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**Course Code: 109**
**Course Title: CHE**

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**Section: 5**

**Experiment-5: Determination of the Molar Mass of an unknown monoprotic acid, HA (0.60g in 100mL).**

**Theory:**

A monoprotic acid is an acid that donates only one proton or hydrogen atom per molecule to an aqueous solution, such as: Hydrochloric acid (HCl), Nitric acid (HNO 3 ), Acetic acid (CH 3 COOH). The molar mass of a chemical compound is the mass of a sample of that compound divided by the amount of substance in that sample, measured in moles. Molar masses are usually expressed in g/mol.

Chemical reactions between acids and bases are used to analyze the quantity of a pure substance in a mixture. In this experiment, the standardized base, NaOH, is used to determine the molar mass of an unknown weak acid. Based on the molar mass, you will determine the identity of the unknown weak acid.

Reaction: **NaOH (aq) + HA (aq) NaA (aq) + H 2 O (l)**

Since 1 mol of NaOH reacts with 1 mol of HA, the following expression can be written:

**(M HA ×V HA )= (M NaOH ×V NaOH )…….(1)**

Where,

M NaOH = Molarity of NaOH

V NaOH = Volume of NaOH

V HA = Volume of HA

M HA = Molarity of HA

**Procedure:**

**a) Dilution of HA:**

Retrieve the **1M CH3COOH** solution and a 100mL volumetric flask from the stockroom. In order to make **0.1M CH3COOH** solution, take 10mL of **1M** stock **CH3COOH** solution, transfer it to 100mL volumetric flask and dilute it up to the mark with water.

[Using the formula M1 *V1 = M2* V2 ; where "1" represents the concentrated conditions (i.e. stock solution

Molarity, 1M and volume) and "2" represents the diluted conditions (i.e. desired volume, 100mL and

Molarity, 0.1M)].

**b) Determination of the concentration of HA:**

Take 10 mL of HA (CH 3 COOH, as 0.60g in 100 mL) in a conical flask with the help of pipette. Add two drops (0.1mL) of phenolphthalein indicator. Titrate until the last drop of NaOH solution leaves a permanent pink color in the solution and

record the final reading in Table.

Calculate the difference between two burette readings (initial and final), which is the amount of

NaOH required neutralizing CH 3 COOH. [always substract volume of CH 3 COOH (10mL) and volume of indicator (0.1mL) from total volume, which was added before titration]

**Data:**

| Volume of NaOH, ml | pH of Acid |
|---|---|
| 0 | 2.88 |
| 0.2 | 3.19 |
| 0.4 | 3.42 |
| 0.6 | 3.58 |
| 0.8 | 3.71 |
| 1 | 3.81 |
| 1.2 | 3.9 |
| 1.4 | 3.97 |
| 1.6 | 4.04 |
| 1.8 | 4.1 |
| 2 | 4.16 |
| 2.2 | 4.21 |
| 2.4 | 4.26 |
| 2.6 | 4.3 |
| 2.8 | 4.35 |
| 3 | 4.39 |
| 3.2 | 4.43 |
| 3.4 | 4.47 |
| 3.6 | 4.51 |
| 3.8 | 4.55 |
| 4 | 4.58 |
| 4.2 | 4.62 |
| 4.4 | 4.65 |
| 4.6 | 4.69 |
| 4.8 | 4.72 |
| 5 | 4.76 |
| 5.2 | 4.79 |
| 5.4 | 4.83 |
| 5.6 | 4.86 |
| 5.8 | 4.9 |
| 6 | 4.93 |
| 6.2 | 4.97 |
| 6.4 | 5.01 |
| 6.6 | 5.05 |
| 6.8 | 5.08 |
| 7 | 5.13 |
| 7.2 | 5.17 |
| 7.4 | 5.21 |
| 7.6 | 5.26 |
| 7.8 | 5.31 |
| 8 | 5.36 |
| 8.2 | 5.42 |

| | |
|---|---|
| 8.4 | 5.48 |
| 8.6 | 5.55 |
| 8.8 | 5.62 |
| 9 | 5.71 |
| 9.2 | 5.82 |
| 9.4 | 5.95 |
| 9.6 | 6.14 |
| 9.8 | 6.45 |
| 10 | 8.7 |
| 10.2 | 10.98 |
| 10.4 | 11.28 |
| 10.6 | 11.45 |
| 10.8 | 11.58 |
| 11 | 11.67 |
| 11.2 | 11.74 |

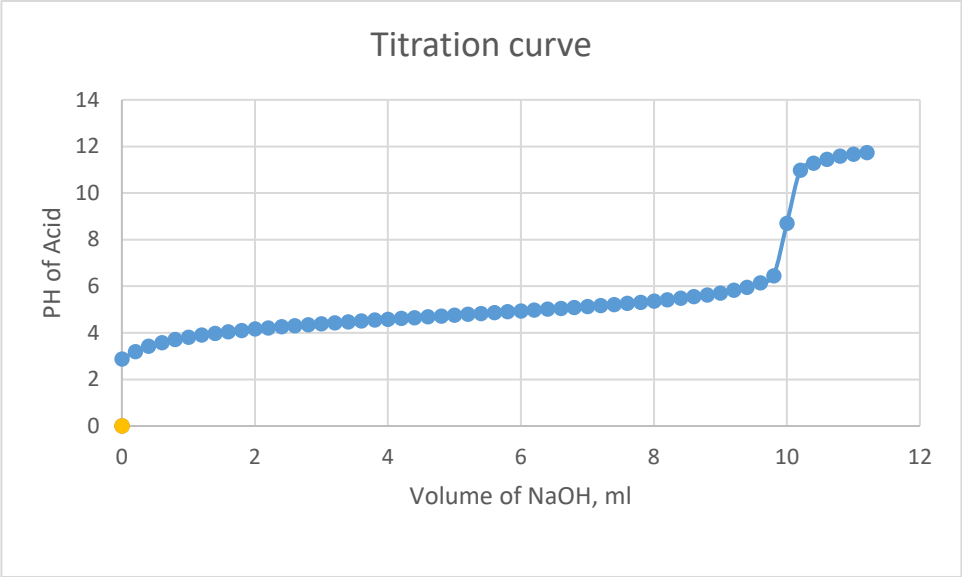
## Calculation:

| Va x Ma = Vb x Mb | |
|---|---|
| | |
| Va, Volume of CH3COOH | 10 ml |
| Ma, Molarity of CH3COOH | ? |
| Vb, Volume of NaOH | 10.2 ml |
| Mb, Molarity of NaOH | 0.1M |
| | |
| **Ma=Vb*Mb/Va** | **0.102M** |

| Percentage of error |
|---|
| Error = \|(Theo.value-Exp.value)/(Theo.value)\|×100% |
| **= [(0.1-0.102)/0.1]*100%** |
| **= 2%** |

| **(0.6g in 100ml)** | |
|---|---|
| 1000ml 1M | 1 mol |
| 100 ml 1M | 100/1000 |
| 100 ml 0.102M | (100*0.102)/1000 |
| | **0.0102 mole** |

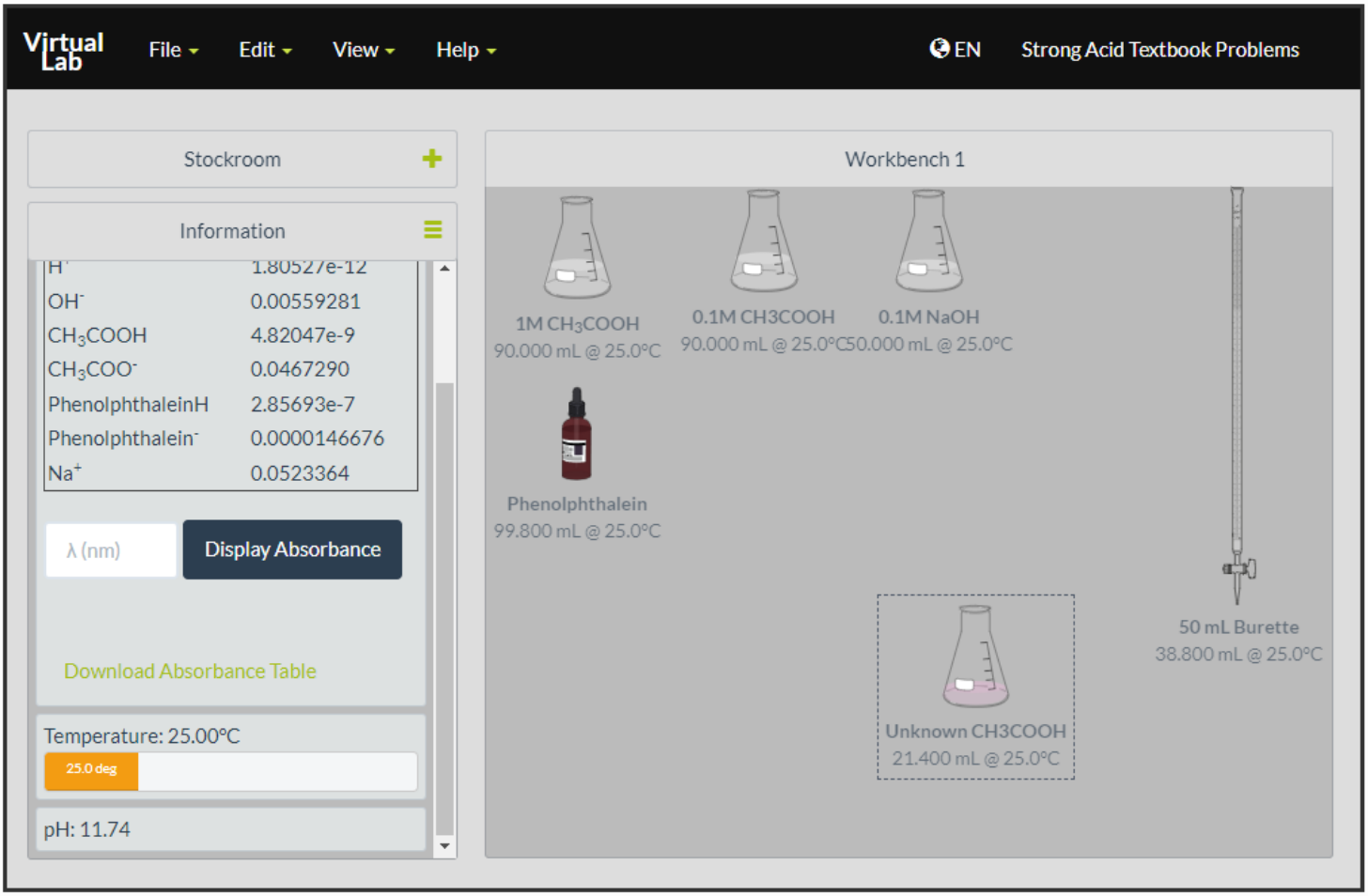
| | |
|---|---|
| M | = m/n |
| | **= 0.6/0.012** |
| | **= 59g/mole** |

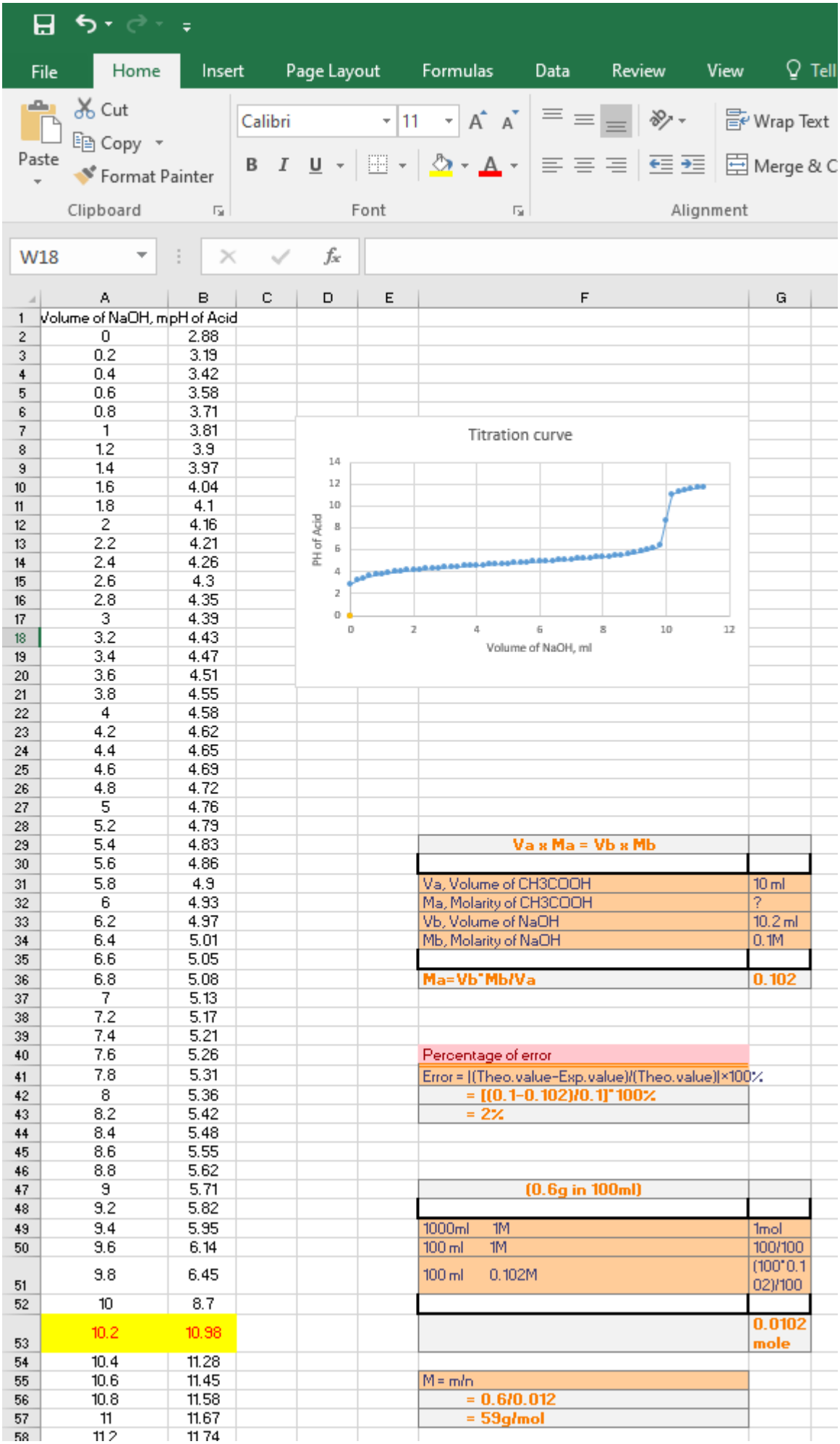



# VIRTUAL LAB: Strong Acid and Base Problems

We are pleased to announce a new HTML5 based version of the virtual lab. Please use FireFox or Chrome web browser to access this page, errors have been reported when using Internet Explorer.

Introductory Video and Support Information






| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | Volume of NaOH, m | pH of Acid | | | | | |
| 2 | 0 | 2.88 | | | | | |
| 3 | 0.2 | 3.19 | | | | | |
| 4 | 0.4 | 3.42 | | | | | |
| 5 | 0.6 | 3.58 | | | | | |
| 6 | 0.8 | 3.71 | | | | | |
| 7 | 1 | 3.81 | | | | | |
| 8 | 1.2 | 3.9 | | | | | |
| 9 | 1.4 | 3.97 | | | | | |
| 10 | 1.6 | 4.04 | | | | | |
| 11 | 1.8 | 4.1 | | | | | |
| 12 | 2 | 4.16 | | | | | |
| 13 | 2.2 | 4.21 | | | | | |
| 14 | 2.4 | 4.26 | | | | | |
| 15 | 2.6 | 4.3 | | | | | |
| 16 | 2.8 | 4.35 | | | | | |
| 17 | 3 | 4.39 | | | | | |
| 18 | 3.2 | 4.43 | | | | | |
| 19 | 3.4 | 4.47 | | | | | |
| 20 | 3.6 | 4.51 | | | | | |
| 21 | 3.8 | 4.55 | | | | | |
| 22 | 4 | 4.58 | | | | | |
| 23 | 4.2 | 4.62 | | | | | |
| 24 | 4.4 | 4.65 | | | | | |
| 25 | 4.6 | 4.69 | | | | | |
| 26 | 4.8 | 4.72 | | | | | |
| 27 | 5 | 4.76 | | | | | |
| 28 | 5.2 | 4.79 | | | | | |
| 29 | 5.4 | 4.83 | | | | Va x Ma = Vb x Mb | |
| 30 | 5.6 | 4.86 | | | | | |
| 31 | 5.8 | 4.9 | | | | Va, Volume of CH3COOH | 10 ml |
| 32 | 6 | 4.93 | | | | Ma, Molarity of CH3COOH | ? |
| 33 | 6.2 | 4.97 | | | | Vb, Volume of NaOH | 10.2 ml |
| 34 | 6.4 | 5.01 | | | | Mb, Molarity of NaOH | 0.1M |
| 35 | 6.6 | 5.05 | | | | | |
| 36 | 6.8 | 5.08 | | | | Ma=Vb*Mb/Va | 0.102 |
| 37 | 7 | 5.13 | | | | | |
| 38 | 7.2 | 5.17 | | | | | |
| 39 | 7.4 | 5.21 | | | | | |
| 40 | 7.6 | 5.26 | | | | Percentage of error | |
| 41 | 7.8 | 5.31 | | | | Error = \|(Theo.value-Exp.value)/(Theo.value)\|×100% | |
| 42 | 8 | 5.36 | | | | = [(0.1-0.102)/0.1]*100% | |
| 43 | 8.2 | 5.42 | | | | = 2% | |
| 44 | 8.4 | 5.48 | | | | | |
| 45 | 8.6 | 5.55 | | | | | |
| 46 | 8.8 | 5.62 | | | | | |
| 47 | 9 | 5.71 | | | | (0.6g in 100ml) | |
| 48 | 9.2 | 5.82 | | | | | |
| 49 | 9.4 | 5.95 | | | | 1000ml 1M | 1mol |
| 50 | 9.6 | 6.14 | | | | 100 ml 1M | 100/100 |
| 51 | 9.8 | 6.45 | | | | 100 ml 0.102M | (100*0.102)/100 |
| 52 | 10 | 8.7 | | | | | |
| 53 | 10.2 | 10.98 | | | | | 0.0102 mole |
| 54 | 10.4 | 11.28 | | | | | |
| 55 | 10.6 | 11.45 | | | | M = m/n | |
| 56 | 10.8 | 11.58 | | | | = 0.6/0.012 | |
| 57 | 11 | 11.67 | | | | = 59g/mol | |
| 58 | 11.2 | 11.74 | | | | | |