ACID-BASE TITRATIONS
WEAK ACID OR BASE

CHEM 251 SDSU

STRONG TITRANT, WEAK ANALYTE

- Similar approach as used for the strong/strong titrations: three equations to use.
- Challenges arise since the weak analyte will not dissociate fully - the back reaction can be significant.
- The pK_a of the analyte will play an important role in the calculations.

SAMPLE PROBLEM

Plot the titration curve for the titration of 18.0 mL of 50.0 mM phenylacetic acid with 40.0 mM KOH.

Determine the pH after the following volumes of titrant have been added:

A) 0.00 mL of titrant
B) 6.00 mL of titrant
C) 14.00 mL of titrant
D) 22.50 mL of titrant
E) 26.00 mL of titrant

PH BEFORE THE V_{EQ}

- Before any titrant is added the pH is determined by the K_a.
- Before the equivalence point the analyte will be in excess (dominant species).
- As titrant is added the concentration of the conjugate to the analyte is increased.
- This results in a buffer being formed - Henderson-Hasselbach equation.

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HENDERSON-HASSELBACH TRICK

- We don't need to know the actual concentration of the analyte and its conjugate.
- Knowing V_{eq} - express the concentration as the amount titrated/left by volumes.

$$HA + OH^- \rightleftharpoons H_2O + A^-$$

V_{eq} = 36 mL Titrant added = 15 mL

[HA] =36 - 15 = 19 $[A^-]$ = 15 [HA]+[A] = V_{eq}

PH AT THE EQUIVALENCE POINT

- At the equivalence point the moles of titrant are equal to the moles of analyte.
- The pH is <u>not</u> 7.00.
- Because the analyte acid/base is weak the reverse reaction becomes important.
- $A^- + H_2O \rightleftharpoons HA + OH^-$ $\quad K_b = K_w/K_a$
- Equivalence pH: > 7 for weak acid analytes; < 7 for weak base analytes.

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PH AFTER V_{EQ}

- Once past V_{eq} the titrant is in excess.
- The titrant is always a strong acid/base, it will dissociate completely - this overshadows the back reaction of the analyte.
- The pH is dependent only on the concentration of excess titrant.

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TITRATION CURVE

Plot the titration curve for the titration of 18.0 mL of 50.0 mM phenylacetic acid with 40.0 mM KOH.