UNIVERSITI TEKNOLOGI MARA

NMIM
NATIONAL METROLOGY

INDUSTRIAL TRAINING REPORT

Name	MUHAMMAD AFIQ BIN AZMI
Programme	EH110
Student ID	2018280454
LI Duration	22ND MARCH – 16TH JULY (17 weeks)
Supervisor	ENCIK KHIRUL ANUAR BIN MOHD AMIN
Company Address	NATIONAL METROLOGY INSTITUTE OF MALAYSIA, LOT PT 4803, BANDAR BARU SALAK TINGGI 43900 SEPANG SELANGOR DARUL EHSAN

TABLE OF CONTENT

1.1 INTRODUCTION

1.1.1 Background of Company

National Metrology Institute of Malaysia (NMIM) or formerly known as NML-SIRIM is the national authority on physical and measurement standards and the Malaysia's premier laboratory for measurement science and technology. It acts as the National Metrology Institute (NMI) and reference point for all metrological activities in the country. Furthermore, all the national physical and chemical standards for the SI units of mass (kg), length (m), time (s), temperature (K), luminous intensity (cd), current(A) and mole (mol) were established and maintained in NMIM.

1.1.2 About NMIM

NMIM plays an important role in disseminating the traceability of measurement to the whole country based on the International System of Units. Just like the other world standard laboratories, NMIM has great responsibility in ensuring the national metrology infrastructures meet and comply with the global measurement standards. The importance of the role and the functions of NMIM had increased significantly after Malaysia signed the WTO-TBT Agreement, which emphasizes on the importance of harmonized national infrastructure measurement system either domestically or internationally.

NMIM had been mandated to realize, maintain and cause to be maintained the National Measurement Standards and Certified Reference Materials under the National Measurement System Act 2007 (Act 675), while under the Weights and Measures Act 1972 (Act 71), NML-SIRIM had been mandated as the Custodian of the Weights and Measures and at once serves to advise the Minister on matters relating to measurement. With the mandate given, NMIM continuously move forward towards equipping the scope of services to the agency or government department where mainly enforcement agencies such as the Royal Malaysian Police, Road Transport Department, PUSPAKOM, Ministry of Domestic Trade, Cooperatives and

Consumerism Ministry of Environment. Same goes to educational institutions or education and industry in-order to ensure that individuals, organisations and agencies that receive services can make precise measurements and that has traceability to NMIM.

NMIM also works closely with the Department of Standards Malaysia to ensure traceability to the accredited testing and calibration laboratories and also provides Proficiency Testing and Measurement Audit programs.

To ensure the credibility of the National Measurement System Malaysia at the international level, NMIM had participated in many international comparisons such as key comparison, supplementary comparison and proficiency testing program, including active involvement as a member of the Asia Pacific Metrology Program (APMP) and Asia Pacific Legal Metrology Forum (APLMF). NMIM also a signatory to the CIPM-MRA on behalf of Malaysia, which allow National Measurement Standards, which are developed in Malaysia as well as certificates of measurement or calibration issued are globally recognized. International memberships of NML-SIRIM includes General Conference of Weights and Measures (CGPM) / Meter Convention, the International Organization of Legal Metrology (OIML), the ASEAN Consultative Committee on Standards and Quality (ACCSQ), the ASEAN Consultative Committee on Standards and Quality on Legal Metrology (ACCSQ-WG3) and the National Conference of Standards Laboratories International (NCSLI).

1.1 Vision and Mission of company

1.1.1 Vision

- To be the National Centre of Excellence of International Recognition in Metrology.

1.1.2 Mission

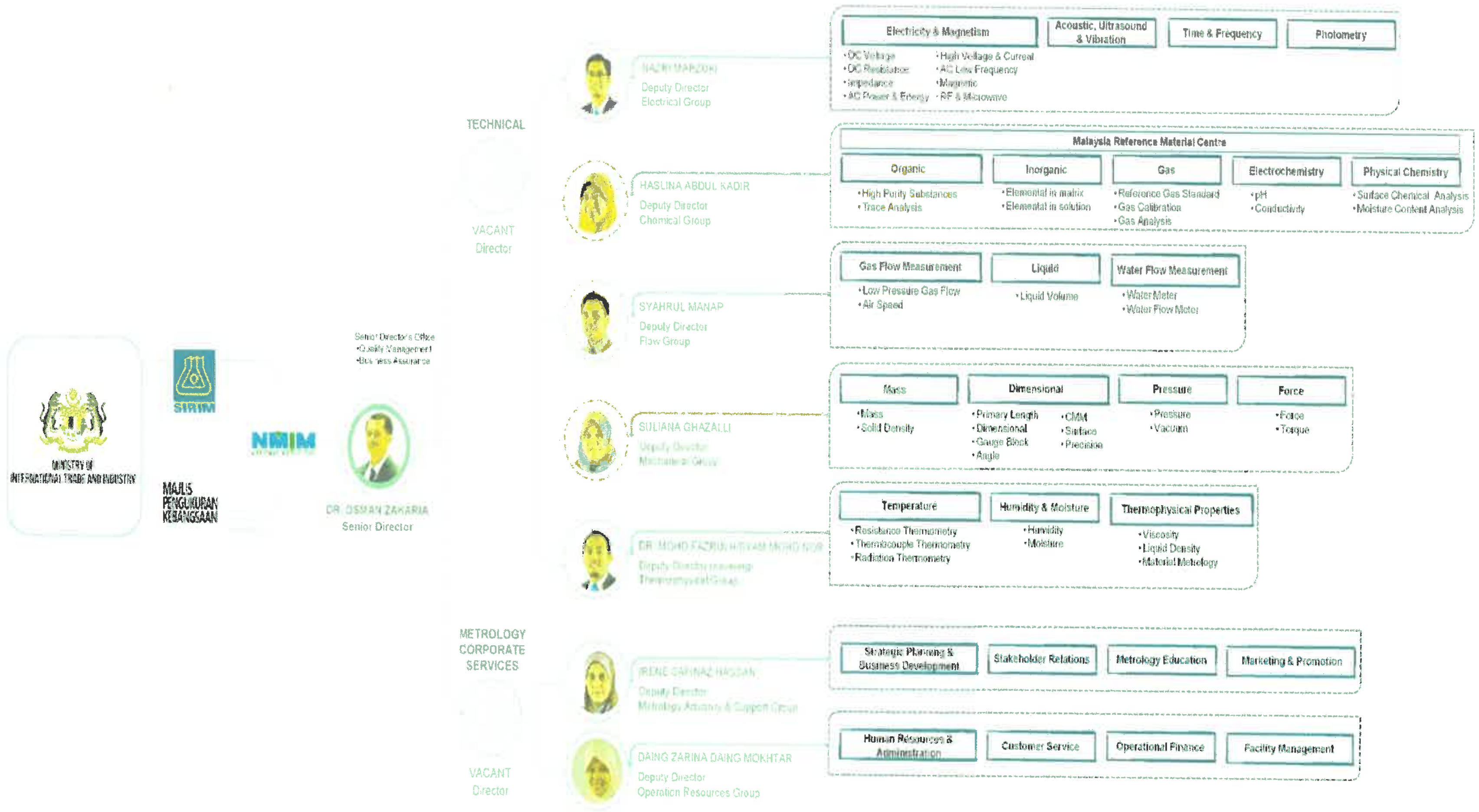
- We make businesses compete better through measurement and calibration services provided, and we develop and maintain the national infrastructure for the measurement standards to support economic and social development

National Task of NMIM

IMPLEMENTATION OF METROLOGY LEGISLATIONS	• National Measurement System Act 2007 • Weights and Measures Act 1972 • Support of other related Acts
FUNDAMENTALS OF METROLOGY	• Realization, maintenance and dissemination of the legal units of the SI
METROLOGY FOR THE ECONOMY	• Increase in competitiveness of Malaysian made products
METROLOGY FOR QUALITY OF LIFE	• Promotion of fair trade • Promotion of consumer safety • Promotion of accurate diagnosis for health • Promotion of clean environment
INTERNATIONAL METROLOGY	• Sustainability of international recognition of NMIM
METROLOGY EDUCATION	• Increase the level of expertise of calibration laboratories nationwide
METROLOGY SUPPORT FOR NATIONAL QUALITY INFRASTRUCTURE	• Sustainability of the National Measurement System

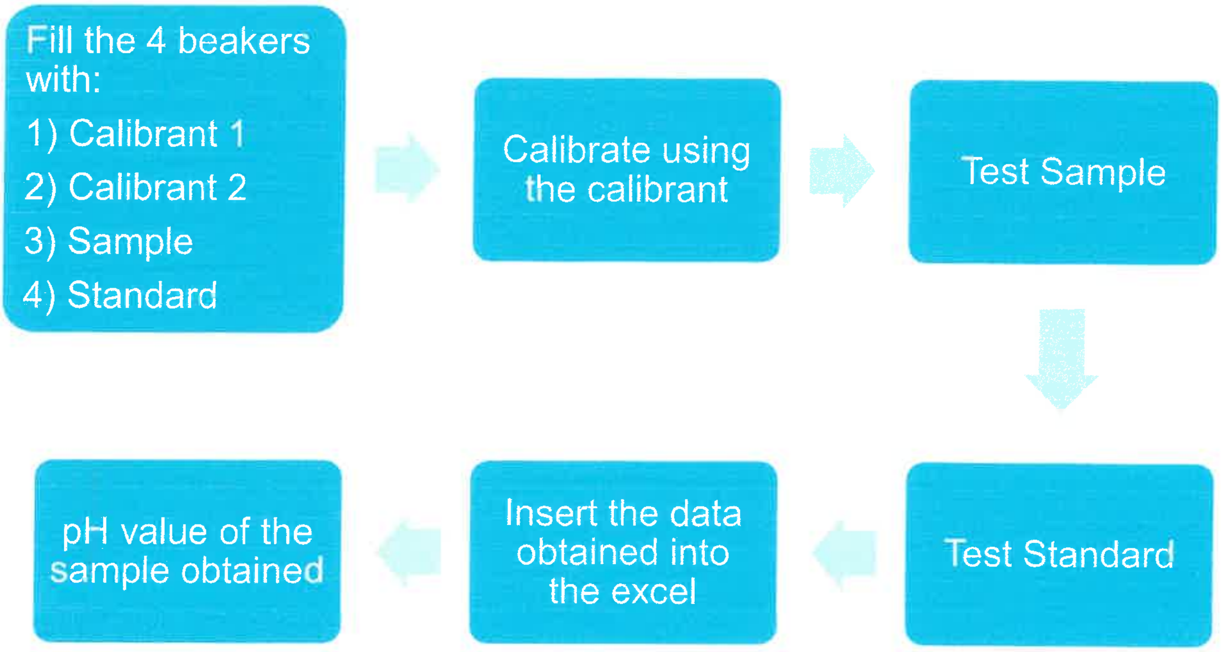
2.0 CONTENT

2.0.1 Organization Chart

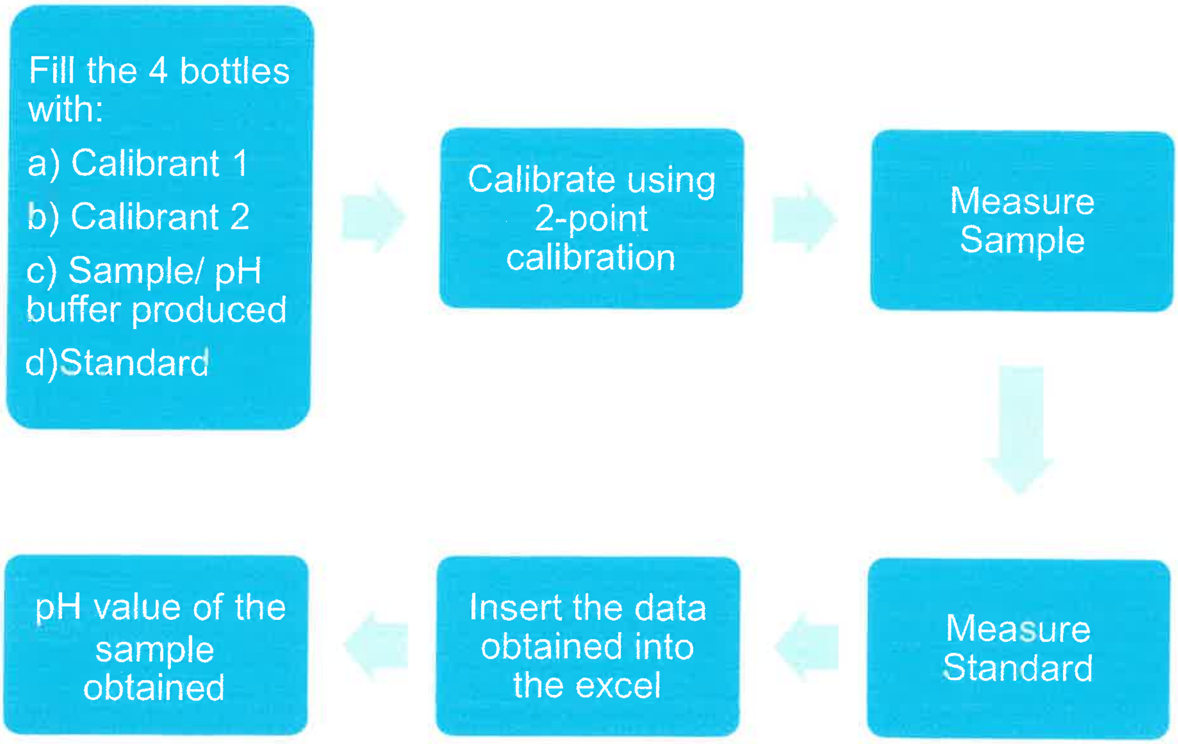


2.1 Process Flow

a) **Calibration of Portable pH Meter (pH1500)**



b) **Verification of pH Buffer using High Accuracy pH Meter System (PHL-90)**



2.2 Brief Weekly Activity

Arrived at National Metrology Institute of Malaysia at 8.00 am to report for duty and waited at the lobby whilst waiting for further instructions from Pn. Halina Binti Halim. At 8.30 am the students were ushered to the meeting room to be briefed on the company's background, rules and regulations by Pn. Yusfahliza, a staff member from the Humans Resources department. Afterwards, the students were dismissed and were introduced to their supervisors. Encik Khirul Anuar, the supervisor assigned, gave a tour around the company's grounds and elaborated the importance of each department and their purpose. At the end of the tour, we arrived at the chemical building, where all the labs regarding or relevant to the measurement of mol is used. There, the supervisor explained his line of work and the history of the building. He explained how the instruments were implemented in each laboratory and how each staff plays a part in calibrating instruments, designing new tools or systems of measurement, interpreting data, or researching the science of measuring. For instance, the evidential breath analyser which is important in measuring blood alcohol content used as a metric of alcohol intoxication for legal or medical purposes. In order to obtain an accurate measurement of the blood alcohol content, they are responsible for producing a standard solution to help calibrate the instrument. Furthermore, each of the staff working under the chemical department was introduced to show the importance of maintaining a good relationship and ethic at a working place. Later that day, the supervisor handed notes and material in respect of pH measurement. He also explained the goals and visions for the entire duration of the internship.

On the following day, the supervisor instructed to read information regarding the fundamentals of pH such as the definition of pH, how it is measured, the formulas implemented to calculate the potential of hydrogen and more. When measuring pH it was noted that the temperature is crucial as slight changes could change the pH of a substance. Therefore, the supervisor deemed it necessary to record the temperature of the lab each day.

In order to prepare for the project that will be executed during the internship, it was necessary to keep the workplace in a clean condition. Hence, some cleaning was done later that afternoon alongside the supervisor. In addition to the methods on how to keep the workplace cleaned, the supervisor educated on the safety and precautions when using the lab. For example, always wear gloves in the electrochemistry lab as there is acid and alkali which could corrode skin and leave permanent or unwanted damage.

In the same week the supervisor gave a task to conduct a stability test at 25°C using the water bath. This was importance in attaining the standard deviation that would later be used in calculating the pH of the sample measured using the pHL-90. In addition to the stability test, reading materials that were previously handed were to be read during spare time or on days where it was unnecessary to enter the lab.

On the second week, the supervisor brief and showed a step by step on the procedures of calibrating a pH meter (pH1500). The method used was two-point calibration and the pH of the sample tested was 6.86. The calibration conducted was to measure the uncertainty of the equipment. Another calibration was also conducted again but with a sample containing a pH of 4.01.

After conducting the calibration with both samples, the data obtained from calibrating of the pH metre and the stability test was then calculated using an excel worksheet provided by the supervisor. From there the uncertainty of the equipment was achieved.

In the same week attended a talk on the procedures of using the EDXRF equipment used to detect the composition of a substance. It was conducted by one of the staffs, Cik Adlan, who was a metrologist with experience in surface chemical analyst.

After successfully attaining the uncertainty of the pH metre, the supervisor briefed on the procedures of producing sodium tetraborate tecahydrate, a pH buffer with a pH of 9.180 at 25°C. The buffer intended to be produced is not yet produced by NMIM. Therefore, the goal was to produce this buffer. This was to be the main project assigned for the internship. However due to unfortunate circumstances caused by the pandemic, the production of this project could not be conducted.

On the following week, to prepare for the main project and be accustomed to the equipment, the pH buffer with a pH of 4.01 was first produced by following the steps and guidance provided by the supervisor. After producing the buffer, the supervisor briefed on the basics and nature of pHL-90 a more advanced pH metre compared to the previous one. The pHL-90 was important in verifying the buffer produced was accurate and within the allowed range of uncertainty. Before the pHL-90 was to be used, the supervisor instructed and guided on how to clean the equipment. After successfully cleaning the pH metre, it was then reassembled and tested to ensure it was in good working condition. In the next week, the tests to verify the buffer was then conducted.

In order to verify the buffer, several attempts were required. During the tests, it was clear an error had appeared in the system of the pH metre. Multiple steps and procedures were carried out with the guidance and help from the supervisor to fix the issue. In order to verify the buffer, it was necessary to be able to measure the tolerance level. Therefore, the supervisor taught on how to do so.

On the 1st June the MCO was enforced and therefore usage of the lab was not possible. The project was then unable to continue. During the MCO the supervisor handed new reading materials to read and study.

2.3 Description of Task Assigned

2.3.1 Callibration of pH Meter (pH 1500)

2.3.1.1 Using Phosphate Standard Solution as Sample (pH 6.86)

2.3.1.1.1 Prepared 4 beakers by rinsing it with distilled water and drying it using tissue.

2.3.1.1.2 Poured phthalate pH standard solution (pH 4.01) into a beaker and labelled it C1 (Calibrant 1)

2.3.1.1.3 Poured phosphate pH standard solution(pH 6.86) into three separate beakers and labelled it C2 (calibrant 2), sample and standard.

2.3.1.1.4 Pressed mode until it showed calibration.

2.3.1.1.5 Then removed the probe of the pH metre out of its storage solution and into the beaker labelled C1.

2.3.1.1.6 Waited for the pH metre to indicate stable then pressed enter and proceeded to record the data.

2.3.1.1.7 Rinsed the electrode with distilled water.

2.3.1.1.8 Placed the probe into the beaker labelled C2 and waited for the ph metre to indicate stable.

2.3.1.1.9 Pressed enter and afterwards pressed standard to change the mode into measuring.

2.3.1.1.10 Rinsed the electorde and placed it in the beaker labelled sample and wait for it to stablise.

2.3.1.1.11 Removed the probe from the beaker then placed it in the beaker and waited to stabilise.

2.3.1.1.12 Repeated step 10-11 five times.

2.3.1.1.13 Rinsed the electrode and then measured the beaker labiled standard.

2.3.1.1.14 Repeated step 13 five times

2.3.1.1.15 Repeated step 10-14 three times and then repeat step 13-14.

2.3.1.1.16 Calculated the uncertainty by inserting the data obtained in the excell worksheet.

2.3.1.2 Using Phtahlate Standard Solution as Sample (pH of 4.01)

1)Prepared 4 beakers by rinsing it with distilled water and drying it using tissue.

2) Poured phosphate pH standard solution (pH 6.86) into a beaker and labelled it C1 (calibrant 1)

3) Poured phthalate pH standard solution(pH 4.01) into three separate beakers and labelled it C2 (calibrant 2), sample and standard.

4) Pressed mode until it showed calibration.

5) Then removed the probe of the pH metre out of its storage solution and into the beaker labelled C1.
6) Waited for the pH metre to indicate stable then pressed enter and proceeded to record the data.
7) Rinsed the electrode with distilled water.
8) Placed the probe into the beaker labelled C2 and waited for the ph metre to indicate stable.
9) Pressed enter and afterwards pressed standard to change the mode into measuring.
10) Rinsed the electorde and placed it in the beaker labelled sample and wait for it to stablise.
11) Removed the probe from the beaker then placed it in the beaker and waited to stabilise.
12) Repeated step 10-11 five times.
13) Rinsed the electrode and then measured the beaker lablled standard.
14) Repeated step 13 five times
15) Repeated step 10-14 three times and then repeat step 13-14.
16) Calculated the uncertainty by inserting the data obtained in the excell worksheet

2.3.2 Environmental Control Test

Filled up the waterbath using tap water until all the the heating coil is submerged in the tap water. Switched on the waterbath and set temperature at 24.5°C. Placed the thermometer in the waterbath and ensured the bulb of the thermometer is properly submerged. The temperature of the waterbath from themometer and the digital display on the waterbath was recorded in a five minute interval for one hour and fourty minutes. The results obtained were calculated using the excell worksheet and the standard deviation were achieved.

2.3.3 Verification of pH buffer (pH 4.01) using the pHL-90

1. Prepared 4 bottles of 250 ml. Poured the Phtalate pH Standard solution (pH 4.01) into 2 seperate bottles and labelled as C1 and Std.
2. Poured the phtalate solution produced into another bottle and labelled it as sample. Poured the phosphate pH Standard Equimolal Solution (pH 6.86) as C2. Leave the bottle into the incubator atleast for a night to homogenize all the solutions.
3. Switched on the waterbath and the pH meter before starting the experiment on the next day. Oppened the stopper located on the side of the electrode. Pressed:

on the pHL-90 to show the reading or measurement of the substance currently measuring.

Started the pump by pressing:

CCW

4. Rinsed the system by placing the deionized water on the jack and letting it run for 5 minutes.
5. After 5 minutes, stopped the pump by pressing:

   STOP

   and replaced the deionized water with the bottle labelled C1 for calibration. The pH of the calibrant was recorded at an interval of one minute until the five reading became constant/ within the tolerance range (±0.0005). Then, pressed:

   CAL 1 (MANU) → MEAS/STANDBY

6. Rinsed the system again using deionized water for 5 minutes before proceeding.Afterwards, stopped the pump and substituted the deionozed water with C2 bottle to for the second point of the callibration. Started the pump recorded the data for every minute until five readings became constant/ within tolerance range (±0.0005). Then pressed:

   CAL 2 (MANU) → MEAS/STANDBY

7. Upon completing the calibration, the standard and sample would be measured to verify the pH buffer produced.
8. Before proceeding the system is rinsed with deionized water for three minutes to rid of any unwanted substances or interference that may cause the readings deviate.
9. Replaced the deionized water with the bottle labelled standard. Ran the system and the data was recorded for every one minute until five readings became constant/ within the tolerance range (±0.0005). Afterwards, rinsed the system using deionized water for three minutes to before measuring the sample.

10. The deionized water was replaced with the sample and the system was run. Recorded the data for every minute until the five readings became constant/ within tolerance range (±0.0005).
11. Repeated steps 8 to 10 for 4 times.
12. After the sixth time of measuring the standard the verification of the pH buffer was done.

Chart 1: Illustration of overall experiment

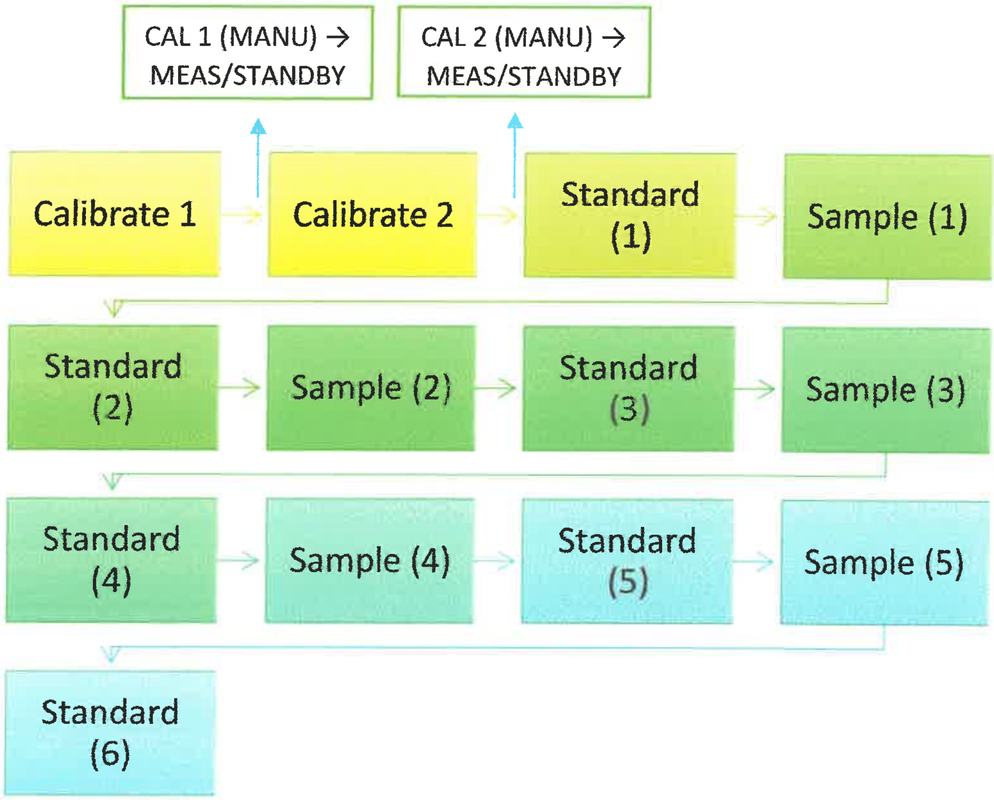
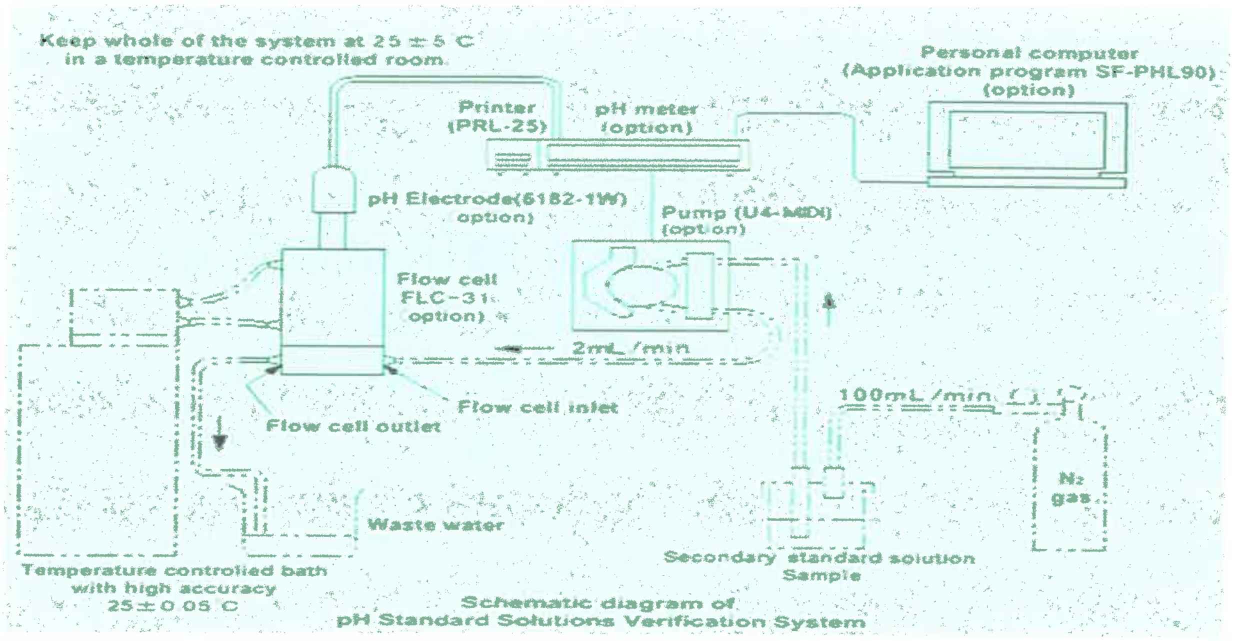


Chart 2: Apparatus Set Up



3.0 RESULTS

***ALL THE CALCULATION HAS BEEN CALCULATED DIRECTLY IN EXCEL**

3.1 Callibration of Portable pH Meter (pH1500)

3.1.1 pH 4.01

(i) pH 6.86 (Cal 1) and pH 4.01 (Cal 2)

Analytical Method: Glass electrode Method

Temperature : 25°C

pH Measurement at 25°C

Period measuremet: 23/3/2021-30/3/2021

Stability test for water bath (25°C)

Time (min)	Temperature (°C)	
	Bath Reading	Temperature
0	25.2	22.00
10	25.1	21.90
20	24.9	21.90
30	24.9	21.80
40	24.7	21.80
50	24.7	21.80
60	24.6	21.80
70	24.6	21.60
80	24.5	21.60
90	24.5	21.60
100	24.5	21.60
Standard Deviation (SD)	0.25	0.238

Equation for Standard Deviation:

$$SD = \sqrt{\frac{\sum(x-X)^2}{N-1}}$$

	Std 1	Std 2	Std 3	Std 4	Std 5
	4.0430	4.0430	4.0120	4.0080	3.9650
	4.0360	4.0350	4.0080	3.9890	3.9600
	4.0330	4.0260	4.0020	3.9820	3.9560
	4.0300	4.0180	3.9880	3.9780	3.9520
	4.0260	4.0120	3.9920	3.9700	3.9490
Average	4.0336	4.0268	4.0024	3.9854	3.9564
Mean	4.0302	4.0146	3.9939	3.9709	
(Cstd-Mean)	-0.0202	-0.0046	0.0161	0.0391	

Equation for average:

$$X = \frac{\sum x}{N}$$

Equation for mean:

$$\text{Mean} = \frac{\text{STD}_i + \text{STD}_{(i+1)}}{2}, \text{ where i= 1,..,5}$$

	Sample 1	Sample 2	Sample 3	Sample 4
	4.0610	4.0530	4.0590	4.0330
	4.0370	4.0510	4.0350	4.0200
	4.0190	4.0460	4.0230	4.0080
	4.0130	4.0410	4.0120	3.9960
	4.0070	4.0360	4.0120	3.9970
Average	4.0274	4.0454	4.0282	4.0108
Corrected STD	4.0072	4.0408	4.0443	4.0499
Mean 1	4.0356			
SD	0.0193			

*Corrected STD = Corrected Using Standard)

Cstd	4.0100
pH value, C	4.03555
(Cstd-C)	-0.0256

±0.0028 (reference value from certificate)

Symbol (u_i)	Type	Source of uncertainty	Uncertainty value	Probability Distribution	Divisor	Sensitivity Coefficient (C_i)	Standard uncertainty (u pH)
U_A	A	Repeatability	0.0086 pH	N	1.0	1.0	0.0086
u_S	B	Calibration solution	0.0028 pH	N	1.0	1.0	0.0028
u_r	B	Resolution of pH meter	0.0005 pH	R	2SQRT(5)	1.0	0.0001
U_T	B	pH change due to temp. change at 25°C	0.238 °C	N	1.0	0.003	0.0008
u_C	-	Combined Uncertainty		Normal	-	-	0.0091
U	-	Expanded Uncertainty		Normal (k=2)	-	-	0.0182

*N: normal distribution, R: rectangular distribution

Final result:

pH value (*)	4.03555
Combine uncertainty	0.0091
Expanded uncertainty	0.0182 (k=2)

3.1.2 pH 6.86 (pH 1500)

(i) pH 6.86 (Cal 1) and pH 4.01 (Cal 2)

Analytical Method: Glass electrode Method

Temperature : 25°C

pH Measurement at 25°C

Period measuremet: 23/3/2021-30/3/2021

Stability test for water bath (25°C)

Time (min)	Bath Reading	Temperature
0	25.2	22.00
10	25.1	21.90
20	24.9	21.90
30	24.9	21.80
40	24.7	21.80
50	24.7	21.80

60	24.6	21.80
70	24.6	21.60
80	24.5	21.60
90	24.5	21.60
100	24.5	21.60
Standard Deviation (SD)	0.25	0.238

Equation for Standard Deviation:

$$SD = \sqrt{\frac{\sum(x-X)^2}{N-1}}$$

	Std 1	**Std 2**	**Std 3**	**Std 4**	**Std 5**
	6.9000	6.9310	6.8510	6.8680	6.8750
	6.8970	6.9240	6.8530	6.8660	6.8730
	6.8940	6.9090	6.8490	6.8660	6.8690
	6.8890	6.9010	6.8470	6.8650	6.8680
	6.8860	6.8940	6.8480	6.8640	6.8660
Average	6.8932	6.9118	6.8496	6.8658	6.8702
Mean	6.9025	6.8807	6.8577	6.8680	
(Cstd-Mean)	-0.0404	-0.0186	0.0044	-0.0059	

Equation for average:

$$X = \frac{\sum x}{N}$$

Equation for mean:

$$Mean = \frac{STD_i + STD_{(i+1)}}{2}, \text{ where i= 1,..,5}$$

	Sample 1	Sample 2	Sample 3	Sample 4
	6.9250	6.9040	6.8640	6.8730
	6.9160	6.8940	6.8630	6.8660
	6.9080	6.8890	6.8640	6.8620
	6.9030	6.8890	6.8620	6.8620
	6.8990	6.8840	6.8590	6.8560
Average	6.9102	6.8920	6.8624	6.8638
Corrected STD	6.8698	6.8734	6.8668	6.8579
Mean 1	6.8670			
SD	0.0066			

*Corrected STD = Corrected Using Standard)

Cstd	6.8621
pH value, C	6.866975
(Cstd-C)	-0.0049

±0.0028 (reference value from certificate)

Symbol (u_i)	Type	Source of uncertainty	Uncertainty value	Probability Distribution	Divisor	Sensitivity Coefficient (C_i)	Standard uncertainty (u pH)
U_A	A	Repeatability	0.0030 pH	N	1.0	1.0	0.0030
u_s	B	Calibration solution	0.0028 pH	N	1.0	1.0	0.0028
u_r	B	Resolution of pH meter	0.0005 pH	R	2SQRT(5)	1.0	0.0001
U_T	B	pH change due to temp. change at 25°C	0.238 °C	N	1.0	0.003	0.0008
u_c	-	Combined Uncertainty		Normal	-	-	0.0042
U	-	Expanded Uncertainty		Normal (k=2)	-	-	0.0083

*N: normal distribution, R: rectangular distribution

Final result:

pH value (*)	6.866975
Combine uncertainty	0.0042
Expanded uncertainty	0.0083 (k=2)

3.2 Verification of Phtahalate pH Standard Solution (pH 4.01)

(i) pH 6.86 (Cal 1) and pH 4.01 (Cal 2)

Analytical Method: Glass electrode Method

Temperature : 25°C

pH Measurement at 25°C

Period measuremet: 16/8/2018-18/8/2018

Stability test for water bath (25°C)

Time (min)	Temperature (°C)	
	Bath Reading	Temperature
0	24.5	23.2
10	24.5	23.2
20	24.5	23.2
30	24.4	23.2
40	24.5	23.2
50	24.5	23.30
60	24.3	23.30
70	24.5	23.30
80	24.5	23.30
90	24.5	23.30
100	24.3	23.30
Standard Deviation (SD)	0.08	0.052

Equation for Standard Deviation:

$$SD = \sqrt{\frac{\Sigma(x-X)^2}{N-1}}$$

	Std 1	Std 2	Std 3	Std 4	Std 5
	3.7343	3.6710	3.6057	3.6417	3.6204
	3.7340	3.6709	3.6058	3.6145	3.6202
	3.7342	3.6710	3.6058	3.6146	3.6203
	3.7341	3.6713	3.6062	3.6148	3.6204
	3.7337	3.6714	3.6064	3.6151	3.6207
Average	3.7341	3.6711	3.6060	3.6201	3.6204
Mean	3.7026	3.6386	3.6131	3.6203	
(Cstd-Mean)	0.3074	0.3714	0.3969	0.3897	

Equation for average:

$$X = \frac{\sum x}{N}$$

Equation for mean:

$$\text{Mean} = \frac{STD_i + STD_{(i+1)}}{2}, \text{ where i= 1,..,5}$$

	Sample 1	Sample 2	Sample 3	Sample 4
	3.6329	3.5659	3.6388	3.6151
	3.6335	3.5663	3.6391	3.6156
	3.6332	3.5665	3.6393	3.6159
	3.6333	3.5669	3.6391	3.6162
	3.6336	3.5670	3.6392	3.6165
Average	3.6333	3.5665	3.6391	3.6159
Corrected STD	3.9407	3.9380	4.0360	4.0056
Mean 1	3.9801			
SD	0.0487			

*Corrected STD = Corrected Using Standard)

Cstd	4.0100
pH value, C	3.9800775
(Cstd-C)	0.0299

±0.0028 (reference value from certificate)

Symbol (u_i)	Type	Source of uncertainty	Uncertainty value	Probability Distribution	Divisor	Sensitivity Coefficient (C_i)	Standard uncertainty (u pH)
U_A	A	Repeatability	0.0218 pH	N	1.0	1.0	0.0218
u_s	B	Calibration solution	0.0028 pH	N	1.0	1.0	0.0028
u_r	B	Resolution of pH meter	0.0005 pH	R	2SQRT(5)	1.0	0.0001
U_T	B	pH change due to temp. change at 25°C	0.052 °C	N	1.0	0.003	0.0002
u_c	-	Combined Uncertainty		Normal	-	-	0.0219
U	-	Expanded Uncertainty		Normal (k=2)	-	-	0.0439

*N: normal distribution, R: rectangular distribution

Final result:

pH value (*)	3.9800775
Combine uncertainty	0.0219
Expanded uncertainty	0.0439 (k=2)

4.0 DISCUSSION AND SUGGESTION

For the first project, the calibration of the portable pH meter (pH 1500), from the results for the calibration using the Phthalate Standard Solution as the sample was shown that the uncertainty achieved was ±0.0182 which was within the accepted range. Therefore, it indicated that the the portable pH meter was correctly calibrated and it was a successful project. As for the second calibration done using the Phosphate Standard Solution, the uncertainty obtained was ±0.042 which was also within the accepted range. Hence, the two calibrations conducted on the protable pH meter was a succes.

Based on the project, the main purpose of the project is to produced and verify the pH buffer with the aid of the pHL 90, the highly accurate pH meter system. The pH meter used is the best pH meter in Malaysia and it was used to verify the pH buffer by measuring the pH meter using a method called **two point callibration**. During the measurement of the Phthalate Standard Solution (pH 4.01) it was crucial that the temperature was monitored at all times and was kept at a constant. Hence before conducting the experiment, a test known as an environmental control was run in which the temperature of the water bath and the room temperature was recorded for every 5 minutes. This was required as stated in the **General Requirement for The Competence of Testing and Calibration Laboratories** or known as **ISO/IEC 17025:2017**.

The temperature compensation is contained within the instrument because pH electrodes are sensitive towards temperature. Temperature compensation only corrects for the change in the output of the electrode but not for the change in the actual solution. Buffer is a solution that has a constant pH value and has the ability to resist changes in pH but will be affected by temperature. For example, the pH for phthalate pH Standard Solution is pH 4.01 at 25°C while pH 4.00 at 15°C or pH 4.02 at 30°C. Another example is Tetraborate pH Standard Solution which has a pH of 9.18 at 25°C but during different temperature, there is changes in the pH. Based on the results, the uncertainty obtained during the verification of the bufffer which was ±0.0439 was outside the accepted tolerance range. Hence, it was clear that the verification was done incorrectly. This was probably due to a few errors while conducting the pH meter. During the process of measuring the sample, it was noticed that a few bubbles had emerged in the tubes. Although the amount of bubbes were few in numbers, it had caused the readings to become inaccurate during the procedure. Attempts of removing the bubbles were done but occasionally it would reappear. This maybe due to the tubes being faulty or human error during conducting the experiment.

Next, the selection of the buffer. Buffer or known as Secondary pH Standard is a solution that can resist the changes of solution in hydrogen ion concentration upon the addition of small amounts of acid or alkaline. The reference pH values for primary pH standards are established by high accuracy potentiometric measurements. They are using a specially designed electrochemical cells and platinum-hydrogen gas electrode rather than a glass electrode, as the H^+ - sensing electrode. The major function is to avoids an error in potential measurement arising from liquid junction potential and the asymmetry potential.

After that, regarding to the glass electrode. It is developed in an aqueous solution is proportional to hydrogen activity or pH of the solution. Hydrogen ion in the solution forms a dynamic equilibrium with hydrogen ions that are "bound" to the membrane surface in ion exchange type process, thereby establishing a potential across the membrane. In the same time, the magnitude of potential is proportional to the pH of the solution. For pH measurements in the range 1 to 10, general purpose glass electrode is suitable. To get the best result, the electrode should be care. For example, when not in use, the filling hole of the reference electrode should be covered with the plug provided for this. For reliable pH measurement, properly stored and maintained and do not be stored in water. For additional cleaning, soak the pH electrode in either 0.1 molar HCl or 0.1 molar Nitric acid. To calibrate the pH meter, first prepare atleast two buffer solution with known pH. The chosen buffers should not be more than 3 pH unit or no less than 1 pH unit apart because to let it free from contamination, sediment and mould. For example in this experiment, we are using pH 4.01 with pH 6.86 and pH 4.01 as the calibrant.

Before the experiment it is important the analsyt should know the general knowledge regarding to this experiment. First of all, the meaning of pH and the pH scale. If we are talking about pH, it means the measurement of pH is either in Acid or Base. By having an Acid or Base reactions, the relationship of pH to the acidity and basicity is based on the Nernst equation. There are different type of techniques for measuring pH. It can be in indicators, pH papers or pH meters. After gaining the knowledge on pH, the analyst should know procedures on properly operating and maintaining a pH meter by reading and studying the appropriate instruction manuals and guides to obtained the satisfactory results.

5.0 CONCLUSION

The 17 weeks in NMIM Sepang was a memorable and honourable experience. The opportunity given to conduct the practical training at NMIM is truly a blessing as there were many advantages and new knowledge gained whilst working in the company. The staffs are very friendly as they gave a warm welcome when first arrived. Furthermore, they were very willinginly to aid and share their knowledge and experience. Eventhough pH can often be regarded as simple, there is more behind it and if study throughly can be complex as their is still a great deal that could be discovered. The study of pH plays a great deal in not only the survival of human beings but many more such as the quality of products.

Overall, in the time spent in the company was highly beneficial as new experience were gathered not only on the measurements of pH but also the methods of producing pH buffers. During the time spent, it was realized that temperature play a huge role in the measurement of pH as it can effect the measurements with the slightest change in temperature. Hence, the supervisor, Encik Khirul Anuar, had advised to monitor and record the temperature of the lab daily. In addition, the oppurtunity to conduct and operate the pH meter was very knowledgable and will someday be benefitted. It was clear that operating the pH meter can be a difficult task as there were uncertaintities during the experiment. All in all, the time and knowledge gained during the internship was eye opening and it was profitable.