

Characterizing a TRIS Buffer

When microorganisms reproduce they release waste products that may change the pH of their environment in a manner that prevents their further reproduction. This can present a problem in biology labs where microorganisms are grown in the closed environment of a culture dish. Culture media, therefore, are usually buffered. One common buffer is made using the weak base tris(hydroxymethyl)aminomethane, which is more commonly called TRIS, and its conjugate weak acid, TRISH⁺. Relevant information about this buffering system is provided here:

TRIS is $(\text{HOCH}_2)_3\text{CNH}_2$ and has a K_b of 1.19×10^{-6}

TRISH⁺ is $(\text{HOCH}_2)_3\text{CNH}_3^+$ and is available as the salt $(\text{HOCH}_2)_3\text{CNH}_3\text{Cl}$

1. What range of pH values are possible for buffers made using TRIS and TRISH⁺?
2. At what pH will a TRIS/TRISH⁺ buffer have its greatest capacity for neutralizing against the addition of strong acid?
3. Suppose you want to make a TRIS/TRISH⁺ buffer with a pH of 9.00 and that the equilibrium concentration of TRIS needs to be 0.100 M. What concentration of TRISH⁺ will you need?
4. A TRIS/TRISH⁺ buffer is prepared by dissolving 50.0 g of TRIS and 65.0 g of TRIS·HCl (the chloride salt of TRISH⁺; see formula above) in deionized water and diluting to 2.00 L. What is the pH of this buffer?
5. What is the pH after adding 0.5 mL of 12.0 M HCl to a 200.0-mL portion of the buffer from Problem 4?
6. What is the buffer capacity against the addition of strong base for a 200.0-mL portion of the buffer from Problem 4? Express your answer in terms of the maximum volume, in mL, of 6.0 M NaOH that can be added?