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Course Code: 109
Course Title: CHE

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Section: 5

Experiment-3: Standardization of a strong base (NaOH) with a standard weak acid, potassium hydrogen phthalate (KHP)

Theory:

Potassium hydrogen phthalate (KHP) is a monophonic acidic salt (monopotassium salt of phthalic acid, weak acid) with the formula, KHC 8 H 4 O 4 . It is often used as a primary standard for acid-base titrations because it is solid and air-stable, making it easy to weigh accurately and not hygroscopic. KHP dissociates completely in water, giving the potassium cation (K +) and hydrogen phthalate anion (HP – or Hphthalate −).

Equation:

And then as a weak acid hydrogen phthalate reacts reversibly with water to give hydronium (H 3 O +) and phthalate ions.

HP − + H 2 O ⇌ P 2− + H 3 O +

As KHP is monophonic, 1 mol of NaOH reacts with 1 mol of KHP according to the following equation:

NaOH (aq) + KHC 8 H 4 O 4(aq) KNaC 8 H 4 O 4(aq) + H 2 O (l) ……..(1)

Or, NaOH (aq) + KHP (aq) KNaP (aq) + H 2 O (l)

Therefore, the concentration of standardized NaOH can be determined from reaction (1):

(M NaOH ×V NaOH) = (M KHP × V KHP)…… (2)

Where,

Mb = Molarity of NaOH

Va = Volume of KHP

Vb = Volume of NaOH

Ma = Molarity of KHP

Data:

Volume of NaOH, ml	pH of acid
0	2.76
0.1	3.5
0.2	3.8
0.3	3.98
0.4	4.11
0.5	4.22
0.6	4.31

0.7	4.38
0.8	4.45
0.9	4.51
1	4.57
1.1	4.62
1.2	4.66
1.3	4.71
1.4	4.75
1.5	4.79
1.6	4.83
1.7	4.87
1.8	4.91
1.9	4.95
2	4.98
2.1	5.02
2.2	5.05
2.3	5.08
2.4	5.12
2.5	5.15
2.6	5.18
2.7	5.21
2.8	5.25
2.9	5.28
3	5.31
3.1	5.35
3.2	5.38
3.3	5.42
3.4	5.45
3.5	5.49
3.6	5.53
3.7	5.56
3.8	5.6
3.9	5.64
4	5.69
4.1	5.73
4.2	5.78
4.3	5.83
4.4	5.89
4.5	5.95
4.6	6.02
4.7	6.1
4.8	6.19
4.9	6.29
5	6.43
5.1	6.62
5.2	6.94
5.3	10.57
5.4	11.8
5.5	12.09

5.6	12.26
5.7	12.38
5.8	12.47

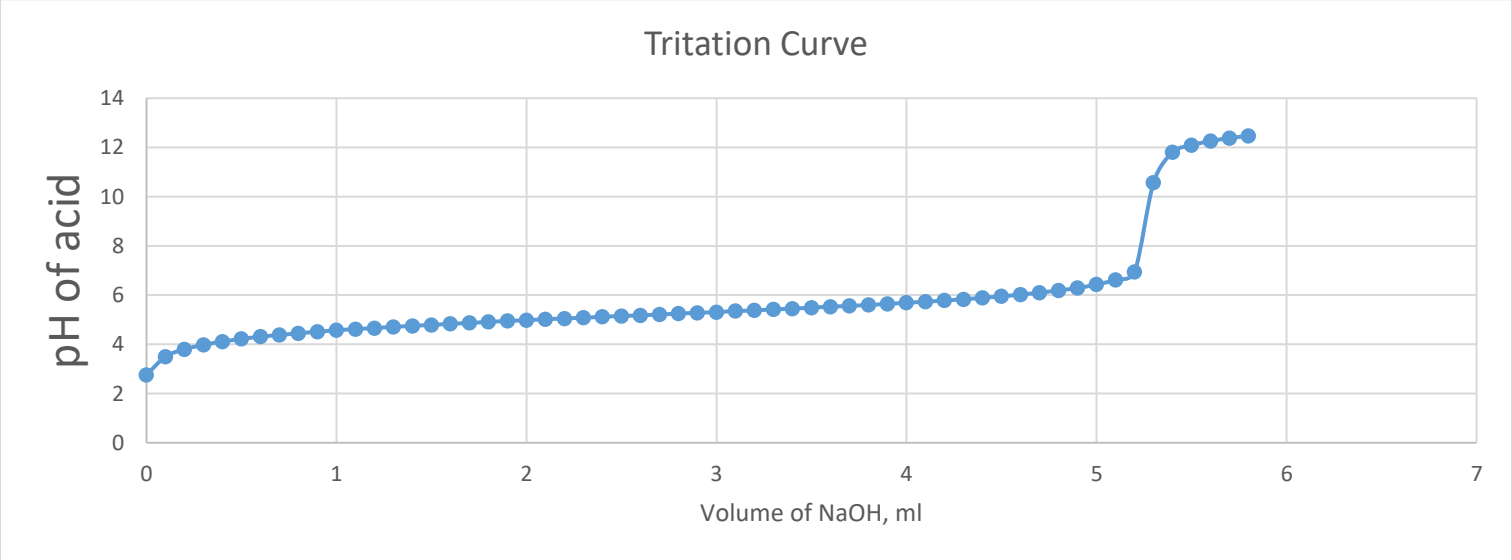
Va x Ma = Vb x Mb	
Va, Volume of KHP	**10 ml**
Ma, Molarity of KHP	**0.5 M**
Vb, Volume of NaOH	**5.3 ml**
Mb, Molarity of NaOH	**??**
Mb=Va*Ma/Vb	**0.94 M**

Percentage of error:

$$\text{Error} = \left|\frac{Theo.value - Exp.value}{Theo.value}\right| \times 100\%$$

= [(1-0.94)/1]*100%

= 6%



Virtual Lab | File | Edit | View | Help | EN | Standardization of NaOH

Stockroom

Information

H^+	3.37888e-13
OH^-	0.0298812
KHP	1.67349e-8
KHP^-	0.312500
PhenolphthaleinH	9.08099e-11
$Phenolphthalein^-$	2.49092e-8
Na^+	0.342381

λ (nm) Display Absorbance

Download Absorbance Table

Temperature: 25.00°C

25.0 deg

pH: 12.47

Workbench 1

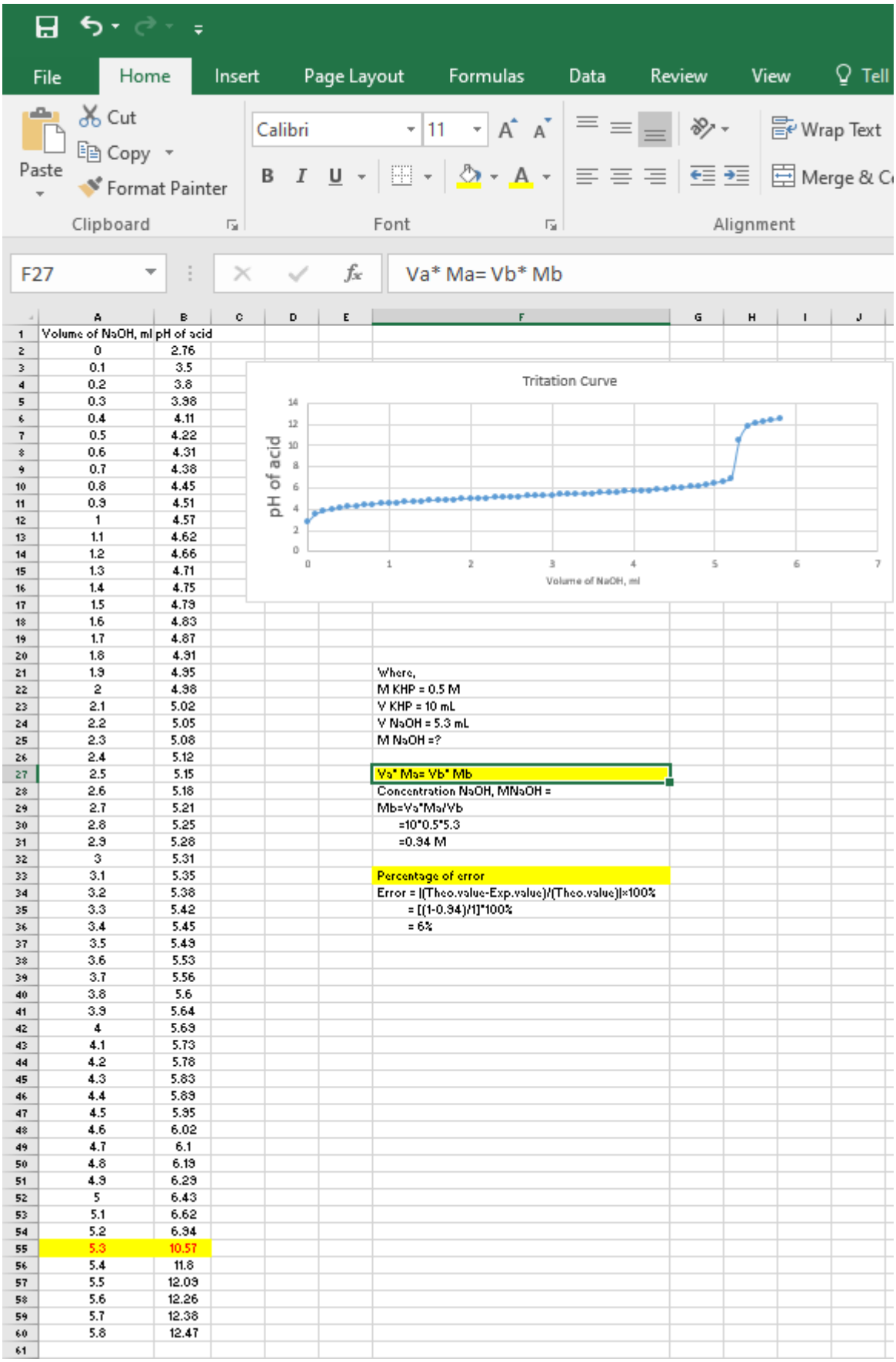
0.500M KHP
15.000 mL @ 25.0°C

Unknown NaOH
50.000 mL @ 25.0°C

Phenolphthalein
99.800 mL @ 25.0°C

50 mL Burette
44.200 mL @ 25.0°C

500 mL Flask
16.000 mL @ 25.0°C



	A	B	C	D	E	F	G	H	I	J
1	Volume of NaOH, ml	pH of acid								
2	0	2.76								
3	0.1	3.5								
4	0.2	3.8								
5	0.3	3.98								
6	0.4	4.11								
7	0.5	4.22								
8	0.6	4.31								
9	0.7	4.38								
10	0.8	4.45								
11	0.9	4.51								
12	1	4.57								
13	1.1	4.62								
14	1.2	4.66								
15	1.3	4.71								
16	1.4	4.75								
17	1.5	4.79								
18	1.6	4.83								
19	1.7	4.87								
20	1.8	4.91								
21	1.9	4.95				Where,				
22	2	4.98				M KHP = 0.5 M				
23	2.1	5.02				V KHP = 10 mL				
24	2.2	5.05				V NaOH = 5.3 mL				
25	2.3	5.08				M NaOH =?				
26	2.4	5.12								
27	2.5	5.15				Va* Ma= Vb* Mb				
28	2.6	5.18				Concentration NaOH, MNaOH =				
29	2.7	5.21				Mb=Va*Ma/Vb				
30	2.8	5.25				=10*0.5*5.3				
31	2.9	5.28				=0.94 M				
32	3	5.31								
33	3.1	5.35				Percentage of error				
34	3.2	5.38				Error = [(Theo.value-Exp.value)/(Theo.value)]×100%				
35	3.3	5.42				= [(1-0.94)/1]*100%				
36	3.4	5.45				= 6%				
37	3.5	5.49								
38	3.6	5.53								
39	3.7	5.56								
40	3.8	5.6								
41	3.9	5.64								
42	4	5.69								
43	4.1	5.73								
44	4.2	5.78								
45	4.3	5.83								
46	4.4	5.89								
47	4.5	5.95								
48	4.6	6.02								
49	4.7	6.1								
50	4.8	6.19								
51	4.9	6.29								
52	5	6.43								
53	5.1	6.62								
54	5.2	6.94								
55	5.3	10.57								
56	5.4	11.8								
57	5.5	12.09								
58	5.6	12.26								
59	5.7	12.38								
60	5.8	12.47								
61										