TITRATION CALCULATIONS (pH) "What’s in your dish?"

EQUILIBRIUM POINT IN A TITRATION, ONLY PRODUCTS ARE PRESENT!

PRODUCTS DETERMINE THE pH EQ POINT

I. SA/SB Strong acid / Strong base titrant

\[ \text{H}_2\text{X} + \text{MOH} \rightarrow \text{H}_2\text{O} + \text{MX} \] neutral

\[ \text{pK}_a = 7.0 \text{ EQ POINT } \text{pH} \]

NO BUFFER FORMED BEFORE \[ \text{pH} = -\log [\text{H}] \]

\[ [\text{H}] = [\text{HX}] \]

\[ \text{DUE TO} \]

\[ \text{pH} = -\log [\text{excess SA}] \]

\[ \text{pH} = 14 - \text{pOH} \]

25.0 mL of 0.1M HCl analyze titrate with 0.1M NaOH titaent \[ \text{H}_2\text{O}, \text{NaCl} \]

\[ \text{pH} \text{ after adding 10.0 mL of } \text{titrant} \]

\[ \text{KCl} \]

\[ \text{pH} = -\log [\text{excess OH}^-] \]

\[ \text{pH} = 14 - \text{pOH} \]

\[ \text{NaOH} \times (0.100) \times (0.010) = 0.00100 \text{ mol NaOH} \]

\[ \text{HCl} \times (0.100) \times (0.005) = 0.00050 \text{ mol HCl} \]

\[ \text{LEAST} \]

\[ \text{H}_2\text{O}, \text{NaCl}, \text{NaOH} \]

\[ 0.0015 \text{ mol HCl} = 0.0015 \text{ mol H}^+ \]

\[ \text{pOH} = -\log [\text{excess OH}^-] \]

\[ \text{pH} = 14 - \text{pOH} \]

\[ \text{pH} = 1.37 \]
TITRATION CALCULATIONS (PH) "WHAT'S IN YOUR DISH"  

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PRODUCTS DETERMINE THE pH EQ POINT

I. STRONG ACID / STRONG BASE TITRATION

\[ \text{HX} + \text{MOH} \rightarrow \text{H}_2\text{O} + \text{MX} \] Neutral

\[ \text{pH} = 7.0 \text{ EQ POINT} \quad \text{pH} \]
NO BUFFER FORMED
BEFORE \[ \text{pH} = \frac{-\log[\text{M}] - \log[\text{HX}]}{[\text{H}^+] = [\text{OH}^-]} \]

\[ \text{OUR EQ} \]
\[ \text{pH} = \frac{-\log[\text{excess HX}]}{\text{pH}} \]

PAST
\[ \text{pH} = \frac{-\log[\text{excess OH}^-]}{14 - \text{pOH}} \]

25.0 mL of 0.1M HCl analyze
TITRATE w/ 0.1M NaOH TITRANT \text{H}_2\text{O, NaCl} \text{KCl}

pH after adding 10.10 mL of titrant?
< DURING >

NaOH \( \text{c(0.10M)(0.010L)} = 0.00100 \) \text{NaOH}
HCl \( \text{c(0.10M)(0.025L)} = 0.00250 \) \text{HCl}

\[ \text{PAST} > \text{H}_2\text{O, NaCl, NaOH} \]

\[ \text{pH} = 14 - \text{pOH} \]

\[ \text{[HCl]} \leftrightarrow 0.0350 \]
\[ 0.0430 \text{ M } \text{pH} = 1.37 \]
1. Weak acid + strong base $\rightarrow$ pH?

HF $K_a = 3.5 \times 10^{-4}$

HF + OH$^-$ $\rightarrow$ H$_2$O + F$^-$

25.0 mL HF

0.10 M analyte

0.10 M titrant

A) Before

$K_a = \frac{[H^+][X^-]}{[HX]}$

$\chi = [H^+]$

$\chi = \frac{0.005}{0.1}$

$\chi = 0.058 M$

$pH = 2.23$

B) During

BUFFER

$pH$ after adding 15 mL of OH$^-$?

$pH = pK_a + \log \frac{[X^-]}{[HX]}$

$V = 40 mL$

HF = (0.10 M)(0.025 L) = 0.0025$ moles HF

OH$^- = (0.10 M)(0.015 L) = 0.0015$ moles OH$^-$ $\rightarrow$ 0.0015 moles F$^-$

$0.0015$ moles HF

$[F^-] = \frac{0.0015}{0.040} = 0.038 M$

$[HF] = \frac{0.0025}{0.040} = 0.0625 M$

$pH = 3.46 + \log \frac{0.038}{0.0625}$

$\chi = 3.64$

C) At EQ point

$K_b = \frac{x^2}{[X^-]}$

$K_b = 2.9 \times 10^{-11}$

$pOH = -\log \chi$

$pH = 14 - pOH$