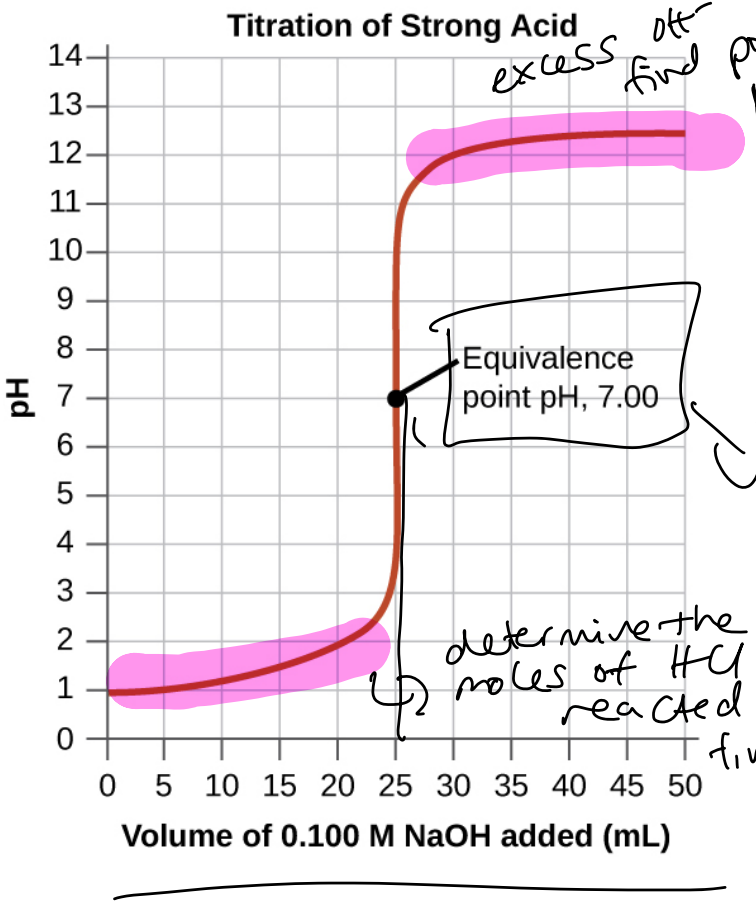
$HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$




excess OH⁻ → find pH

pH

**Analyte: 25.0 mL of 0.100 M HCl**

**Titrant: 0.100 M NaOH**

b/c neutral salt

titration curve #1

strong acid - strong base

determine the moles of HCl reacted

find pH

# Strong Acid–Strong Base Titration Example Problem

- Use stoichiometry to determine moles of acid or base
- Determine concentration in titration flask, pH = -log[$H_3O^+$]

analyte

A 50.0 mL sample of 0.200 M sodium hydroxide is titrated with 0.200 M nitric acid. [titrant]

$NaOH(aq) + HNO_3(aq) \rightarrow$

a. Calculate the pH when 25.0 mL of nitric acid is added.

$0.0250\,L \times 0.200\,M = 0.0050\,mol$

$NaNO_3(aq) + H_2O$

b. Calculate the pH when 75.0 mL of nitric acid is added.

mol NaOH

$0.0500\,L \times \frac{0.200\,mol}{L} =$

0.010 mol of NaOH

$NaOH_{(aq)} + HNO_3 \rightarrow NaNO_3 + H_2O$

0.010 mol + 0.005

−0.005 mol − 0.005

0 0

0.0050 mol $OH^-$

$M\ [OH^-] = \frac{0.0050\,mol}{0.075\,L} = 0.067M$

checkout titration curve

$pOH = 1.2$

$pH = 14 - 1.2 = 12.8$

b) The pH after 75.0 mL of nitric acid is added

mol acid: $0.200\ mol/L \times 0.075 = 0.015\ mol$

$NaOH + HNO_3 \rightarrow NaNO_3 + H_2O$

(aq) (aq) (aq) (l)

0.010 mol 0.0150

$-0.010\ mol$ — 0.010

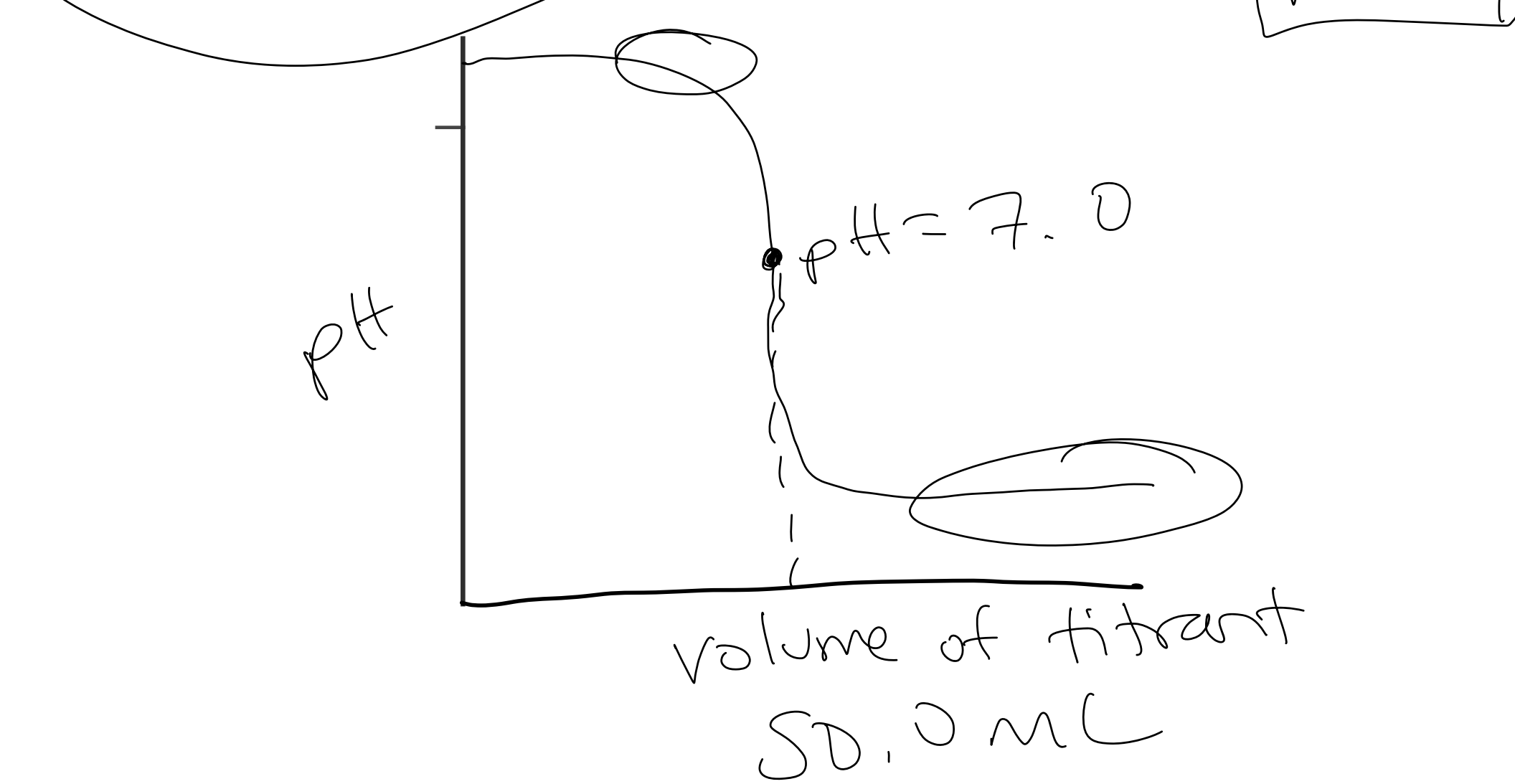
0

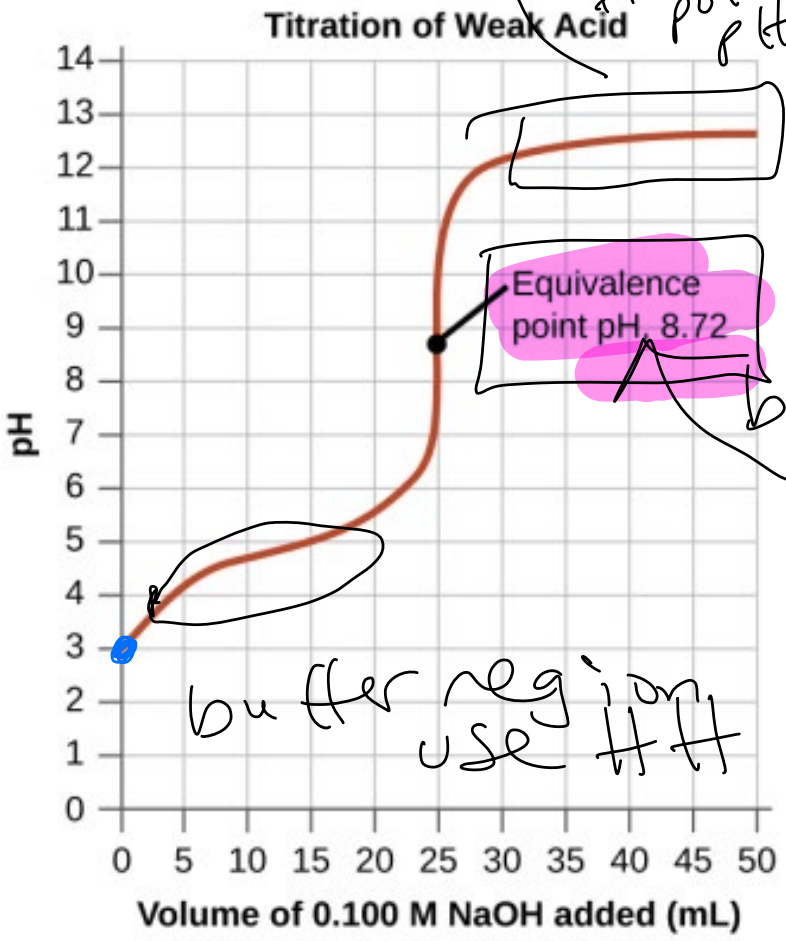
Find $[HNO_3]$, M

$\frac{0.050\ mol}{0.125\ L} = 0.04$

$pH = -\log(0.04$

$pH = 1.4$


pH
pH = 7.0
volume of titrant
50.0 mL




excess base → strong → find pOH → pH

$HC_2H_3O_{2(aq)} + NaOH_{(aq)} \rightarrow$

$NaC_2H_3O_{2(aq)} + H_2O$

Analyte: 25.0 mL of 0.100 M acetic acid

Titrant: 25.0 mL of 0.100 M NaOH

b/c we have a basic salt as a salt

hydrolysis to produce determine the pH

@ eq point

buffer region use HH

@ before any titrant it is a weak acid

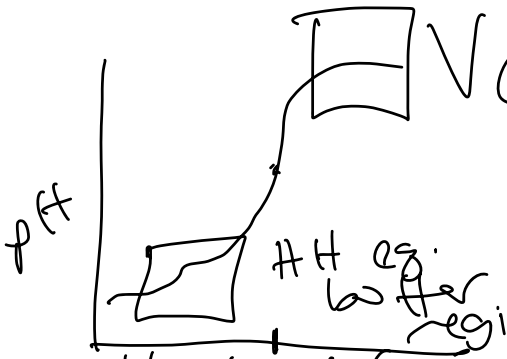
**Example :** **Weak Acid–Strong Base Titration pH Curve**

**A 40.0 mL sample of 0.100 M HA (a generic monoprotic weak acid) is titrated with 0.200 M KOH. Ka for HA is 4.6 10 $^{-6}$. Calculate :**

**a.the volume required to reach the equivalence point**
**b.the pH after adding 5.00 mL of KOH**
**c.the pH at one-half the equivalence point**
**d.the pH at the equivalence point**
**e.pH after 40.0 mL of KOH is added**

$$HA_{(aq)} + KOH_{(aq)} \rightarrow KA_{(aq)} + H_2O_{(l)}$$

a) $0.0400\,L \times \frac{0.100\,mol}{L} = 0.00400\,mol\ HA$




V@eq. $0.00400\,mol \times \frac{1\,L}{0.200\,mol} =$

$V = 20.0\,mL$

b) pH after adding 5.00 mL of KOH

mol of KOH: $0.00500\,L \times \frac{0.200\,mol}{L} =$

$0.00100\,mol$ base

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

| | $OH^-$ | $A^-$ |
|---|---|---|
| $0.00400\,mol$ | $0.00100\,mol$ | $0.00100\,mol$ |
| $-0.00100\,mol$ | $-0.00100\,mol$ | |
| $0.00300\,mol$ | 0 | |

$$pH = pKa + \log\left(\frac{[base]}{[acid]}\right)$$

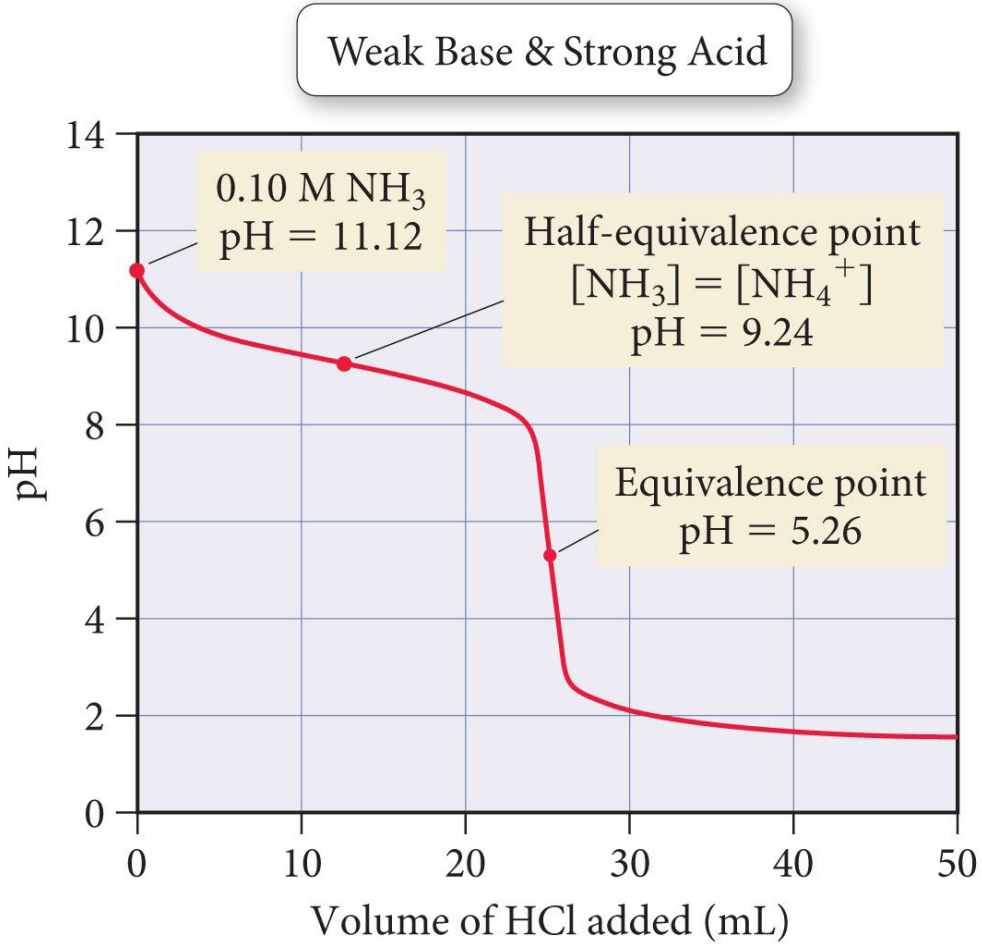
$$\mathrm{pH} = \mathrm{p}K_a + \log\frac{[\text{base}]}{[\text{acid}]}$$

$$pH = -\log(4.6\times10^{-6}) + \log\left(\frac{0.00100}{0.0030}\right)$$

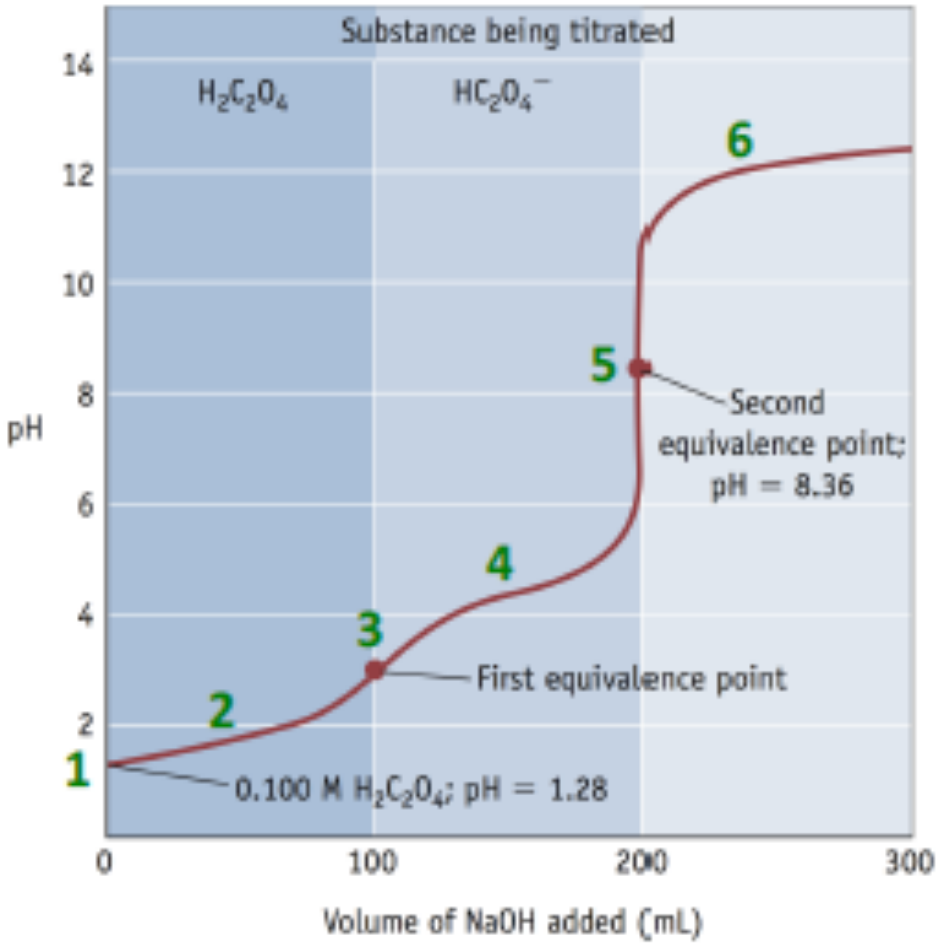
sig fig

$$\boxed{pH = 4.85}$$

# Titration Curve of a Weak Base with a Strong Acid



Titrate 100. mL of 0.100 M oxalic acid ($H_2C_2O_4$) with **0.100 M NaOH**



# Titration of sodium carbonate