



4. A titration of 25 mL of a 0.01 M HCl solution was conducted using 0.02 M NaOH. What is the pH of the solution after the addition of 10.0 mL of the 0.02 M NaOH?

5. A student performed a titration of 15 mL of a 0.10 M acetic acid solution with 0.10 M NaOH. At the equivalence point the student was surprised to find the pH of the solution was greater than 7.0. Using actual numerical values, show why the pH at the equivalence point of this titration is greater than 7.0.

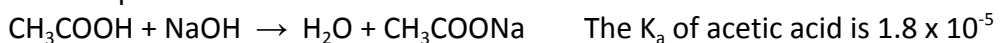
The balanced equation is:



6. For the titration of 20.0 mL of 0.20 M acetic acid with 0.10 M NaOH, determine the pH when:

1. 10.0 mL of NaOH has been added
2. 45.0 mL of NaOH has been added

The balanced equation is:



7. We have 1 L of a buffer solution that is 0.20 M in the weak acid, HA, and 0.20 M in NaA, the salt of the weak acid. What is the pH after the addition of 0.01 moles of HCl? Assume the addition of the HCl causes no change in volume. The  $K_a$  of the weak acid, HA, is  $6.5 \times 10^{-5}$ .

8. What is the solubility of  $\text{Mg}(\text{OH})_2$ , the active ingredient in Roloids in g/L? The  $K_{\text{sp}}$  of  $\text{Mg}(\text{OH})_2$  is  $1.2 \times 10^{-11}$ , and the formula mass of  $\text{Mg}(\text{OH})_2$  is 58.3 g/mol.

9. Many cities fluoridate their water to help reduce tooth decay. Additionally, many cities have hard water, such as Georgetown, and our city water does not have added fluoride. As a rough estimate, the calcium content of Georgetown water is about  $5.1 \times 10^{-3} \text{ M Ca}^{2+}$ . If  $\text{CaF}_2$  were to precipitate out of solution that would make the fluoride unavailable to help reduce tooth decay.

a. At what level could Georgetown add fluoride to its water just to the point of precipitating  $\text{CaF}_2$ ? The  $K_{\text{sp}}$  for  $\text{CaF}_2$  at 25 °C is  $4.0 \times 10^{-11}$ .

b. If the United States Public Health Service recommends a level of  $F^-$  of  $3.68 \times 10^{-5} \text{ M}$  fluoride to prevent cavities, could Georgetown fluoridate its water and not precipitate out  $\text{CaF}_2$ ?