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Course Code: 109
Course Title: CHE

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Section: 5

Experiment-4: Standardization of a strong acid (HCl) with a standard weak base (Na2CO3).

Theory:

Sodium carbonate is the salt of a weak acid, carbonic acid (H2CO3). It is a primary standard substance. Its reaction with HCl is a two-step process as follows:

Na 2 CO 3(aq) + HCl (aq) NaHCO 3(aq) + NaCl (aq) ……..(1)

NaHCO 3(aq) + HCl (aq) NaCl (aq) + H 2 O (l) + CO 2(g) … …….(2)

The overall reaction:

Na 2 CO 3(aq) + 2HCl (aq) 2NaCl (aq) + H 2 O (l) + CO 2(g) ……..(3)

Since 1 mol of Na 2 CO 3 reacts with 2 mol of HCl, the following expression can be written:

Va Ma = 2Vb Mb ……..(4)

Where,

Mb= Molarity of Na2CO3

Vb = Volume of Na2CO3 = 10mL

Va = Volume of HCl

Ma = Molarity of HCl =?

Procedure:

a) Dilution of standard 0.1M Na 2 CO 3 from 1M Na 2 CO 3 solution:

Retrieve the 1M Na 2 CO 3 solution and a 100 mL volumetric flask from the stockroom. Take 10mL of 1M stock Na 2 CO 3 solution, transfer it to 100mL volumetric flask and dilute it up to the mark with water.

Dilution:

How to prepare 0.1 M HCl solution from 1.0 M HCl solution

Solution 1: Stock solution; HCl, 1 M

Solution 2: this is the target solution. have to prepare 0.1 M HCl in 100 mL volumetric flask.

Equation is V1M1 = V2M

Solution 1, mother solution, 1.0 M Na2CO3

Solution 2, target solution, 0.1 M Na2CO3 in 100 mL

V1M1 = V2 M2

V1=?

M1 = 1 M

V2 = 100 mL

M2 = 0.1 M

V1= V2xM2/M1

Then we get V1 = 10 mL

b) Standardization of HCl:

Take HCl (0.1M) solution in a burette and record the initial reading in Table.

Pipette 10 mL of standard 0.1M Na 2 CO 3 solution into a 250 mL conical flask. Add 0.1mL (2 drops) of methyl orange indicator to 10mL Na 2 CO 3 solution and the solution's color changes to yellow.

Titrate the solution with the given HCl by continuously adding 0.2 mL (1drop) each time until changing its color from yellow to red. At the end point, record the final reading on burette in table.

Calculate the difference between two burette readings (initial and final), which is the amount of HCl required neutralizing Na2CO3

Data:

Volume of HCl, ml	pH of base
0	11.64
0.2	11.54
0.4	11.44
0.6	11.35
0.8	11.27
1	11.19
1.2	11.12
1.4	11.06
1.6	11
1.8	10.95
2	10.89
2.2	10.85
2.4	10.8
2.6	10.76
2.8	10.71
3	10.67
3.2	10.63
3.4	10.6
3.6	10.56
3.8	10.52
4	10.49
4.2	10.45
4.4	10.42
4.6	10.38
4.8	10.35

5	**10.31**
5.2	**10.28**
5.4	**10.24**
5.6	**10.21**
5.8	**10.17**
6	**10.14**
6.2	**10.1**
6.4	**10.07**
6.6	**10.03**
6.8	**9.99**
7	**9.95**
7.2	**9.91**
7.4	**9.86**
7.6	**9.82**
7.8	**9.77**
8	**9.71**
8.2	**9.66**
8.4	**9.6**
8.6	**9.53**
8.8	**9.45**
9	**9.37**
9.2	**9.26**
9.4	**9.13**
9.6	**8.96**
9.8	**8.71**
10	**8.33**
10.2	**7.95**
10.4	**7.7**
10.6	**7.53**
10.8	**7.4**
11	**7.3**
11.2	**7.21**
11.4	**7.14**
11.6	**7.07**
11.8	**7.01**
12	**6.95**
12.2	**6.9**
12.4	**6.85**
12.6	**6.8**
12.8	**6.76**
13	**6.72**
13.2	**6.68**
13.4	**6.64**
13.6	**6.6**
13.8	**6.56**
14	**6.53**
14.2	**6.49**
14.4	**6.46**
14.6	**6.42**
14.8	**6.39**

15	**6.35**
15.2	**6.32**
15.4	**6.28**
15.6	**6.25**
15.8	**6.21**
16	**6.18**
16.2	**6.14**
16.4	**6.1**
16.6	**6.06**
16.8	**6.02**
17	**5.98**
17.2	**5.94**
17.4	**5.9**
17.6	**5.85**
17.8	**5.8**
18	**5.75**
18.2	**5.69**
18.4	**5.63**
18.6	**5.56**
18.8	**5.49**
19	**5.4**
19.2	**5.29**
19.4	**5.16**
19.6	**4.97**
19.8	**4.67**
20	**3.91**
20.2	**3.17**
20.4	**2.88**
20.6	**2.71**
20.8	**2.59**
21	**2.49**

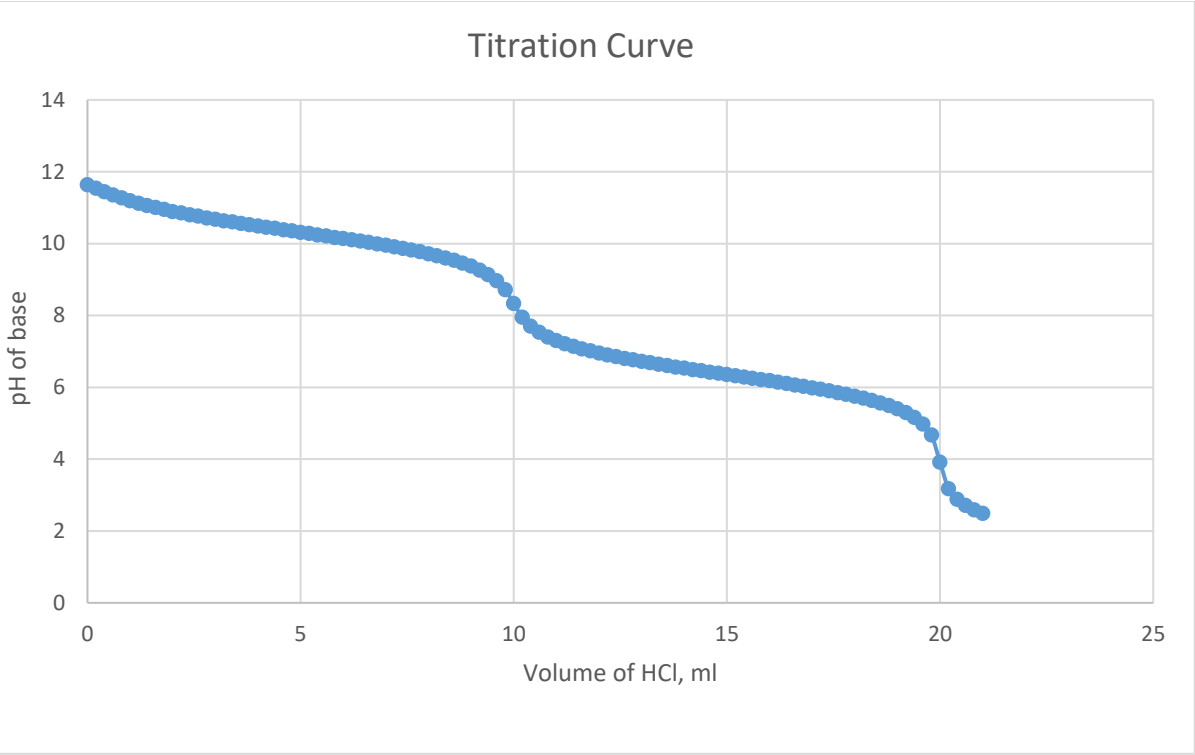
Va x Ma = 2Vb x Mb	
Va, Volume of HCl	20.2
Ma, Molarity of HCl	?
Vb, Volume of Na2CO3	10 ml
Mb, Molarity of Na2CO3	0.1M
Ma=2Vb*Mb/Va	**0.099M**

Percentage of error:

Error = |(Theo.value-Exp.value)/(Theo.value)|×100%

= [(0.1-0.099)/0.1]*100%

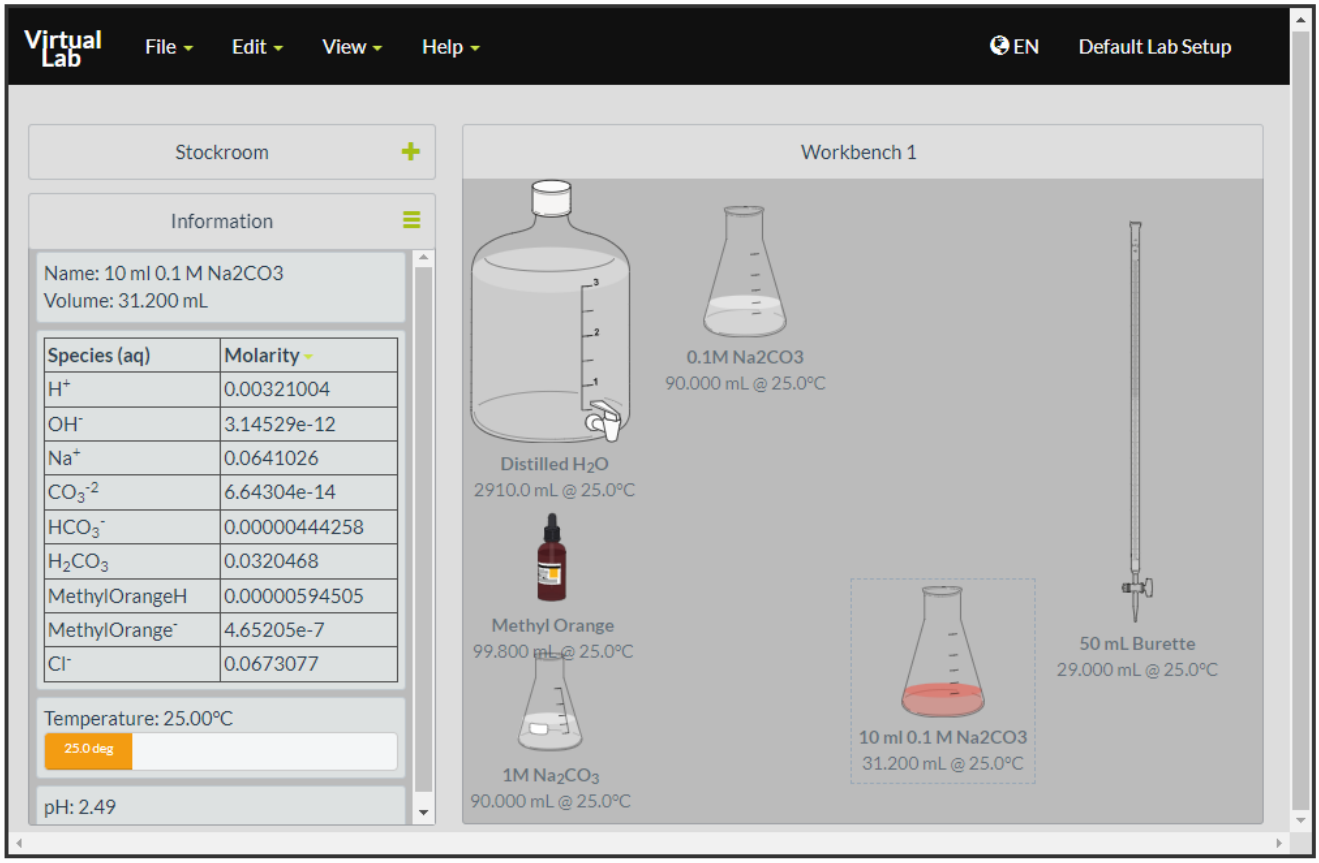
= 1%

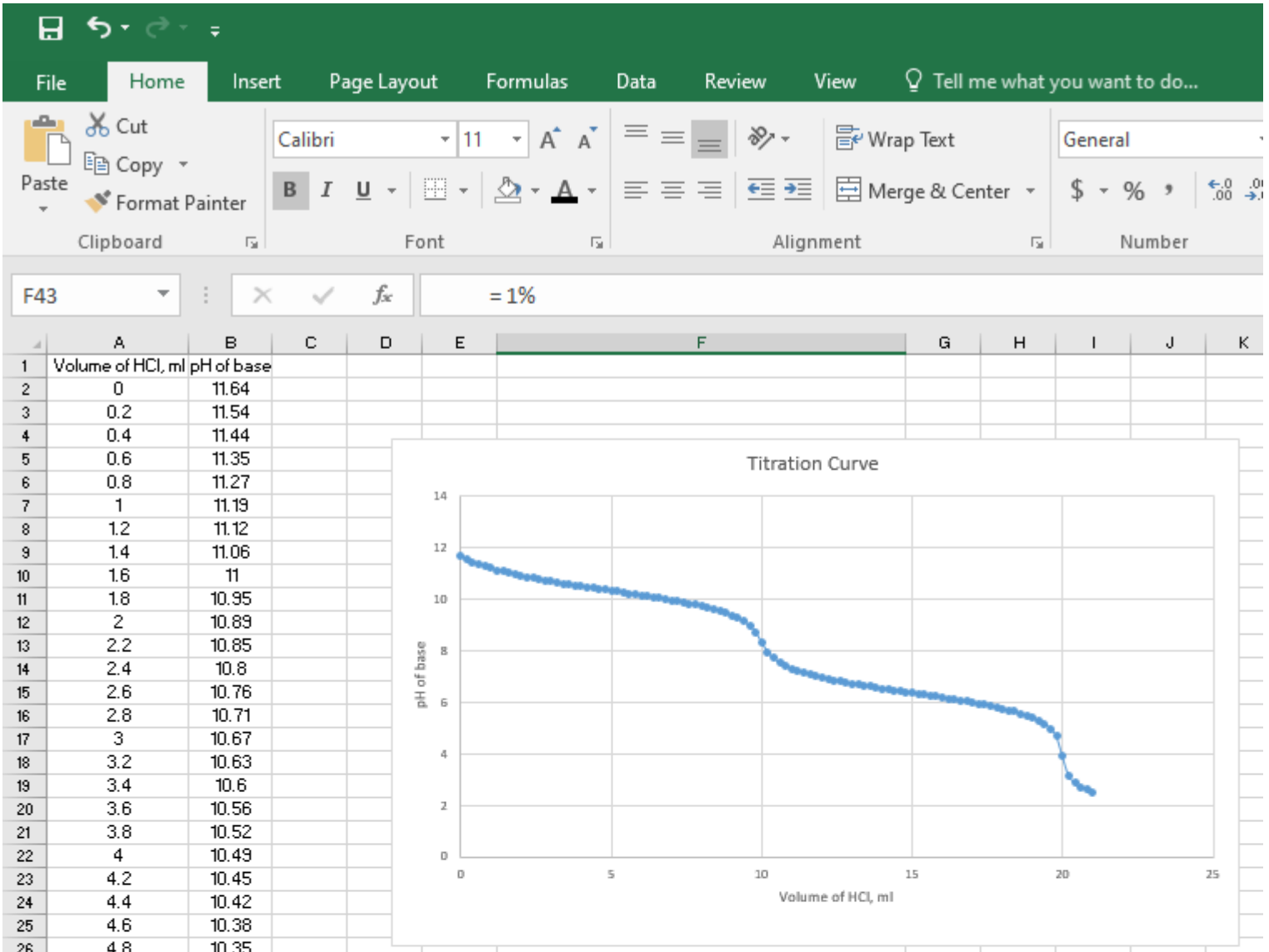


VIRTUAL LAB: **Default Virtual Lab Stockroom**

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	H	I	J	K
1	Volume of HCl, ml	pH of base									
2	0	11.64									
3	0.2	11.54									
4	0.4	11.44									
5	0.6	11.35									
6	0.8	11.27									
7	1	11.19									
8	1.2	11.12									
9	1.4	11.06									
10	1.6	11									
11	1.8	10.95									
12	2	10.89									
13	2.2	10.85									
14	2.4	10.8									
15	2.6	10.76									
16	2.8	10.71									
17	3	10.67									
18	3.2	10.63									
19	3.4	10.6									
20	3.6	10.56									
21	3.8	10.52									
22	4	10.49									
23	4.2	10.45									
24	4.4	10.42									
25	4.6	10.38									
26	4.8	10.35									
27	5	10.31									
28	5.2	10.28									
29	5.4	10.24				**Va x Ma = 2Vb x Mb**					
30	5.6	10.21									
31	5.8	10.17				Va, Volume of HCl	20.2				
32	6	10.14				Ma, Molarity of HCl	?				
33	6.2	10.1				Vb, Volume of Na2CO3	10 ml				
34	6.4	10.07				Mb, Molarity of Na2CO3	0.1M				
35	6.6	10.03									
36	6.8	9.99				**Ma=2Vb*Mb/Va**	**0.099**				
37	7	9.95									
38	7.2	9.91									
39	7.4	9.86									
40	7.6	9.82				Percentage of error					
41	7.8	9.77				Error = |(Theo.value-Exp.value)/(Theo.value)|×100%					
42	8	9.71				= [(0.1-0.099)/0.1]*100%					
43	8.2	9.66				= 1%					
44	8.4	9.6									
45	8.6	9.53									
46	8.8	9.45									
47	9	9.37									
48	9.2	9.26									
49	9.4	9.13									
50	9.6	8.96									
51	9.8	8.71									
52	10	8.33									
53	10.2	7.95									
54	10.4	7.7									
55	10.6	7.53									
56	10.8	7.4									

F43 = 1%

	A	B	C	D	E
52	10	8.33			
53	10.2	7.95			
54	10.4	7.7			
55	10.6	7.53			
56	10.8	7.4			
57	11	7.3			
58	11.2	7.21			
59	11.4	7.14			
60	11.6	7.07			
61	11.8	7.01			
62	12	6.95			
63	12.2	6.9			
64	12.4	6.85			
65	12.6	6.8			
66	12.8	6.76			
67	13	6.72			
68	13.2	6.68			
69	13.4	6.64			
70	13.6	6.6			
71	13.8	6.56			
72	14	6.53			
73	14.2	6.49			
74	14.4	6.46			
75	14.6	6.42			
76	14.8	6.39			
77	15	6.35			
78	15.2	6.32			
79	15.4	6.28			
80	15.6	6.25			
81	15.8	6.21			
82	16	6.18			
83	16.2	6.14			
84	16.4	6.1			
85	16.6	6.06			
86	16.8	6.02			
87	17	5.98			
88	17.2	5.94			
89	17.4	5.9			
90	17.6	5.85			
91	17.8	5.8			
92	18	5.75			
93	18.2	5.69			
94	18.4	5.63			
95	18.6	5.56			
96	18.8	5.49			
97	19	5.4			
98	19.2	5.29			
99	19.4	5.16			
100	19.6	4.97			
101	19.8	4.67			
102	20	3.91			
103	20.2	3.17			
104	20.4	2.88			
105	20.6	2.71			
106	20.8	2.59			
107	21	2.49			