

Acid/base practice problems

You should be able to do these problems without a calculator.

- 1) Calculate the pH (at 25°C, where $K_w = 1.0 \times 10^{-14}$) of the following mixtures:
- a) 30.0 mL of 0.020 M $\text{Ca}(\text{OH})_2$ and 20.00 mL of 0.040M HBr. Calculate the pOH of this solution as well. [**pH = 11.90, pOH = 2.10**]
 - b) 25.0 mL of 1.0 M HA ($K_a = 4 \times 10^{-4}$). [**1.70**]
 - c) 25.0 mL of 1.0 M HA and 10.0 mL of 1.0 M NaOH [**3.22**]
 - d) 25.0 mL of 1.0 M HA and 12.5 mL of 1.0 M NaOH [**3.40**]
 - e) 25.0 mL of 1.0 M HA and 15.0 mL of 1.0 M NaOH [**3.58**]
 - f) 25.0 mL of 1.0 M HA and 25.0 mL of 1.0 M NaOH [**8.55**]
 - g) 25.0 mL of 1.0 M HA and 26.0 mL of 1.0 M NaOH [**12.30**]
 - h) 25.0 mL of 10.0 M H_2SO_4 . K_{a2} for $\text{H}_2\text{SO}_4 = 1.1 \times 10^{-2}$ [**-1.00**]
 - i) 25.0 mL of 1.0 M "B" (a weak base), for which $K_b = 4.0 \times 10^{-4}$ [**12.30**]
 - j) 25.0 mL of 1.0 M NH_3 and 10.0 mL of 1.0 M HCl [**10.78**]
 - k) 25.0 mL of 1.0 M NH_3 and 12.5 mL of 1.0 M HCl [**10.60**]
 - l) 25.0 mL of 1.0 M NH_3 and 15.0 mL of 1.0 M HCl [**10.42**]
 - m) 25.0 mL of 1.0 M NH_3 and 25.0 mL of 1.0 M HCl [**5.45**]
 - n) 25.0 mL of 1.0 M NH_3 and 26.0 mL of 1.0 M HCl [**1.70**]
 - o) 25.0 mL of 1.0 M H_2A (for which $K_{a1} = 4.0 \times 10^{-4}$ and $K_{a2} = 4.0 \times 10^{-8}$) [**1.70**]
 - p) 25.0 mL of 1.0 M H_2A and 10.0 mL of 1.0 M NaOH [**3.22**]
 - q) 25.0 mL of 1.0 M H_2A and 12.5 mL of 1.0 M NaOH [**3.40**]
 - r) 25.0 mL of 1.0 M H_2A and 15.0 mL of 1.0 M NaOH [**3.58**]
 - s) 25.0 mL of 1.0 M H_2A and 25.0 mL of 1.0 M NaOH [**5.40**]
 - t) 25.0 mL of 1.0 M H_2A and 35.0 mL of 1.0 M NaOH [**7.22**]
 - u) 25.0 mL of 1.0 M H_2A and 37.5 mL of 1.0 M NaOH [**7.40**]
 - v) 25.0 mL of 1.0 M H_2A and 40.0 mL of 1.0 M NaOH [**7.58**]
 - w) 25.0 mL of 1.0 M H_2A and 50.0 mL of 1.0 M NaOH [**10.46**]
 - x) 25.0 mL of 1.0 M H_2A and 55.0 mL of 1.0 M NaOH [**12.80**]
- 2) H_3A is a weak acid with $\text{p}K_{a1} = 3.0$, $\text{p}K_{a2} = 7.0$, and $\text{p}K_{a3} = 11.0$. Calculate the ratio of $[\text{H}_3\text{A}]:[\text{H}_2\text{A}^{-1}]:[\text{HA}^{-2}]:[\text{A}^{-3}]$ in a solution with a pH of 6.0. If you were going to make a solution with a pH of 6.0 and only allowed to use two of H_3A , NaH_2A , Na_2HA , and Na_3A , which two would you pick? [**$10^3:10^6:10^5:1$, NaH_2A and Na_2HA**]
- 3) A certain indicator has a $\text{p}K_{\text{ind}} = 2.0$. You use it in the titration of 10.00 mL of 0.1200 M HCl with 0.1000 M NaOH. At what added volume of NaOH will the endpoint be reached? Does this make it a good or a bad indicator for this titration? [**10.00 mL, no**]