titration of 25 ml of 0.100 M HCl to which 25 ml of water is added Then the solution is titrated with 0.100 M NaOH base solution

this is how I calculated your lab pH #

Concentration of HCl =

$M_{dil} V_{dil} = M_{con} V_{con}$

$M_{con} = 0.100\ M$, $V_{con} = 25\ ml$

$M_{dil} = ?$ $V_{dil} = 50.0\ ml$ (25 ml + 25 ml)

HCl Water

$$M_{dil} = \frac{(0.100\ M)(25.0\ ml)}{(50.0\ ml)} = 0.0500\ M$$

HCl

Volume at equivalence point

$M_{base} V_{base} = M_{acid} V_{acid}$

M_{base}: 0.100 M

V_{base}: ?

M_{acid}: 0.050

V_{acid}: 50.0 ml

$$V_{base} = \frac{(0.050\,M)(50.0\,mL)}{(0.100\,M)} = 25.0\,mL$$

base volume at equivalence point

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at 0.00 mL NaOH added (before added any base)

$$pH = -\log(0.050\,M) = 1.30$$

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at 9.00 mL NaOH added (before equivalence point)

$$\#\text{ moles } H^+ = 50.0\,mL \times \frac{0.050\,mol}{1000\,mL}$$

$$\#\text{ mole } HCl = 2.5 \times 10^{-3}\,\text{moles}$$

$$\#\text{ mole } NaOH = 9.00\,mL \times \frac{0.100\,mol}{1000\,mL}$$

$$\#\text{ moles } NaOH = 9.00 \times 10^{-4}$$

$$M_{HCl} = \frac{\left(2.5\times10^{-3}\ \text{mol}_{HCl} - 9.00\times10^{-4}\ \text{mol}_{NaOH}\right)}{\left\{\left(50.0\text{ml}_{\text{acid}} + 9.00\text{ml}_{NaOH}\right)\times\left(\frac{l}{1000\text{ml}}\right)\right\}}$$

$$M_{HCl} = 0.03636$$

$$pH = -\log(0.03636) = 1.44$$

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at 30 ml of added NaOH

$$\#\text{ moles}_{HCl}\ (\text{same as at start}) = 2.5\times10^{-3}\ \text{mole}_{HCl}$$

$$\#\text{ moles}_{NaOH} = 30\text{ml}_{NaOH}\times\frac{0.100\text{ moles NaOH}}{1000\text{ ml NaOH}}$$

$$\#\text{ moles}_{NaOH} = 3.00\times10^{-3}\text{ moles}$$

(larger # than # moles acid so must subtract acid from base)

$$\#\text{ moles NaOH left} = 3.00\times10^{-3}\text{ moles NaOH} - 2.5\times10^{-3}\text{ mol HCl}$$

$$M(\text{NaOH}) = \frac{3.00\times10^{-3}\text{ mol NaOH} - 2.5\times10^{-3}\text{ mol HCl}}{\left\{\left[50.0\text{ mL acid (HCl)} + 30\text{ mL NaOH added}\right]\times\frac{1\text{ L}}{1000\text{ mL}}\right\}}$$

$$M_{(\text{NaOH})} = \frac{9.00\times10^{-4}\text{ mol NaOH}}{0.0800\text{ L}} = 6.25\times10^{-3}\text{ M NaOH}$$

$$pOH = -\log\left(6.25\times10^{-3}\text{ M NaOH}\right) = 2.20$$

$$pH + pOH = 14$$

$$pH = 14 - 2.20 = 11.8$$

volume NaOH	pH
0.00	1.30
5.00	1.44
10.00	1.60
15.00	1.81
20.00	1.95
25.00	7.00
30.00	11.95
35.00	12.22