Chemistry 116 - Fall 2021

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Discussion Worksheet - Week 14

1. Why does an acid-base titration curve (pH versus volume of titrant) have an abrupt change at the equivalence point?

2. 100 mL of 0.3750 M $Ba(OH)_2$ is titrated with 0.4540 M $HClO_4$. Determine the pH

   a) before any acid is added [13.88]

   b) one mL before the equivalence point [11.24]

   c) at the equivalence point [7.00]

   d) one mL after the equivalence point [2.77]

3. 100 mL of 0.150 M aqueous ammonia ($K_b = 1.8 \times 10^{-5}$) is titrated with 0.100 M hydrochloric acid.

   a) What is the pH before the titation begins? [11.21]

   b) What is the pH at the half-equivalence point? [9.25]

   c) What is the pH at the equivalence point? [5.24]

   d) What is the pH when the titration is 1 mL past the equivalence point? [3.4]

4. The acid HA has $pK_a = 7.00$. Which is the principal species, HA or A^- at a) pH 6.00, b) pH 8.00? What is the quotient $[A^-]/[HA]$ at c) pH 7.00, d) pH 6.00? [HA, A^-, 1.0, 0.10]

5. The diprotic acid H_2A has $pK_{a1} = 4.00$ and $pK_{a2} = 8.00$. At what pH is a) $[H_2A] = [HA^-]$, b) $[HA^-] = [A^{2-}]$? Which is the principal species, $[H_2A]$, $[HA^-]$, or $[A^{2-}]$ at c) pH 2.00, d) pH 6.00, e) 10.00?

[4.00, 8.00 H_2A, HA^-, A^{2-}]

6. The base B has $pK_b = 5.00$. a) What is the value of pK_a for BH^+? b) At what pH is $[BH^+] = [B]$? c) Which is the principal species, B or BH^+, at pH 7.00? c) What is the quotient $[B]/[BH^+]$ at pH 12.00?

[9.00, 9.00, BH^+, 1.00×10^3]

7. What is the pH of 0.050 M $NaHSO_3$? For H_2SO_3 $K_{a1} = 1.39 \times 10^{-2}$ and $K_{a2} = 6.73 \times 10^{-8}$ [4.51]

8. The dibasic compound B ($pK_{b1} = 4.00$, $pK_{b2} = 8.00$) was titrated with 1.00 M HCl. The initial solution of B was 0.100 M and had a volume of 100.0 mL. Find the pH at the following volumes of acid added:

a) 0 mL [11.49]

b) 1 mL [10.95]

c) 5 mL

d) 9 mL

e) 10 mL [8.00]

f) 11 mL [6.95]

g) 15 mL

h) 19 mL

i) 20 mL [3.54]

j) 22 mL [1.79]