LAB EXPERIMENT: DIGITAL PH METER

To determine the pH of a given fluid using pH Meter

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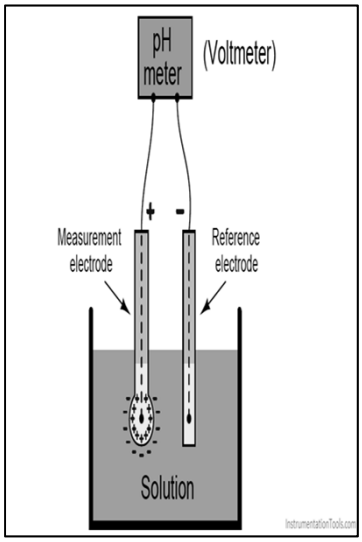
Working Principle of pH Meter:

- The working principle of pH meter is based on the relation between the electric voltage and hydrogen ion concentration.
- The pH meter consists of glass (also called as measurement electrode) and reference electrode.
- Both electrodes are connected to a voltmeter.
- The measurement electrode consists of a glass membrane, which is sensitive to hydrogen ion concentration.
- The reference electrode is standard and has constant potential.
- The acidic solution is rich in H+ ion concentration.
- When pH probe is dipped in an acidic solution and switch on the voltmeter.
- The H+ ion moves close to the glass membrane of the sensitive glass bulb (external side of the bulb).
- A similar reaction occurs inside the bulb, which is filled with a buffer solution of neutral pH (which has constant number of Hydrogen ions).



pH Measurement

Working Principle of pH Meter:

- The H+ ions present inside the bulb also moves close to glass membrane (internal side of the bulb).
- Hence, this causes the difference in the concentration of hydrogen ions across the membrane.
- ***When*** *the hydrogen ion concentration inside the glass bulb is less than the outside solution (test solution), then the given solution is acidic and hence the pH is lower than 7.*
- ***When*** *the hydrogen ion concentration inside the glass bulb is similar to the outside solution (test solution), then the given solution is natural pH hence the pH is 7.*
- ***When*** *the hydrogen ion concentration inside the glass bulb is more than the outside solution (test solution), then the given solution is alkaline and hence the pH is higher than 7.*

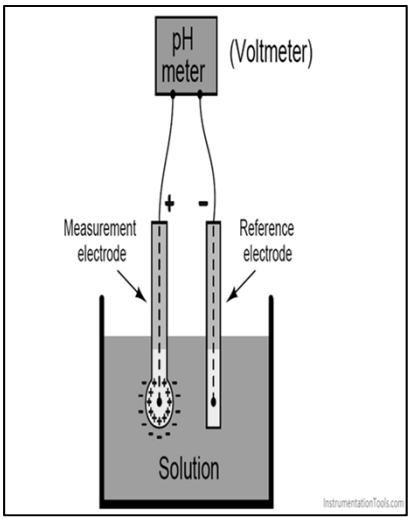


Fig 2: pH Measurement

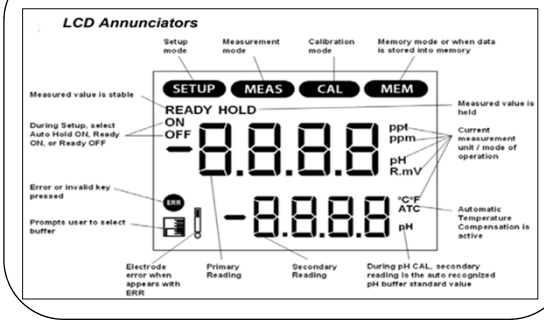
THEORY:

- pH of the solution is the logarithm of the reciprocal of the (H^+) concentration in gm/lit.
- The acidity and the alkalinity of the drilling fluid can be measured by the concentration of the **(H+) ion** in the fluid.

$$pH = -\log [H^+] = \log \frac{1}{[H^+]}$$

- On the scale 7 is neutral, less than 7 is acidic and greater than 7 is basic or alkaline.

Display Screen:



Procedure:

1. Before measurement, rinse pH electrode and ATC probe with distilled water to remove any impurities stuck onto the bodies of probes.
2. Wipe pH electrode and ATC probe with clean dry tissue paper..
3. Power on the meter using ON/OFF key. Press MODE key to select your desired mode (pH) of operation (pH, mV, Ion, or Temperature).
4. Dip and stir both probes gently into given test sample, swirl gently and wait for the reading to stabilize. Note the reading. Freeze the displayed if desired.
5. Note the value of pH with temperature.
6. Rinse probes with distilled water before taking next reading or storage.

Precautions:

1. Don't use the electrode as a stirring glass rod when adjusting pH
2. Do the calibrations before testing the each sample using standard buffer solutions.
3. Avoid temperature fluctuations and never keep the pH meter exposed to direct sunlight.
4. Always do the calibration by attaching ATC to the electrode for best accuracy.
5. The glass electrode should not be left out of the storage solution prolonged intervals as the glass membrane gets dehydrated resulting in slower response or response failure.

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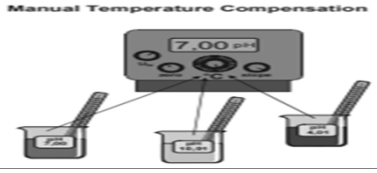
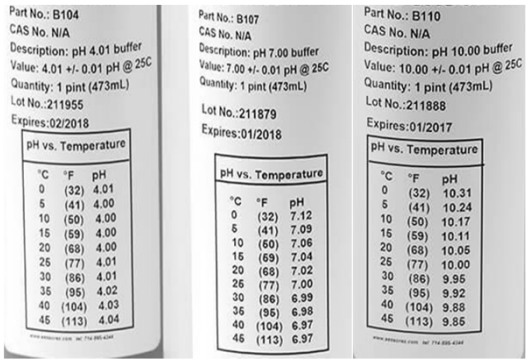
CALIBRATION:



Buffer solutions with pH table:



Part No.: B104
CAS No. N/A
Description: pH 4.01 buffer
Value: 4.01 +/- 0.01 pH @ 25C
Quantity: 1 pint (473mL)
Lot No.:211955
Expires:02/2018

pH vs. Temperature		
°C	°F	pH
0	(32)	4.01
5	(41)	4.00
10	(50)	4.00
15	(59)	4.00
20	(68)	4.00
25	(77)	4.01
30	(86)	4.01
35	(95)	4.02
40	(104)	4.03
45	(113)	4.04

Part No.: B107
CAS No. N/A
Description: pH 7.00 buffer
Value: 7.00 +/- 0.01 pH @ 25C
Quantity: 1 pint (473mL)
Lot No.:211879
Expires:01/2018

pH vs. Temperature		
°C	°F	pH
0	(32)	7.12
5	(41)	7.09
10	(50)	7.06
15	(59)	7.04
20	(68)	7.02
25	(77)	7.00
30	(86)	6.99
35	(95)	6.98
40	(104)	6.97
45	(113)	6.97

Part No.: B110
CAS No. N/A
Description: pH 10.00 buffer
Value: 10.00 +/- 0.01 pH @ 25C
Quantity: 1 pint (473mL)
Lot No.:211888
Expires:01/2017

pH vs. Temperature		
°C	°F	pH
0	(32)	10.31
5	(41)	10.24
10	(50)	10.17
15	(59)	10.11
20	(68)	10.05
25	(77)	10.00
30	(86)	9.95
35	(95)	9.92
40	(104)	9.88
45	(113)	9.85

- Accuracy level of the buffer solutions are ±0.01 pH@25°C.

Procedure:

1. Before calibration, rinse pH electrode and ATC probe with clean water to remove any impurities stuck onto the bodies of probes.
2. Wipe pH electrode and ATC probe with clean dry tissue paper..
3. Power on the meter using ON/OFF key. Press MODE key to select your desired mode (pH) of operation (pH, mV, Ion, or Temperature).
4. You have to calibrate the equipment with three buffer solution(pH-4, pH-7 & pH-10)
5. Always remember for calibration you should take pH-7 buffer solution first.
6. Dip and stir both probes gently into ph-7 buffer solution and press the CAL mode.
7. In display screen the top value shows the original reading and bottom shows the calibration point.
8. After stabilized the reading press ENTER to accept the calibration.
9. Note the reading with temperature and match with the buffer solution table.
10. Rinse probes with distilled water before calibration with pH-4 buffer solution.
11. The buffer solutions are for single time useable.
12. The buffer solutions should be preserve at a temperature between(25°C to 27°C)
13. Same procedure will be followed for pH-4 and pH-10 Buffer solutions.

Calibration frequency:

- Once a month.

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ASSIGNMENT:

Group-A

Theory question

1. Full form of ATC in the pH measurement equipment is ?

a) Automatic Temperature Compensation
b) Automatic Temperature Comparison
c) Accelerated Temperature Compensation
d) Accelerated Temperature Comparison

2. pH meter shouldn't be exposed to direct sunlight? Reason.

a) Due to safety issues
b) Effect on accuracy of the equipment.
c) Reduce life of the equipment
d) None of the above.

3. During calibration of pH meter which buffer solution should you take first?

a) Buffer solution(pH:4)
b) Buffer solution (pH:7)
c) Buffer solution(pH:10)
d) All of the above.

Numerical question

4. Determine the pH of a solution that has a H^+ concentration of $7.45X10^{-3}M$.

Group-B

Theory question

Numerical question

4. Determine the pH of a solution that has a H^+ concentration of $4.45X10^{-3}M$.

Group-C

Theory question

Numerical question

4. Determine the pH of a solution that has a H^+ concentration of $10.45X10^{-3}M$.

Group-D

Theory question

Numerical question

4. Determine the pH of a solution that has a H^+ concentration of $6.45X10^{-3}M$.