Quick Review

1. Strong acid by strong base titrations.
2. Strong base by strong acid titrations.

Announcements

1. Review sheet posted on-line.
2. Exam Thursday from 7-8:15pm check website for location.
4. Bring pencil, eraser, calculator and ID to exam.
5. Class May 6th optional.
Weak Acid by Strong Base Titration

- **Weak acid**: \( \text{pH} = \text{pK}_a \)
- **Buffer**: \( \text{pH} = \text{pK}_a \)
- **Strong base**: Equivalence point
- **Weak base**: Vol NaOH added (mL)
Weak Acid by Strong Base Titration

Four Parts to Weak Acid by Strong Base Titration Curve:

1. Before strong base is added this is a weak acid problem.

2. After strong base is added and up to just before the equivalence point, this is a buffer problem. The effect of adding OH⁻ is to convert the weak acid into its conjugate base. Between the initial point and the equivalence point, both HA and A⁻ are present, hence a buffer. At halfway to the equivalence point just enough OH⁻ has been added to convert one-half of the weak acid into its conjugate base, therefore [HA] = [A⁻], so pH = pKₐ.
3. At the equivalence point, this is a weak base problem. Just enough strong base has been added to convert all the weak acid, HA, to its conjugate base, A⁻. Only A⁻, Na⁺ and H₂O remain. At the equivalence point of a weak acid by strong base titration, the pH is always greater than 7.00 because a weak base is present.

4. After the equivalence point, strong base is in excess. This is a strong base problem. Figure out how much OH⁻ is present, then calculate pH. There are two bases present at this point (A⁻ and OH⁻) but the pH is determined by the strongest base. The contribution of OH⁻ by the weak base is negligible as compared to the strong base present.
Useful Tips

1. These types of calculations usually involve two problems in one. First a stoichiometry problem, which involves a strong base reacting with the weak acid. Since a strong base is reacting, the reaction goes to completion, hence the stoichiometry problem. After the stoichiometry part of the calculation, see what is remaining in solution to determine the type of problem, i.e. buffer, weak base or strong base problem.

2. Work with mmoles or moles instead of concentrations.

3. First calculate the volume of base necessary to reach the equivalence point. This will allow you to determine what type of problem you should have at each volume point.
Example

A 25.0 mL sample of 0.100 M lactic acid (HC$_3$H$_5$O$_3$, pK$_a$ = 3.86) is titrated with 0.100 M NaOH. Calculate the pH after the addition of:

(a) 0.0 mL
(b) 8.0 mL
(c) 12.5 mL
(d) 25.0 mL
(e) 30.0 mL
Example
Example
Weak Base by Strong Acid Titrations

Half-way to equivalence
\[ \text{pH} = pK_a \text{ or } pOH = pK_b \]

Weak base

Weak acid
Weak Base by Strong Acid Titrations

Five Parts to Weak Base by Strong Acid Titration Curve:

1. Before any strong acid is added this is a weak base problem.

2. After strong acid is added until just before the equivalence point a buffer solution is present.

3. At half-way to equivalence $\text{pH} = pK_a$ or $\text{pOH} = pK_b$.

4. At the equivalence point only weak acid is present, therefore it is a weak acid problem.

5. After the equivalence point strong acid is in excess.
Weak Base by Strong Acid Titrations

A 25 mL sample of NH₃ (Kₐ = 1.8 x 10⁻⁵) was titrated with 0.100 M HCl. Calculate the pH at the following volumes of strong acid added:

(a) 0.0 mL
(b) 12.5 mL
(c) 25.0 mL
Example