*Experiment 2*

*(Titration Curves)*

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***Experiment date: 07/03/2011***

***Submission date: 14/03/2011***

**Objective:**

1) To measure the change of the ph of different acidic solutions by the titration of the acidic solution with different basic solutions**.**

2) To draw the corresponding different titration-curves; ph of the solution vs. ml of base added.

3) To learn how to find the equivalence-point for each titration curve.

4) To learn how to choose the correct indicator according to each titration- curve.

5) To learn how to find the Pka of a weak acid from the titration-curve.

**Theory:**

* + (SA & SB) HCl + NaOH → NaCl + H2O
  + (WA & SB) HAc + NaOH → NaAc + H2O
  + (SA & WB) HCl + NH4OH → NH4OH + H2O
  + (WA & WB) CH3COOH + NH4OH → CH3COOHNH4 + H2O

**Procedure:**

1) Titration of 0.2M HCL solution with 0.2M NaOH solution:

a) Pipette 20ml of HCL in 100ml beaker.

b) Add 20ml distilled water, fill burette with 0.2M NaOH.

c) Put magnetic bar in the beaker and put it on the stirrer.

d) Insert the PH meter electrodes (Note: do not break the electrodes by the magnetic bar.

e) Measure the PH at v=0 then add 1.00ml of NaOH and measure the PH, continue the adding of 1.00ml and measuring the PH.

f) When the added base is 17.00ml add 0.50ml and measure the PH, continue adding 0.50ml of the base until the end point reached.

g) Take 4 additional readings (1.00ml addition of base) after the end point reached.

2) Titration of 0.2M HAc solution with 0.2M NaOH solution.

a) Follow the same procedure as part 1 but pipet in the beaker 20ml of 0.2M HAc and burett fulled with 0.2M NaOH.

3) Titration of 0.2M NH3 solution with 0.2M HCL solution.

a) Follow the same procedure as part 1 but pipet in the beaker 20ml of 0.2M NH3 and buret filled with 0.2M HCL.

4) Titration of 0.2M HAc solution with 0.2M NH3 solution.

a) Follow the same procedure as part 1 but pipet in the beaker 20ml of 0.2M HAc and buret filled with 0.2M NH3

**equipments:**

a) Burette.

b) Pipette.

c) Acid-Base indicator.

d) PH meter.

e) 100ml Beaker.

table of data and results:

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***Table 1* :** (HCl/NaOH)  ***Table 2*:(HAC/NaOH)**

VHcl=20 ml VHAC=20 ml

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| V(ml) PH | |  | V(ml) PH | | |
| 0 | 1.40 |  | | 0 | 4.18 |  |  |
| 1 | 0.95 |  | | 1.5 | 4.44 |  |  |
| 2 | 0.92 |  | | 2 | 4.28 |  |  |
| 3 | 0.90 |  | | 3 | 4.59 |  |  |
| 4 | 0.90 |  | | 4 | 4.68 |  |  |
| 5 | 0.91 |  | | 5 | 4.88 |  |  |
| 6 | 0.96 |  | | 6 | 4.97 |  |  |
| 7 | 1.15 |  | | 7 | 5.05 |  |  |
| 8 | 1.18 |  | | 8 | 5.18 |  |  |
| 9 | 1.20 |  | | 9 | 5.28 |  |  |
| 10 | 1.24 |  | | 10 | 5.45 |  |  |
| 11 | 1.26 |  | | 11 | 5.70 |  |  |
| 12 | 1.35 |  | | 12 | 5.92 |  |  |
| 13 | 1.43 |  | | 12.5 | 6.05 |  |  |
| 14 | 1.49 |  | | 13 | 6.90 |  |  |
| 15 | 1.57 |  | | 13.5 | 10.46 |  |  |
| 16 | 1.80 |  | | 14 | 10.80 |  |  |
| 17 | 2.33 |  | | 14.5 | 10.95 |  |  |
| 17.5 | 3.30 |  | | 15 | 11.05 |  |  |
| 18 | 10.96 |  | | 15.5 | 11.19 |  |  |
| 19 | 11.58 |  | | 16 | 11.30 |  |  |
| 20 | 11.77 |  | | 16.5 | 11.44 |  |  |
| 21 | 11.93 |  | | 17 | 11.54 |  |  |
| 22 | 12.02 |  | | 17.5 | 11.70 |  |  |
|  |  |  | | 18 | 11.80 |  |  |
|  |  |  | | 18.5 | 11.90 |  |  |
|  |  |  | | 19 | 11.95 |  |  |
|  |  |  | | 19.5 | 12.04 |  |  |
|  |  |  | | 20 | 12.25 |  |  |

**Table 3 : NH3/HCl *Table 4 : HAC/NH3***

VNH3=20ml. VHAC=20ml

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| V(ml) PH | |  | V(ml) PH | | |
| 0 | 11.24 |  | | 0 | 3.6 |
| 1 | 10.81 |  | | 1 | 4.05 |
| 2 | 10.63 |  | | 2 | 4.35 |
| 3 | 10.32 |  | | 3 | 4.48 |
| 4 | 10.24 |  | | 4 | 4.59 |
| 5 | 10.13 |  | | 5 | 4.72 |
| 6 | 10.01 |  | | 6 | 4.80 |
| 7 | 9.89 |  | | 7 | 4.90 |
| 8 | 9.76 |  | | 8 | 4.96 |
| 9 | 9.67 |  | | 9 | 5.03 |
| 10 | 9.52 |  | | 10 | 5.11 |
| 11 | 9.42 |  | | 11 | 5.17 |
| 12 | 9.28 |  | | 12 | 5.23 |
| 13 | 9.11 |  | | 13 | 5.32 |
| 14 | 8.75 |  | | 14 | 5.39 |
| 15 | 4.5 |  | | 15 | 5.49 |
| 16 | 4.12 |  | | 16 | 5.52 |
| 17 | 3.37 |  | | 17 | 5.61 |
| 17.5 | 3.25 |  | | 17.5 | 5.67 |
| 18 | 3.14 |  | | 18 | 5.71 |
| 18.5 | 2.99 |  | | 18.5 | 5.76 |
| 19 | 2.82 |  | | 19 | 5.81 |
| 19.5 | 2.72 |  | | 19.5 | 5.87 |
| 20 | 2.65 |  | | 20 | 5.94 |

**Methods Of Calculation:**

1)\* For experiment –a- between HCl/NaOH

Graph1

\*For experiment –b- between HAC/NaOH

Graph 2

\*For experiment –c- between NH3/HCl.

Graph 3

\*For experiment –d- between HAC/NH3

Graph 4

**Method of Calculation:**

* + 1. Draw on a graph paper for each titration the pH value versus ml base ( or acid).
       - * The graphs for all four reactions are represented on the previous pages in the “Table of Data and Results” section.
    2. Show on the graph the value of the pH at the endpoint.
* The pH and Veq for the four reactions are listed below

|  |  |  |
| --- | --- | --- |
|  | pH | V Equivalence Point (ml) |
| HCl/NaOH | 7 | 17.7 |
| HAC/NaOH | 8.3 | 13.1 |
| NH3/HCl | 6.1 | 14.6 |
| HAC/NH3 | Endpoint isn’t reached | |

* + 1. From the results of the experiment part (b) and the titration curve, determine the KHAc
* From our graph of the titration curve, we find the Veq and pH from the experiment in part b to equal to 13.1 ml and 8.3 respectively. At half Veq the volume is 6.55 ml and the pH is **4.6**, and w know that at half the Veq the pH = pKa of a solution. So now to find the KHAc we use the equation  So now we substitute 4.6 into the equation and calculate KHAc.
* pKHAc = − log [4.6]

KHAc = 10−4.6

**KHAc = 2.5 x 10−5**

**Sources of errors affecting the experiment:**

-Miscalibration of the ph-meter .

-Over stirring.

-Inadequate adding volume of the solution in the buret.

-Unrinsing of the buret and the beaker used with distilled water and with the solution itself

-Misreading of the buret at 0 ml.

-Using reagents that are impure or that have been contaminated.