

pH MEASUREMENT



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pH - Take Home Messages

- ◆ pH is an electrochemical measurement, useful in many applications.
- ◆ As with many electrochemical analyses, pH requires frequent calibration to achieve accurate results.
- ◆ Proper probe maintenance is essential.



pH Measurement - Outline

- ◆ Introduction to pH and electrochemistry
- ◆ Understanding pH
- ◆ Measuring pH
- ◆ Probe care and maintenance



pH Measurement

- ◆ pH is typically measured with a meter and probe
- ◆ This is an electrochemical method of analysis





What is Electrochemistry?

◆ Electrochemical measurements include:

➤ pH

➤ Ion-selective electrode (ISE)





Understanding pH





pH Theory

- ◆ pH is a measurement of the relative acidity of an aqueous solution
- ◆ pH is a measurement of hydrogen ion concentration

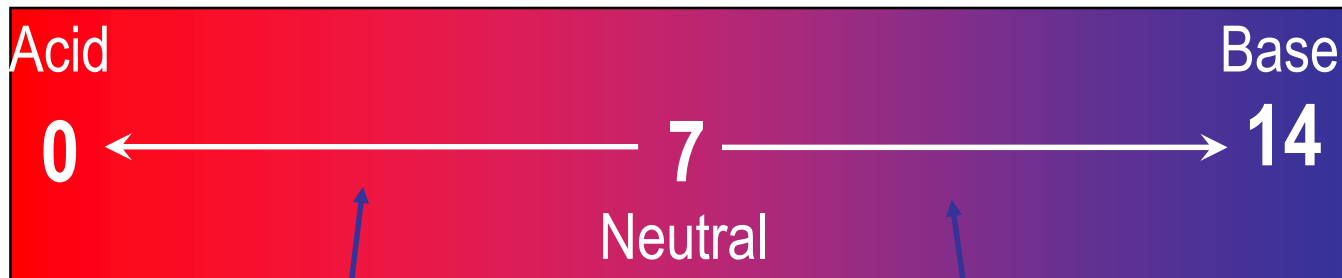


pH Theory

- ◆ Acid - increases the hydrogen ion (H^+) concentration in a solution
- ◆ Base - increases the hydroxide ion (OH^-) concentration in a solution



pH Scale



Vinegar pH 3

Ammonia pH 11.5



Measuring pH





How Does a pH Probe Work?

- ◆ Probe measures hydrogen ion concentration
 - ✦ Two electrodes in probe - sensing half-cell, reference half-cell





METER

**Ion Sensing
Half-Cell**

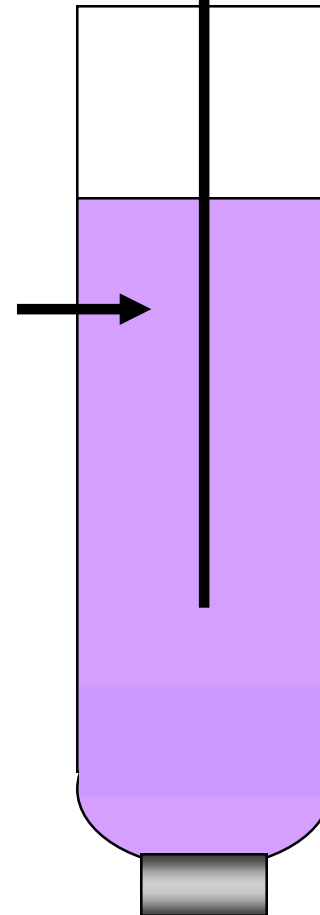
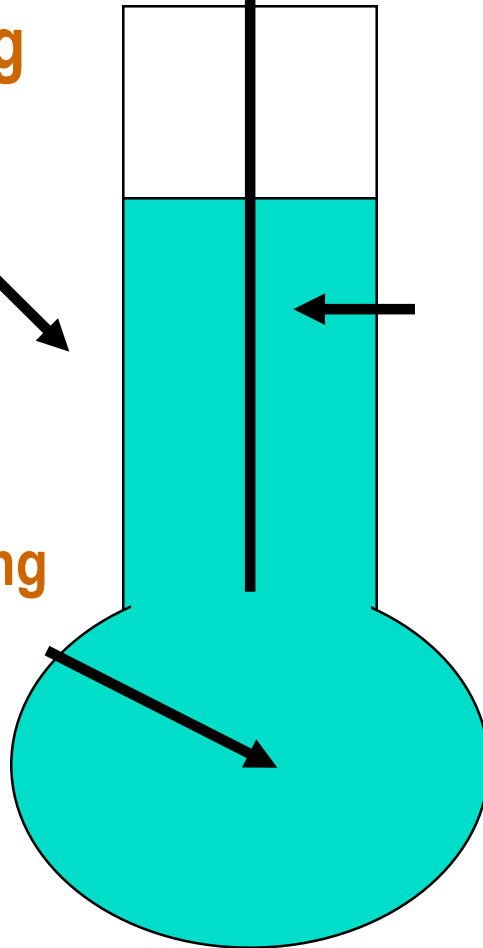
**Reference
Half-Cell**

**Ag/AgCl
Wire**

**Internal Filling
Solution**

**Reference
Electrolyte**

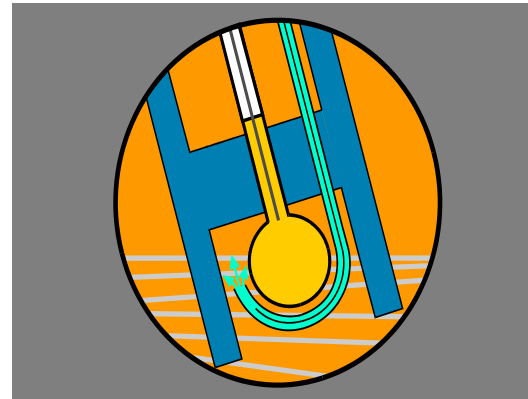
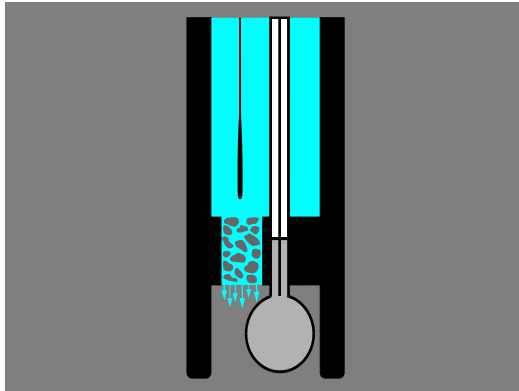
**Salt Bridge
Junction**





Reference Half-Cell

- ◆ Dispenses reference solution which completes circuit for meter



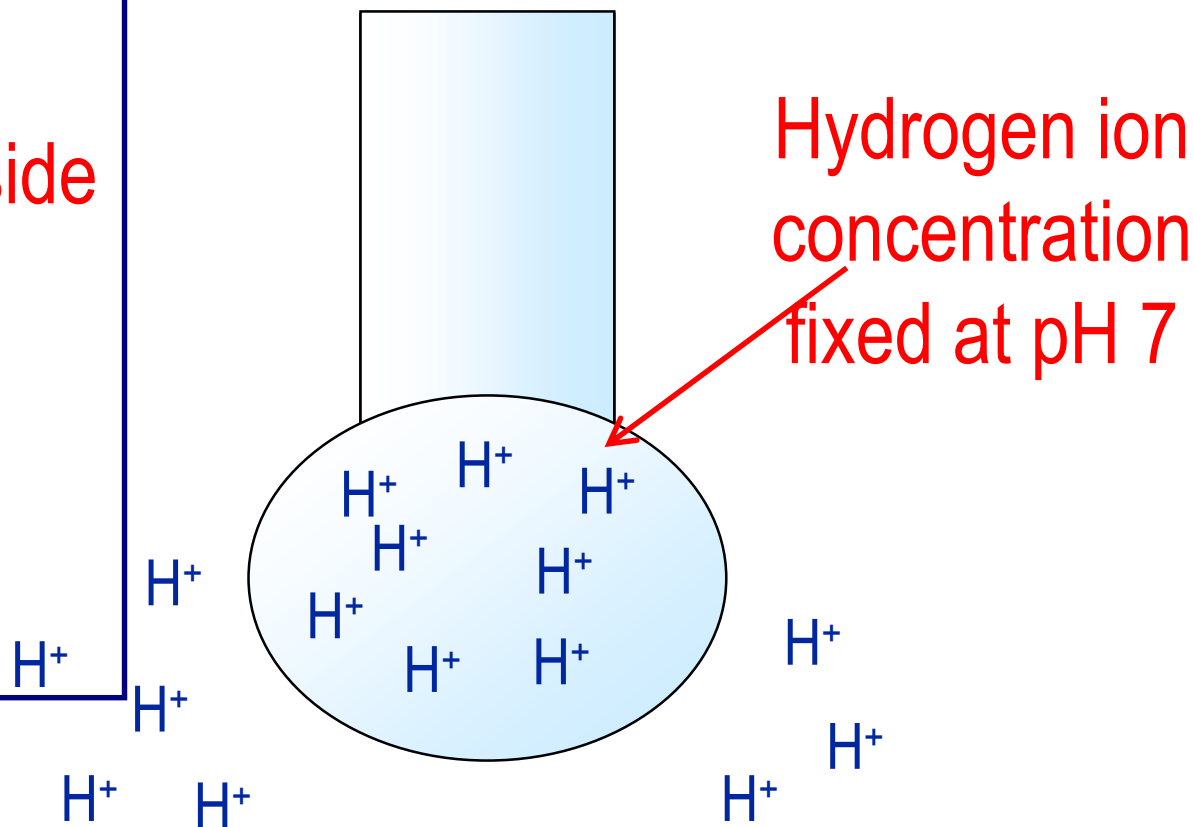


Sensing Half-Cell

pH 7 Solution

H^+ conc the same both inside and outside glass bulb

*No potential develops



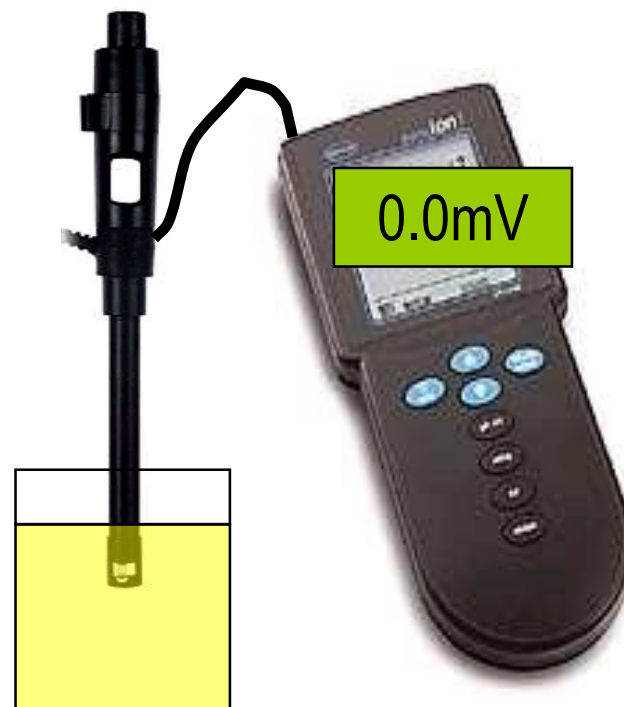


Sensing Half-Cell

pH 7 Solution

H^+ conc the same both
inside and outside
glass bulb

*No potential develops



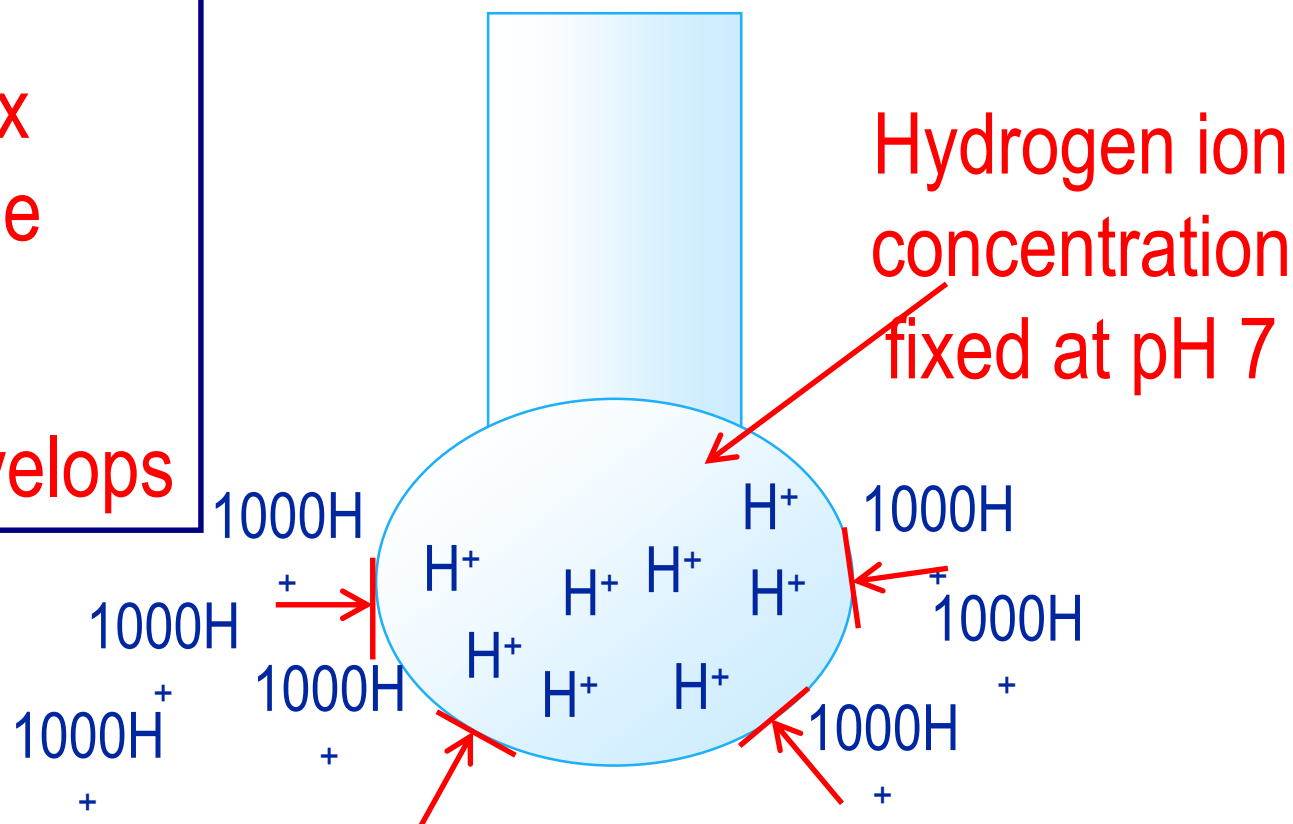


Sensing Half-Cell

pH 4 Solution

H^+ conc 1000x
greater outside
glass bulb

*Potential develops





Sensing Half-Cell

pH 4 Solution

H^+ conc 1000x greater
outside glass bulb

*Potential develops



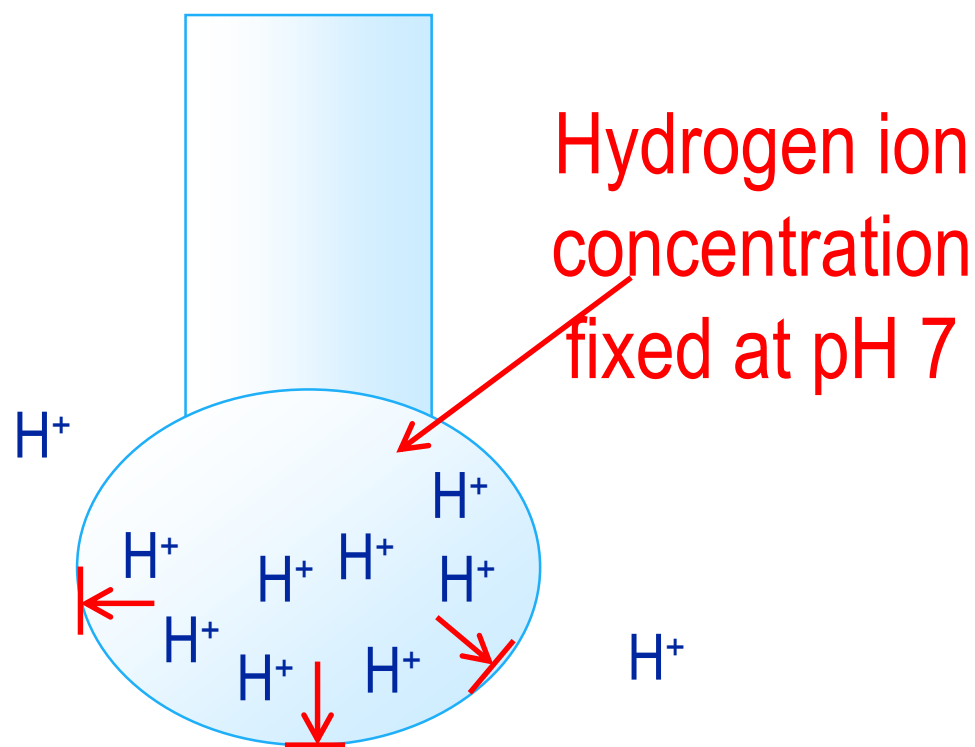


Sensing Half-Cell

pH 10 Solution

H^+ conc 1000x
greater inside glass
bulb

*Potential develops



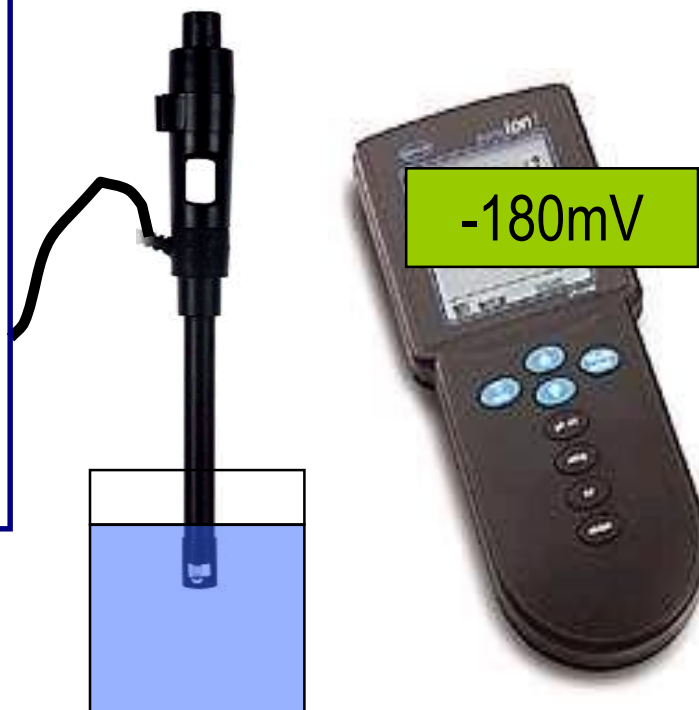


Sensing Half-Cell

pH 10 Solution

H^+ conc 1000x greater
inside glass bulb

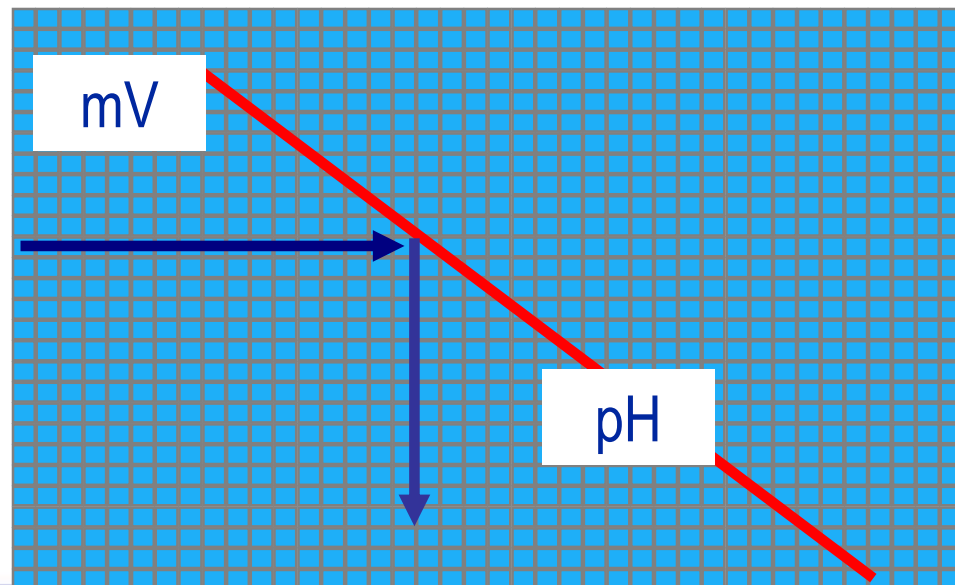
*Potential develops





Calibration

- ◆ A calibration curve allows the meter to convert a measured millivolt potential into a pH reading.





Probe Care and Maintenance





Maintenance

- ◆ New probe
- ◆ Calibration
- ◆ Measurement/Storage
- ◆ Troubleshooting
- ◆ Cleaning





New Probe

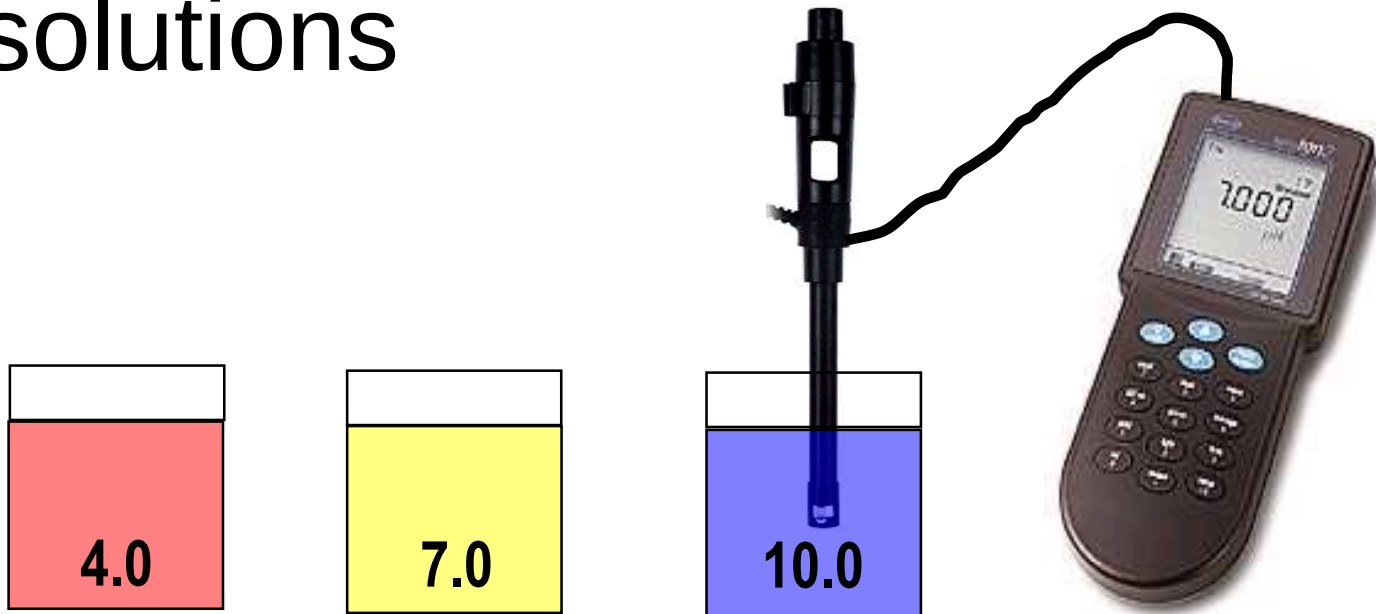
- ◆ Condition new pH probe in pH 7 buffer for approximately 30 minutes before initial use





Calibrate

- ◆ Calibrate pH meters daily using two or three buffer solutions





Measurement

- ◆ Place probe into sample, stir, and wait for readings to stabilize
- ◆ Rinse and dry between measurements
- ◆ Storage between measurements
 - ✦ Sample *or* solution of similar ionic strength to sample
 - ✦ pH7 buffer



Troubleshooting

- ◆ mV reading in pH 7 buffer
 - Should read 0 ± 30 mV in pH 7 buffer
- ◆ Response time
 - May require cleaning if slow in buffered solution
- ◆ Slope
 - Optimal slope is -58 ± 3 mV/decade



Cleaning

- ❖ Slow response may indicate need for cleaning
 - Alternate soaking in dilute hydrochloric acid and dilute sodium hydroxide
 - Rinse with deionized water
 - Condition in pH 7 buffer before use



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