I. PURPOSE

pH is a measure of the acidity or alkalinity of a solution and can be represented by the equation:
\[ \text{pH} = -\log[H^+] \]
with \( H^+ \) representing the concentration. When a precise pH on urine or other body fluid is desired, an electronic pH meter is used. The electronic pH meter is a sensitive electrometer designed to measure the hydrogen ion concentration in a liquid medium. It performs the measurement by indicating the voltage developed between two electrodes. These electrodes are connected to a galvanometer which in turn translates the result into a digital readout. The pH meter is equipped with a single ROSS combination electrode. Both the calomel and glass electrodes are in the same glass tubing, but separated physically.

II. POLICY/SCOPE

For use by licensed CLS staff only.

III. TEST AVAILABILITY

Test available 24 hours per day 7 days per week.

IV. SPECIMEN REQUIREMENTS

Red or black top or clean container. Sample stability - Room Temperature: 2 Hrs, Refrigerated: 24 Hrs

A pH may be done on any body fluids in addition to urine. The specimen must be liquid; semi-formed or formed stool cannot be used. Since pH can change on storage, tests should be run immediately. Platelet samples may also be measured by this method.

V. EQUIPMENT, REAGENTS AND SUPPLIES

1. pH Reference Buffer Solution (7.00). Purchased from Fisher, catalog number SB108-500. Stable at room temperature until expiration date on bottle.

2. pH Reference Buffer Solution (4.00). Purchased from Fisher, catalog number SB98-500. Stable at room temperature until expiration date on bottle.


5. HCl (0.1 M): Add 4.2 mL concentrated hydrochloric acid to 250 mL of deionized water in a 500 mL volumetric flask. QS to volume. Stable for 2 years at room temperature.

VI. WARNINGS AND PRECAUTIONS

BIOHAZARD

All products or objects that come in contact with human or animal body fluids should be handled, before and after cleaning, as if capable of transmitting infectious diseases. Wear facial protection, gloves, and protective clothing.

Use bloodborne pathogen precautions when handling patient samples, calibrators or QC materials.

VII. CALIBRATION/ CALIBRATION VERIFICATION

See Procedure below.

VIII. QUALITY CONTROL

1. pH Buffer Solution (7.00), color yellow. Purchased from Fisher, catalog number SB107-500. Stable at room temperature until expiration date on bottle.
IX.  PROCEDURE

I.  Standardization:

The Denver UB-10 pH meter must be standardized each day of use. Use fresh buffers for this step. Once calibration has been performed, recalibration of the meter needs to be performed if the pH 4.00 and pH 7.00 control buffer solutions are out of the posted acceptable ranges.

1.  **Slide the filling hole cover open.**

2.  Immerse electrode in pH 4.00 buffer. Stir gently and allow the electrode to reach a stable value. (S will be displayed on left side of screen when stable.)

3.  If necessary, press and release the **mode** button until the digital display indicates pH mode.

4.  Clear existing buffers when doing a new standardization. Press the **setup** button. When the screen shows Clear, press the **enter** button to clear existing buffers.

5.  Press **standardize**. The meter flashes the current buffer set and recognizes the flashing buffer.

6.  When the signal is stable, the meter displays the percent slope of the electrode as 100% on the first buffer. Press **enter** to accept.

7.  Remove the electrode from the pH 4.00 buffer, rinse with D.I. water, gently blot and place the electrode into the pH 7.00 buffer solution. Gently stir. Allow the electrode to stabilize. When this **S** box appears on the screen, press **standardize**.

8.  The meter will display a slope reading that must be between 90 and 105 % slope to avoid a Slope Error. However, the slope reading must be between **92 and 102%** to be acceptable due to the Ross electrode used. Record the slope value on the maintenance chart. Press **enter** to continue. Recalibrate the pH meter if the slope is not between 92 and 102%.

9.  **Slope Error** indicates that the electrode is not working properly. Measurements causing **Slope Error** are not accepted, used or stored by the meter. Press **enter** to continue.

II.  pH of Unknowns:

1.  For the first sample of the day, calibrate the electrode as described in previous section.

2.  Prior to reading the pH of the unknown sample, read the pH 7.00 and 4.00 control buffers as unknowns. If either buffer is out of the acceptable range, recalibrate the electrode before reading the unknown sample. Record all results on the pH worksheet.

3.  Rinse the electrode with deionized water and gently absorb off the excess water with a gauze sponge.

4.  Place the electrode in the solution.

5.  When the display is stable, record sample pH. Rinse the electrode with deionized water.

6.  Place the electrode in the pH Electrode Storage Solution.

7.  **Slide the filling hole cover closed.**
Notes:

1. Always use fresh buffers for calibration.

2. Check electrode slope daily by performing a two buffer calibration. Slope should be 92 to 102%.

3. To view the slope of current calibration/standardization, press the setup button twice. Press the setup button four more times to return to the measuring mode.

4. Only use ROSS Internal Filling Solution, Orion cat. No. 810007, or 3M KCl.

5. Remove the filling hole cover during measurement and slide it closed during storage.

6. Between measurements, rinse electrode with deionized water and then with the next solution to be measured.

7. Stir all buffers and samples.

8. Avoid rubbing or wiping electrode bulb, to reduce chance of error due to polarization.


10. Weekly Electrode Maintenance

   1) Inspect the electrode for scratches, cracks, salt crystal build-up, or membrane/junction deposits.

   2) Rinse off any salt build-up with deionized water, and remove any membrane/junction deposits.

   3) Drain the reference chamber and refill it with fresh ROSS Filling Solution (3M KCl). To maintain an adequate flow rate, the level of filling solution must cover the end of the coil.

   4) Check lot numbers of all four pH buffers. Record on reagent log sheet if different.

11. Monthly Electrode Cleaning

    Soak the electrode in 0.1 M HCl for half an hour. Drain the reference chamber, flush with fresh ROSS Filling Solution or 3M KCl and refill the chamber. Soak the electrode in storage solution for at least one hour before use.

X. RESULTING/REPORTABLE RANGE

Reportable Range: pH 2.00 to pH 10.00

All results are recorded on the worksheet. The worksheet code is PH. Report urine, body fluid and platelet sample pH's to two decimal places. Report pH values less than 2.00 as <2.00 and values above 10.00 as >10.00.

If the sample is >2 hours old at room temperature, append ETC “STAQ” (Stability period exceeded. Result questionable) to the result.

XI. EXPECTED VALUES (N/A)

XII. LIMITATIONS OF PROCEDURE (N/A)
XIII. SPECIFICITY/INTERFERENCES

Electrode efficiency and each buffer change depending on the temperature of the solution. The table below is representative of most buffers. Due to the insignificant change of the pH at room temperature, an Automatic Temperature Compensation (ATC) probe will not be used and temperature compensation will not take effect.

<table>
<thead>
<tr>
<th>U.S Standard Buffer</th>
<th>pH 4.00</th>
<th>pH 7.00</th>
<th>pH 10.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°C</td>
<td>4.005</td>
<td>7.13</td>
<td>10.34</td>
</tr>
<tr>
<td>5°C</td>
<td>4.003</td>
<td>7.10</td>
<td>10.26</td>
</tr>
<tr>
<td>10°C</td>
<td>4.001</td>
<td>7.07</td>
<td>10.19</td>
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<tr>
<td>15°C</td>
<td>4.002</td>
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<td>10.06</td>
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<tr>
<td>25°C</td>
<td>4.008</td>
<td>7.00</td>
<td>10.00</td>
</tr>
<tr>
<td>30°C</td>
<td>4.010</td>
<td>6.99</td>
<td>9.94</td>
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<td>4.020</td>
<td>6.98</td>
<td>9.90</td>
</tr>
<tr>
<td>40°C</td>
<td>4.030</td>
<td>6.97</td>
<td>9.85</td>
</tr>
<tr>
<td>50°C</td>
<td>4.061</td>
<td>6.97</td>
<td>9.78</td>
</tr>
</tbody>
</table>

XIV. ALTERNATE METHODS

Beckman model 3500 digital pH meter (in Hematology, room M524)

XV. REFERENCES