

TITRATION CALCULATIONS (pH) "What's in your dish"

© EQUIVALENCE POINT IN A TITRATION, ONLY
PRODUCTS are present!

PRODUCTS DETERMINE THE pH @ EQ POINT

I. SA/SB strong acid / strong base
 analyte titrant



pH = 7.0 @ EQ POINT
 NO BUFFER FORMED

pH BEFORE

$pH = -\log[H^+]$
 $[H^+] = [HX]$

DUR NG
 $\Rightarrow pH = -\log[\text{excess } HX]$

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

25.0 mL of 0.1M HCl analyte
 titrate w/ 0.1M NaOH titrant $H_2O, NaCl$

pH after adding 10.0 mL of titrant? (HCl)

< DUR NG >

NaOH : $(0.10M)(0.010L) = 0.0010 \text{ mol NaOH}$

HCl : $(0.10M)(0.025L) = 0.0025 \text{ mol HCl}$

$0.0015 \text{ mol HCl} = 0.0015 \text{ mol } H^+$

< PAST > $H_2O, NaCl, NaOH$

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

$pH = 14 - pOH$

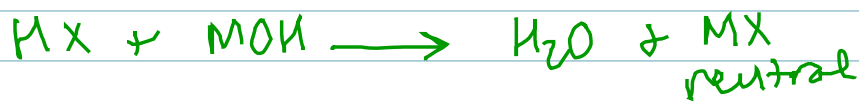
$[H^+] \leftarrow 0.035L$
 $\approx 0.043M$ $pH = 1.37$

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pH

BEFORE

$$pH = -\log[H^+]$$
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DURING

$$\Rightarrow pH = -\log[\text{excess } HX]$$

PAST

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

$$pH = 14 - pOH$$

25.0 mL of 0.1M HCl analyte
titrate w/ 0.1M NaOH titrant

H₂O, NaCl

pH after adding 10.0 mL of titrant?
< DURING >

HCl

$$NaOH = (0.10M)(0.010L) = 0.0010 \text{ mol NaOH}$$

$$HCl = (0.10M)(0.035L) = 0.0035 \text{ mol HCl}$$

< PAST > H₂O, NaCl, NaOH

$$0.0015 \text{ mol HCl} = 0.0015 \text{ mol } H^+$$

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

$$pH = 14 - pOH$$

[H⁺]

0.035L
" 0.043M pH = 1.37

Weak acid + strong base \Rightarrow pH?
 analyte + titrant



25,0 mL HF 0,10 M
 0,10 M analyte OH⁻ titrant

A) BEFORE $K_a = \frac{x^2}{0,1}$ $x = [H^+]$ pH = $-\log x$

$x = 0,0059 M$ pH = 2,23

B) DURING ~~HF~~, ~~H₂O~~, ~~F⁻~~ BUFFER

pH after adding 15 mL of OH⁻? pH = pK_a + log $\frac{[F^-]}{[HF]}$

V = 40 mL HF = (0,10 M)(0,025 L) = 0,0025 mol HF

OH⁻ = (0,10 M)(0,015 L) = 0,0015 mol OH⁻ \Rightarrow mol F⁻
 0,0010 mol HF

[F⁻] = $\frac{0,0015 \text{ mol}}{0,040 L} = 0,038 M$

[HF] = $\frac{0,0010 \text{ mol}}{0,040 L} = 0,025 M$

pH = 3,46 + log $\frac{0,038}{0,025}$

pH = 3,64

C) @ EQ POINT

~~H₂O~~, ~~F⁻~~

$K_b = \frac{10^{-14}}{K_a} = 2,9 \times 10^{-11}$



$n_{F^-} = n_{HF \text{ start}}$

V = 25 mL

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

pOH = $-\log x$ pH = 14 - pOH