95. Determine the pH of a solution during a titration when 25.00 mL of 0.74 mol/L nitric acid, $HNO_3(aq)$, has been added to 26.05 mL of 0.71 mol/L sodium hydroxide, NaOH(aq).

What Is Required?
You need to find the pH at a certain point in an acid-base titration.

What Is Given?
You know that 25.00 mL of $HNO_3(aq)$ having a concentration of 0.74 mol/L has been added to 26.05 mL of NaOH(aq) having a concentration of 0.71 mol /L.

Plan Your Strategy	Act on Your Strategy
Write the balanced chemical equation for the reaction and determine the mole ratio of $HNO_3(aq)$ to NaOH(aq).	$HNO_3(aq) + NaOH(aq) \rightarrow NaNO_3(aq) + H_2O(\ell)$ The balanced chemical equation for the reaction gives a mole ratio $\frac{[HNO_3(aq)]}{[NaOH(aq)]} = \frac{1}{1}$.
Use the formula $n = cV$ to calculate the amount in moles, n, of $HNO_3(aq)$ and NaOH(aq).	$n_{HNO_3} = cV$ $= (0.74\ mol/\cancel{L})(0.02500\ \cancel{L})$ $= 0.01850\ mol$ $n_{NaOH} = cV$ $= (0.71\ mol/\cancel{L})(0.02605\ \cancel{L})$ $= 0.0184955\ mol$
Determine which reagent is in excess. If $HNO_3(aq)$ is in excess, $[HNO_3] = [H_3O^+]$. If NaOH(aq) is in excess, $[NaOH] = [OH^-]$.	$n_{HNO_3} = 0.01850\ mol$ $n_{NaOH} = 0.0184955\ mol$ Since $n_{HNO_3} > n_{NaOH}$, HBr(aq) is the reagent in excess.
Determine the amount in moles, n, of the excess of $HNO_3(aq)$.	$n = 0.1850\ mol - 0.184955\ mol$ $= 4.500 \times 10^{-6}\ mol$
Determine the the total volume, V, of the mixture.	$V = 25.00\ mL + 26.05\ mL$ $= 51.05\ mL$ $= 0.05105\ L$
Use the formula $c = \frac{n}{V}$ to calculate the concentration, c, of the excess reagent.	$c_{HNO_3} = \frac{n}{V}$ $= \frac{4.500 \times 10^{-6}\ mol}{0.05105\ L}$ $= 8.81 \times 10^{-5}\ mol/L$

Since $HNO_3(aq)$ is in excess, $[HNO_3] = [H_3O^+]$. Calculate pH using $pH = -\log [H_3O^+]$.	$pH = -\log [H_3O^+]$ $= -\log (8.81 \times 10^{-5})$ $= 4.05$ (2 sig. digits)

Check Your Solution

The resulting pH is less than 7 indicating an excess of acid (HNO_3). The number of significant digits to the right of the decimal in the pH is the same as the number of significant digits in the given data. The answer seems reasonable.