/L. Indicator is phenolphthalein.

Process:

- a) Press the button.
- b) Choose the titration type: *Titrate strong acid with strong base*.
- c) Enter the *Strong base (titrant) Molarity*: 0.10 mol/L.
- d) Enter the *Strong acid (analyte) Volume*: 25 mL.
- e) Enter the *Strong acid (analyte) Molarity*: 0.09 mol/L.
- f) Choose the indicator: phenolphthalein.
- g) Press button to get the following results:

Titration of strong acid with strong base

Titrant (burette):

Strong base concentration 0.1 mol/L. pH = 13

Analyte (Erlenmeyer flask):

25 mL of strong acid. Concentration 0.09 mol/L. pH = 1.05

Equivalence point:

Volume added 22.5 mL, pH = 7

Range of added titrant volume when error < 1%

[22.27 , 22.72] mL

Range of pH when error < 1%

[10.67 , 3.32]

Indicator:

phenolphthalein [appropriate]

Color change: colorless (acid) - violet (basic)

pH range: [8.2 , 9.8]

Table of values (added Vol. [mL] and pH)

Vol.	pH	Vol.	pH
0.00	1.05	22.45	3.98
5.00	1.23	22.50	7.00
10.00	1.45	22.55	10.02
15.00	1.73	22.60	10.32
19.00	2.10	22.65	10.50
20.00	2.26	22.70	10.62
21.00	2.49	23.00	11.02
22.00	2.97	24.00	11.49
22.25	3.28	25.00	11.70
22.30	3.37	30.00	12.13
22.35	3.50	35.00	12.32
22.40	3.68	40.00	12.43

h) Press button to see the titration curve.

Example 2: Titration of weak acid with strong base.

Calculate the table of results and the titration curve when we titrate 20 mL of acetic acid (CH_3COOH) (analyte) 0.12 mol/L of concentration with sodium hydroxide (NaOH) (titrant) 0.10 mol/L of concentration.

Acidity constant of acetic acid $K_a = 1.80 \times 10^{-5}$. Indicator is phenol red.

Process:

- Press the button.
- Choose the titration type: *Titrate weak acid with strong base.*
- Enter the *Strong base (titrant) Molarity:* 0.10 mol/L.
- Enter the *Weak acid (analyte) Volume:* 20 mL.
- Enter the *Weak acid (analyte) Molarity:* 0.12 mol/L.
- Enter the *Weak acid (analyte) Ka:* 1.8E-5.
- Choose the indicator: phenol red.
- Press the button to get the following results:

Titration of weak acid with strong base

Titrant (burette):

Strong base concentration 0.1 mol/L. pH = 13

Analyte (Erlenmeyer flask):

20 mL of weak acid. Concentration 0.12 mol/L. pH = 2.84

Acidity constant $K_a = 1.8\text{E-}5$

Equivalence point:

Volume added 24 mL, pH = 8.741

Range of added titrant volume when error < 1%

[23.76 , 24.24] mL

Range of pH when error < 1%

[10.73 , 6.74]

Indicator:

phenol red [appropriate]

Color change: yellow (acid) - red (basic)

pH range: [6.4 , 8.2]

Table of values (added Vol. [mL] and pH)

Vol.	pH	Vol.	pH
0.00	2.84	23.95	7.42
5.00	4.17	24.00	8.74
10.00	4.60	24.05	10.06
15.00	4.97	24.10	10.36
20.00	5.44	24.15	10.53
21.00	5.59	24.20	10.66
22.00	5.79	25.00	11.35
23.00	6.11	26.00	11.64
23.75	6.72	30.00	12.08
23.80	6.82	35.00	12.30
23.85	6.95	40.00	12.43
23.90	7.12	45.00	12.51

i) Press button to see the titration curve.

Range for input and output values

Initial concentration x of titrant and analyte	mol/L	$10^{-6} \leq x \leq 10$
Volume x of analyte	mL	$2,5 \leq x \leq 600$
Volume x of titrant at the equivalence point	mL	$5 \leq x \leq 300$
Acidity/basicity constant x (K_a , K_b) of analyte		$10^{-14} < x < 1$
pH range x in titration curve		$-1 \leq x \leq 15$
Volume range x of titrant in titration curve	mL	$0 \leq x \leq 600$ Twice the titrant volume at the equivalence point
<i>Appropriate / Inappropriate</i> indicator criterion		An indicator is appropriate when the midpoint of its pH range falls within the interval around the equivalence point where titration error < 1%

Specifications

Description	Win Titration (WTTR) Windows application for acid base titration calculations.																												
Precision	Volumes: ± 0.01 mL. Tabulated pH values: ± 0.01 ± 0.001 for titrant pH, Initial analyte pH and Equivalence point pH Internal calculations use 16 digits mantissa.																												
Functions	12 Functions <ul style="list-style-type: none"> - Titrant pH - pH of initial analyte concentration - Titrant + analyte mix pH - Equivalence point pH - Titrant volume at the equivalence point - Range of titrant volume when error < 1% - Range of pH when error < 1% - Indicator color of initial analyte concentration - Indicator color gradient - <i>Appropriate / Inappropriate</i> indicator criterion - pH vs. titrate volume added table - pH vs. titrate volume added curve 																												
Titration types	4 Types <ul style="list-style-type: none"> - Strong acid with strong base titration * - Weak acid with strong base titration - Strong base with strong acid titration * - Weak base with strong acid titration * 																												
Indicators	27 Indicators <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">alizarin yellow R</td> <td>litmus</td> </tr> <tr> <td>bromophenol blue</td> <td>methyl violet</td> </tr> <tr> <td>bromothymol blue</td> <td>4-dimethylaminobenzol</td> </tr> <tr> <td>phenolphthalein</td> <td>(F) esculin</td> </tr> <tr> <td>m-cresol purple</td> <td>(F) beta-naphthylamina</td> </tr> <tr> <td>methyl orange</td> <td>(F) alpha-naphthylamina</td> </tr> <tr> <td>bromocresol purple</td> <td>(F) fluorescein</td> </tr> <tr> <td>congo red</td> <td>(F) eosin</td> </tr> <tr> <td>bromophenol red</td> <td>(F) eritrosine</td> </tr> <tr> <td>cresol red</td> <td>(F) acridine</td> </tr> <tr> <td>phenol red</td> <td>(F) umbelliferone</td> </tr> <tr> <td>methyl red</td> <td>(F) coumarin</td> </tr> <tr> <td>neutral red</td> <td>(F) beta-methylumbelliferone</td> </tr> <tr> <td>thymolphthalein</td> <td></td> </tr> </table>	alizarin yellow R	litmus	bromophenol blue	methyl violet	bromothymol blue	4-dimethylaminobenzol	phenolphthalein	(F) esculin	m-cresol purple	(F) beta-naphthylamina	methyl orange	(F) alpha-naphthylamina	bromocresol purple	(F) fluorescein	congo red	(F) eosin	bromophenol red	(F) eritrosine	cresol red	(F) acridine	phenol red	(F) umbelliferone	methyl red	(F) coumarin	neutral red	(F) beta-methylumbelliferone	thymolphthalein	
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neutral red	(F) beta-methylumbelliferone																												
thymolphthalein																													
Size	781 pixels x 580 pixels																												
Notes	(*) Only available in the registered version (F) Fluorescent indicator																												

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