Titration of strong acid with strong base.

Titration of 50 mL (0.05 L) of 0.200 M HNO_3 with 0.100 M solution of NaOH.

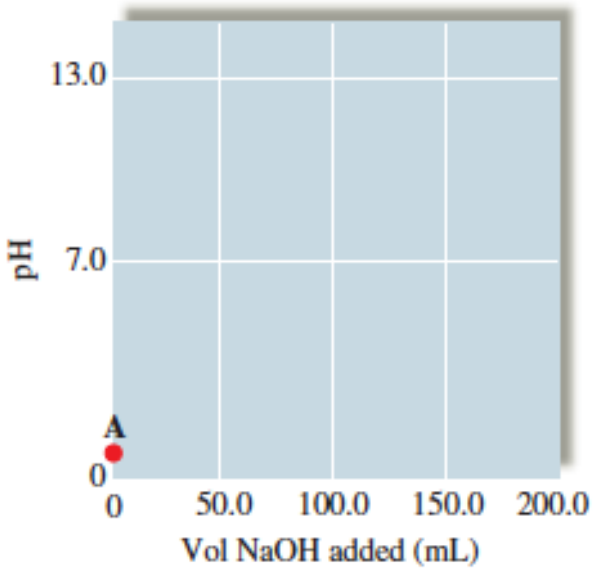
[ ] = Molarity = Moles / Volume (L)

Moles = Molarity x Volume (L)
Moles of HNO_3 = moles of H^+ = Volume x Molarity = 0.05 x 0.2 = 0.01 moles

A) No NaOH was added

1) $[HNO_3] = [H^+] = 0.2$ M,

pH = -log $[H^+]$ = -log 0.2 = **0.699**



B) Add 10 mL (0.01L) of 0.1 M NaOH

Moles of NaOH = Volume (l) x Molarity = 0.01 x 0.1= 0.001 moles of OH^-

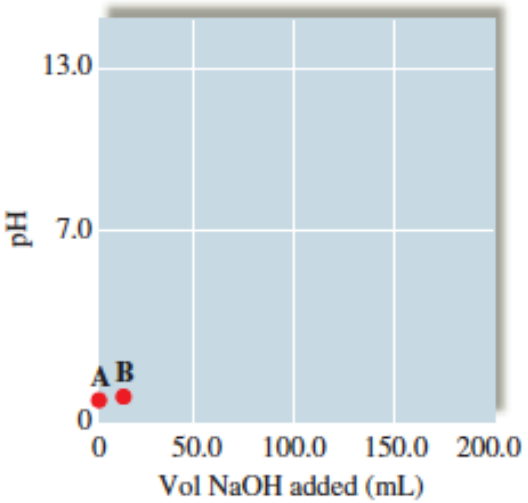
Total volume: 0.05 + 0.01 = 0.06 Liter = Vt

Moles of HNO_3 = 0.01 moles of H^+

	H^+	+	**OH^-**	**=.**	**H_2O**
Before addition	0.01		0.001		
After addition	0.01-0.001		0		
	0.009 moles				

[H^+] = moles/Vt 0.009/0.06 = 0.15 M

pH = -log [H^+] = -log 0.15 = **0.82**



C) Add 20 mL (0.02 L) of 0.1 M NaOH

Moles of NaOH = Volume (l) x Molarity = 0.02 x 0.1= 0.002 moles of OH^-

Total volume: 0.05 + 0.02 = 0.07 Liter = Vt

Moles of HNO_3 = 0.01 moles H^+

	H^+	**+**	**OH^-**	=.	**H_2O**
Before addition	0.01		0.002		
After addition		0.01-0.002	0		
	0.008 moles				
[H^+] = moles/Vt		0.008/0.07 = 0.11 M			
		pH = -log 0.11 = **0.942**			

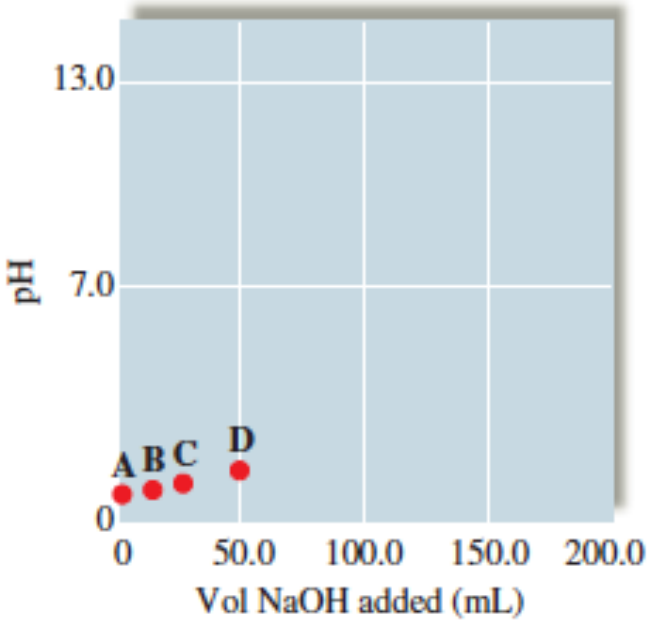
D) Add 50 mL (0.05 L) of 0.1 M NaOH

Moles of NaOH = Volume (l) x Molarity = 0.05 x 0.1= 0.005 moles of OH^-

Total volume: 0.05 + 0.05 = 0.1 Liter = Vt

Moles of HNO_3 = 0.01 moles of H^+

	H^+	**+ OH^-**	**=.**	**H_2O**
Before addition	0.01	0.005		
After addition	0.01-0.005	0		
	0.005 moles			
[H^+] = moles/Vt	0.005/0.1= 0.05 M			
	pH = -log 0.05 = **1.3**			

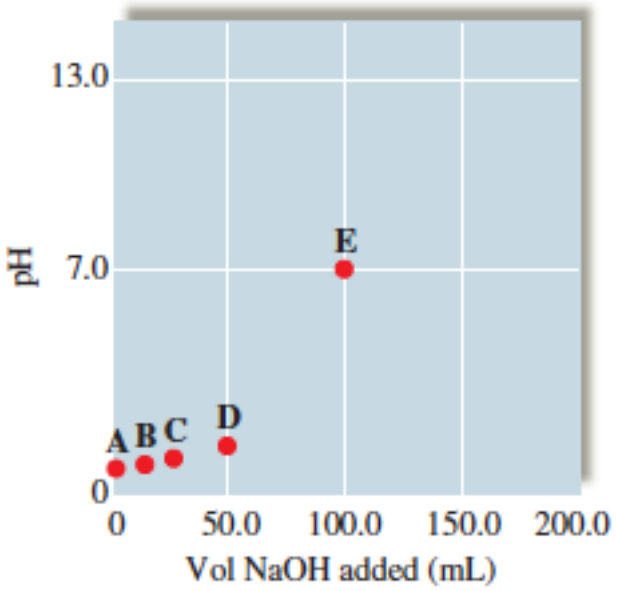


E) Add 100 mL (0.1 L) of 0.1 M NaOH

Moles of NaOH = Volume (l) x Molarity = 0.1 x 0.1= 0.01 moles of OH^-

Moles of HNO_3 = 0.01 moles of H^+

Equivalence point: pH = **7**



F) Add 150 mL (0.15 L) of 0.1M NaOH

Moles of NaOH = Volume (l) x Molarity = 0.15 x 0.1= 0.015 moles of OH^-

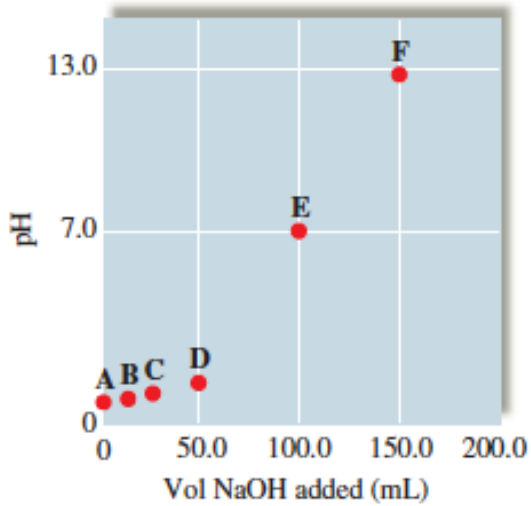
Total volume: 0.05 + 0.15 mL = 0.2 Liter = Vt

Moles of HNO_3 = 0.01 moles H^+

	H^+	**+**	**OH^-**	**=.**	**H_2O**
Before addition	0.01		0.015		
After addition	0.01-0.01		0.015-0.01		
	0		0.005 mole		
[OH^-] = moles/Vt			0.005 /0.2 = 0.025 M		

pOH = -log [OH^-]= -log 0.025

pH = 14 - pOH = **12.4**



G) Add 200 mL (0.2 L) of 0.1M NaOH

Moles of NaOH = Volume (l) x Molarity = 0.2 x 0.1= 0.02 moles of OH^-

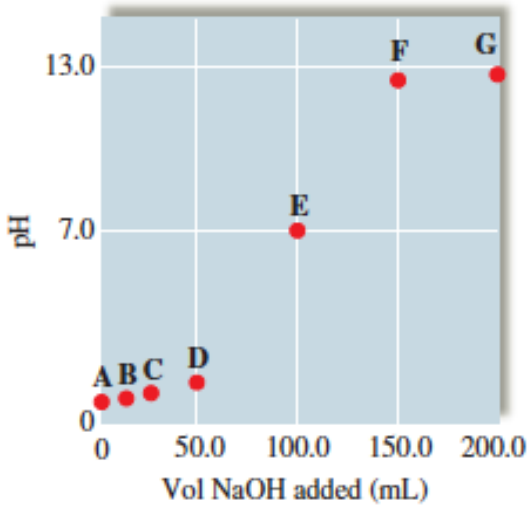
Total volume: 0.05 + 0.2 = 0.25 Liter = Vt

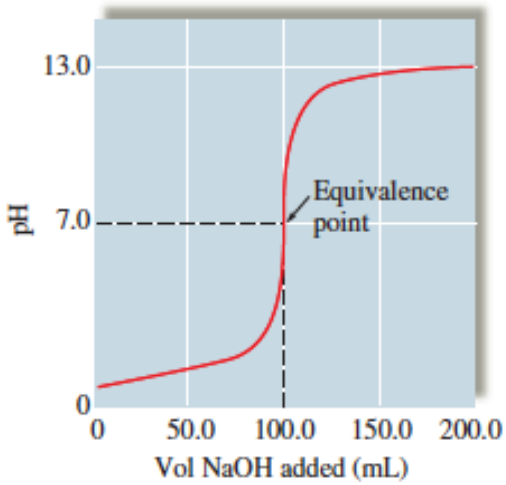
Moles of HNO_3 = 0.01 moles H^+

	H^+	**+ OH^-**	**=.**	**H_2O**
Before reaction	0.01	0.02		
After reaction	0.01-0.01	0.02-0.01		
	0	0.01mole		
[OH^-] = moles/Vt		0.01/0.25 = 0.04 M		

pOH = -log [OH^-]= -log 0.04

pH = 14 - pOH = **12.60**


13.0
7.0
0
pH
A
B
C
D
E
F
G
0
50.0
100.0
150.0
200.0
Vol NaOH added (mL)


13.0
7.0
0
pH
Equivalence point
0
50.0
100.0
150.0
200.0
Vol NaOH added (mL)

Titration of strong base with strong acid

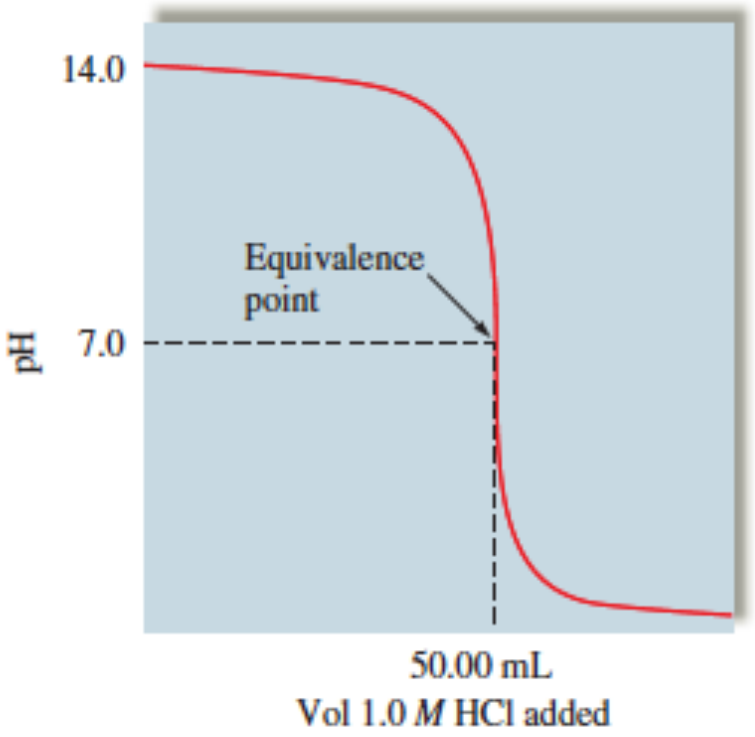


FIGURE 15.2
The pH curve for the titration of 100.0 mL of 0.50 *M* NaOH with 1.0 *M* HCl. The equivalence point occurs at 50.00 mL of HCl added, since at this point 5.0 mmol H^+ has been added to react with the original 5.0 mmol OH^-.