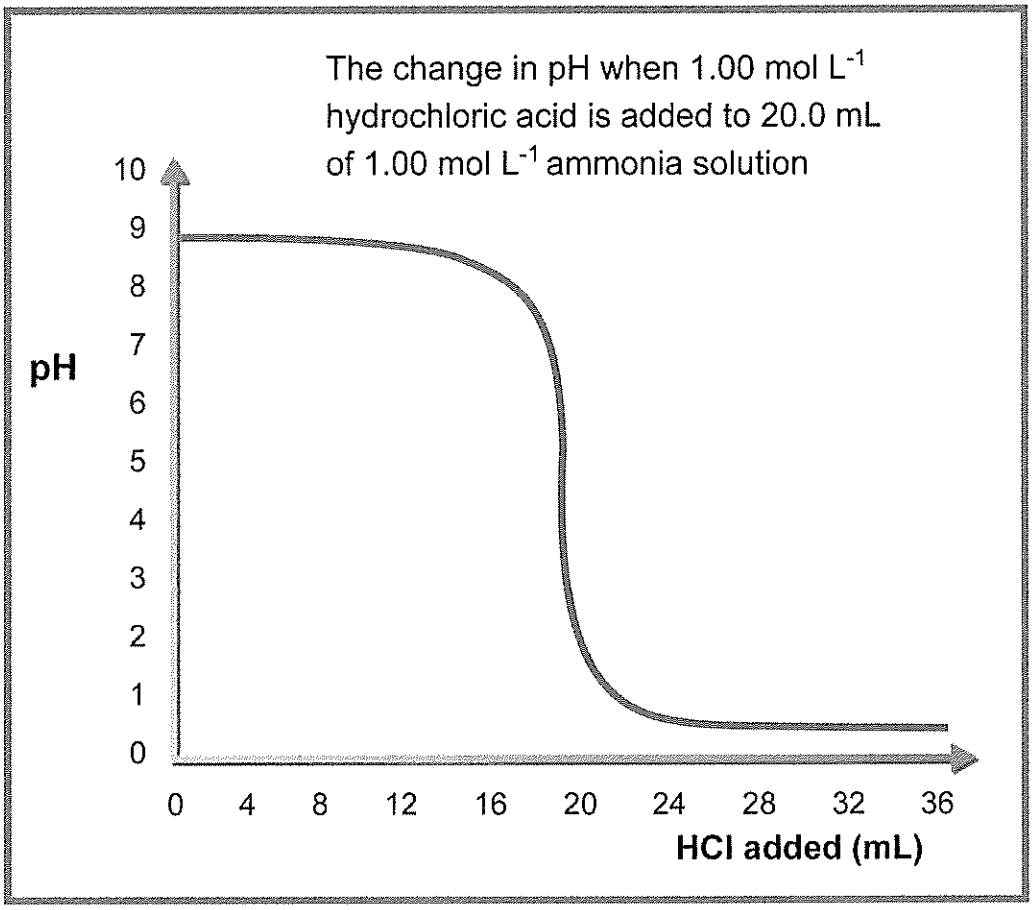
Equivalence points in titrations

1. Below is a titration curve showing the variation of pH when a strong acid (HCl) is added to a weak base (ammonia).



a) Highlight the parts of the graph where there is very little change in pH.

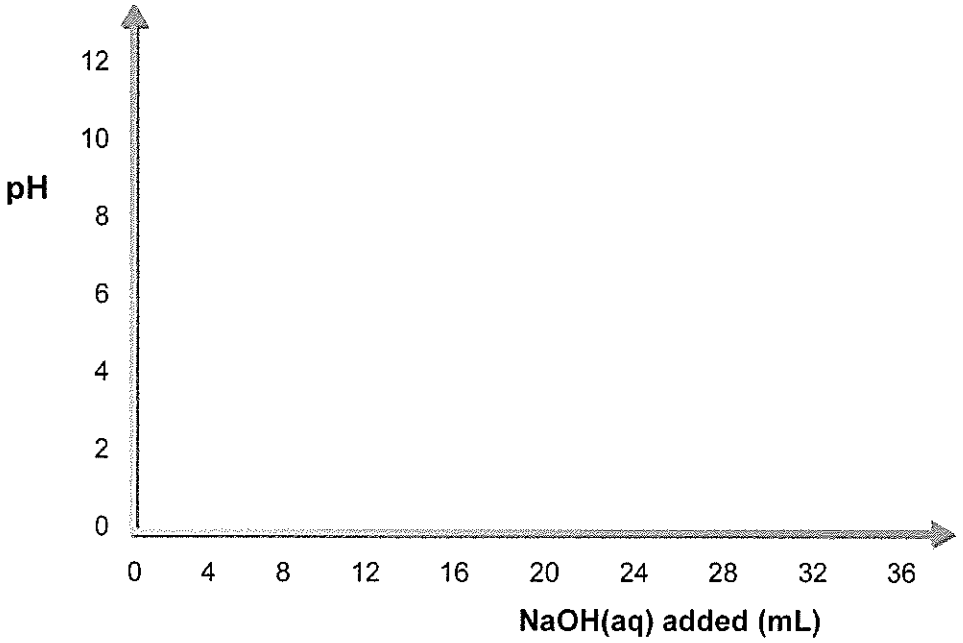
b) Label the equivalence point on the graph.

c) Estimate the pH at the equivalence point. ☐

d) From the graph estimate the volume of the acid added at the equivalence point. ☐

e) By reference to the concentrations of the two solutions, explain why this volume would be expected.

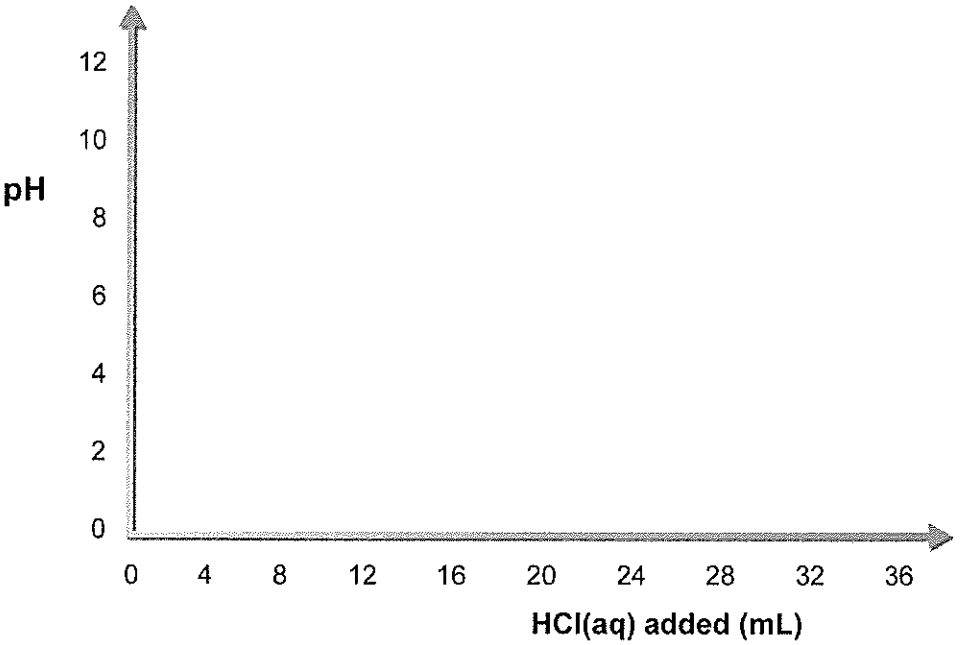
2. On the axis below, sketch the titration curve expected if sodium hydroxide solution with a concentration of 0.100 mol L^{-1} is added to 20.0 mL of acetic acid with a concentration 0.100 mol L^{-1}.



a) Label the equivalence point on the graph and estimate the pH at this point.

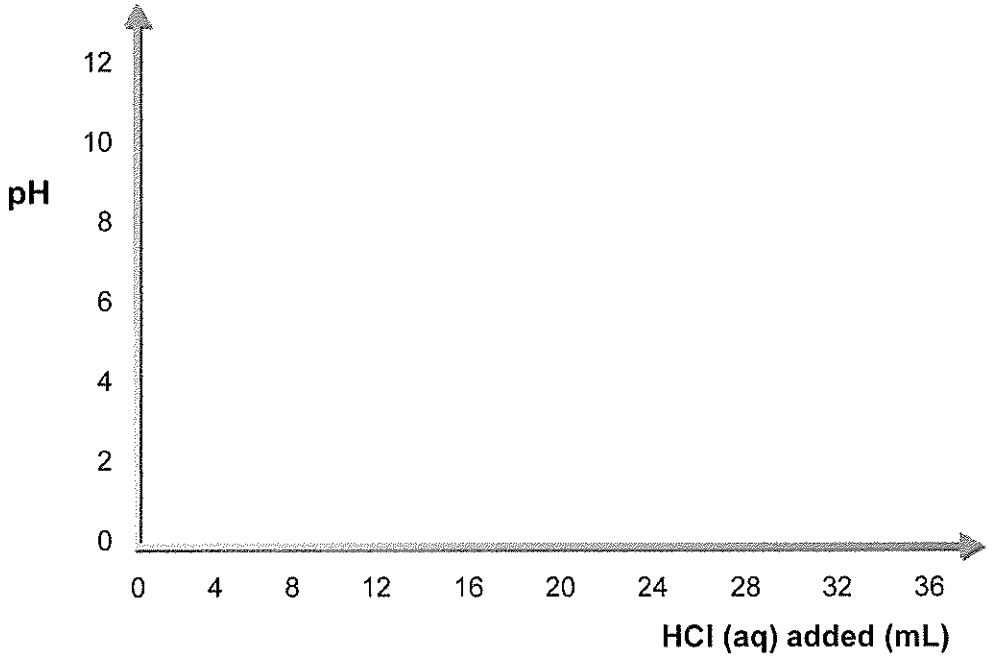
b) Write the formulae of the ions present at the equivalence point.

3. On the axis below, sketch the titration curve expected if a solution of sodium carbonate with a concentration of 0.500 mol L^{-1} was added to 20.0 mL of hydrochloric acid with a concentration of 0.500 mol L^{-1}.



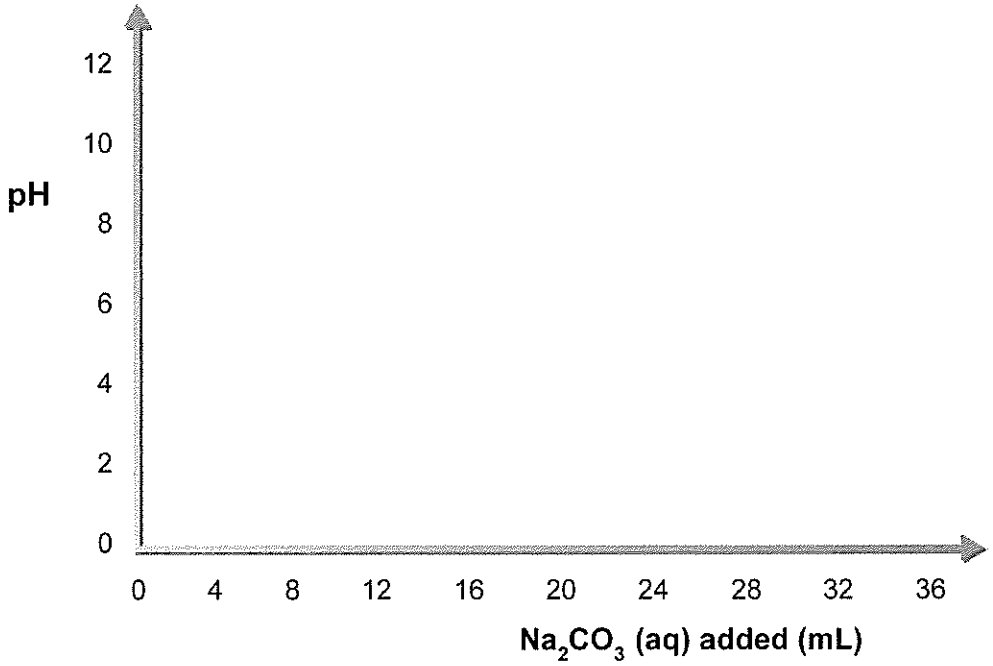
Label the equivalence point on the graph and estimate the pH at this point.

4. On the axis below, sketch the titration curve expected if 0.200 mol L^{-1} hydrochloric acid was added to 20.0 mL of a solution of sodium hydroxide with a concentration of 0.300 mol L^{-1}.



Label the equivalence point on the graph and estimate the pH at this point.

5. On the axis below, sketch the titration curve expected if 0.100 mol L^{-1} sodium carbonate was added to 20.0 mL of acetic acid with a concentration of 0.100 mol L^{-1}.

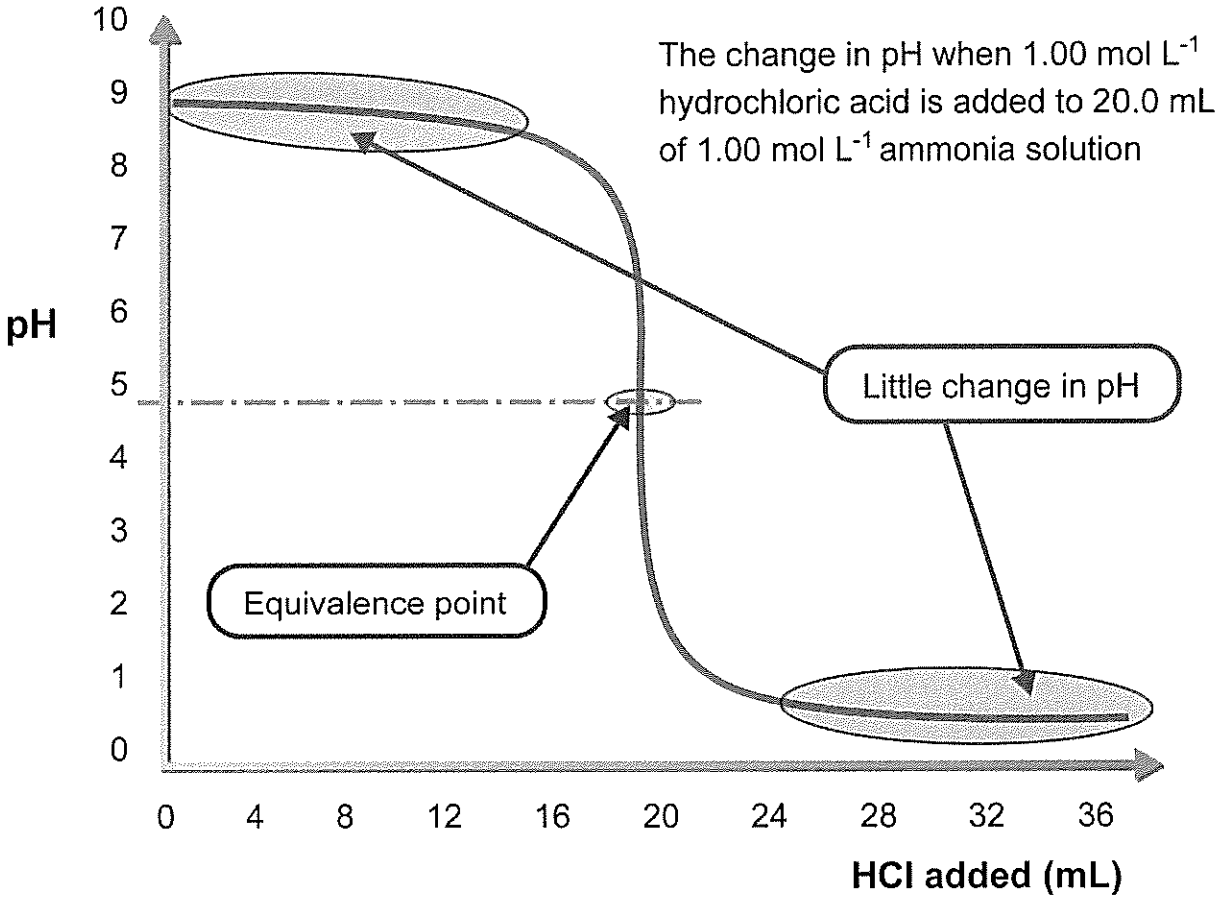


Use this titration curve to explain why titrations are not normally carried out between a weak base and a weak acid.

Equivalence points in titrations

Answers

1. Below is a titration curve showing the variation of pH when a strong acid (HCl) is added to a weak base (ammonia).



a) Highlight the parts of the graph where there is very little change in pH

b) Label the equivalence point on the graph.

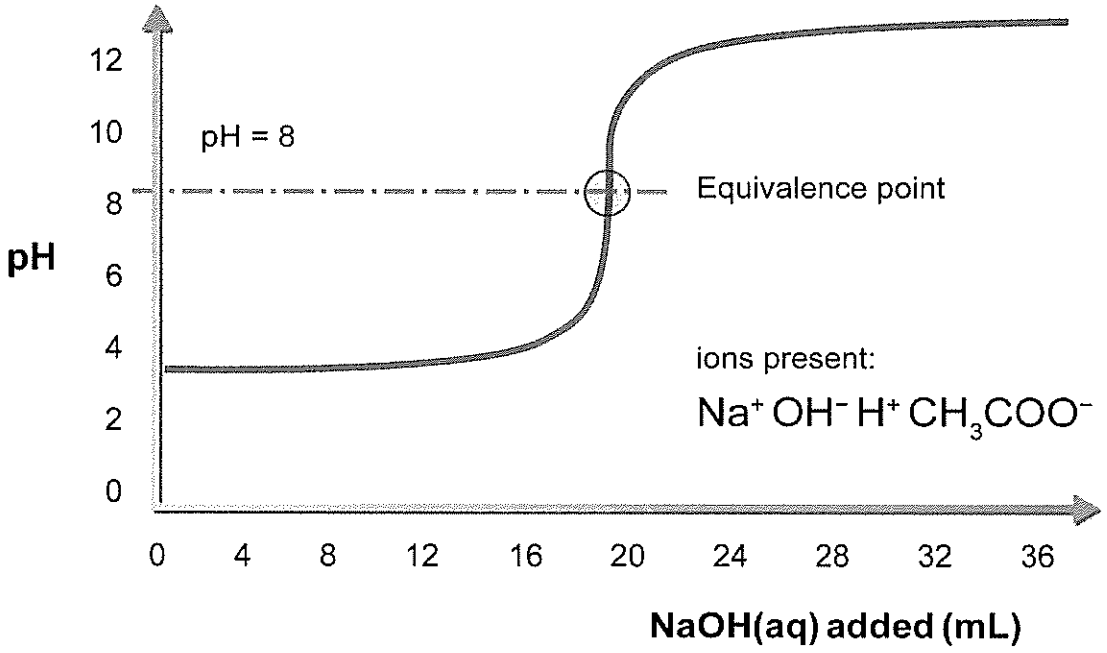
c) Estimate the pH at the equivalence point. 5

d) From the graph estimate the volume of the acid added at the equivalence point. 20ml

e) By reference to the concentrations of the two solutions, explain why this volume would be expected.

The hydrochloric acid and the ammonia react with a one-to-one ratio so you would expect the same number of moles of each at the equivalence point. Because the concentrations of the two solutions are the same, the volumes will also be the same at this point.

2. On the axis below, sketch the titration curve expected if sodium hydroxide solution with a concentration of 0.100 mol L^{-1} is added to 20.0 mL of acetic acid with a concentration 0.100 mol L^{-1}.



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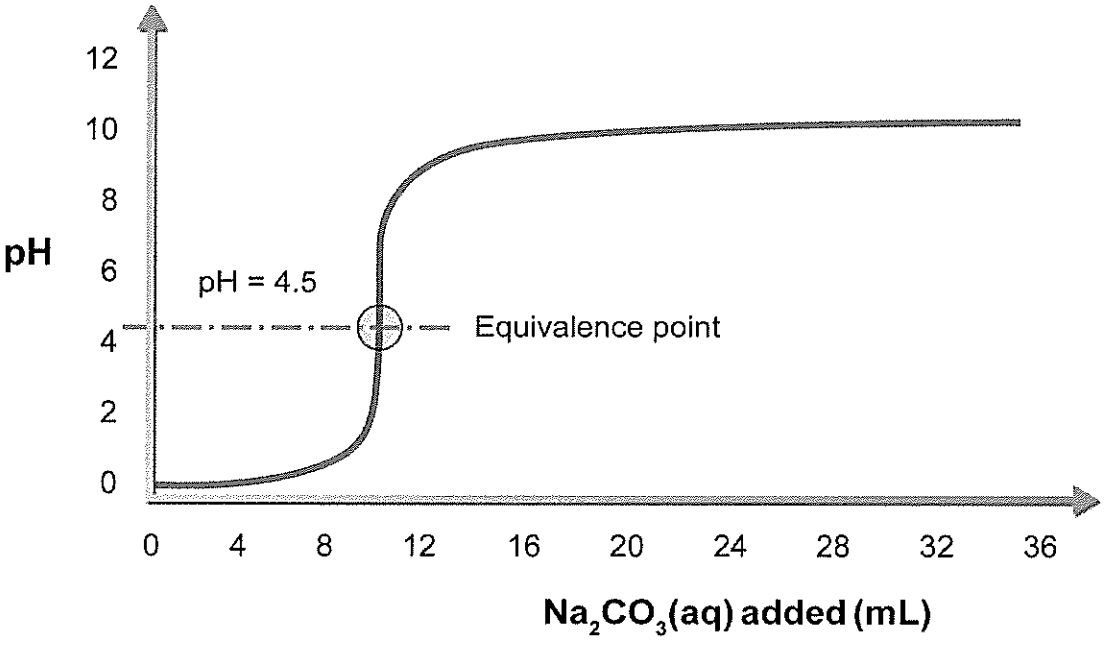

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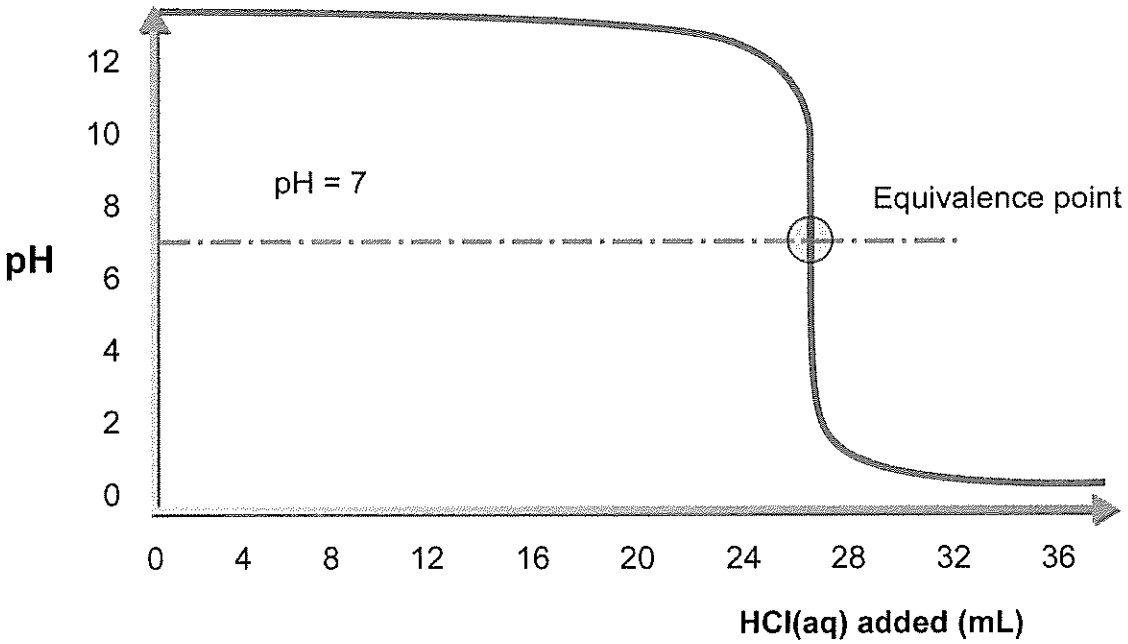

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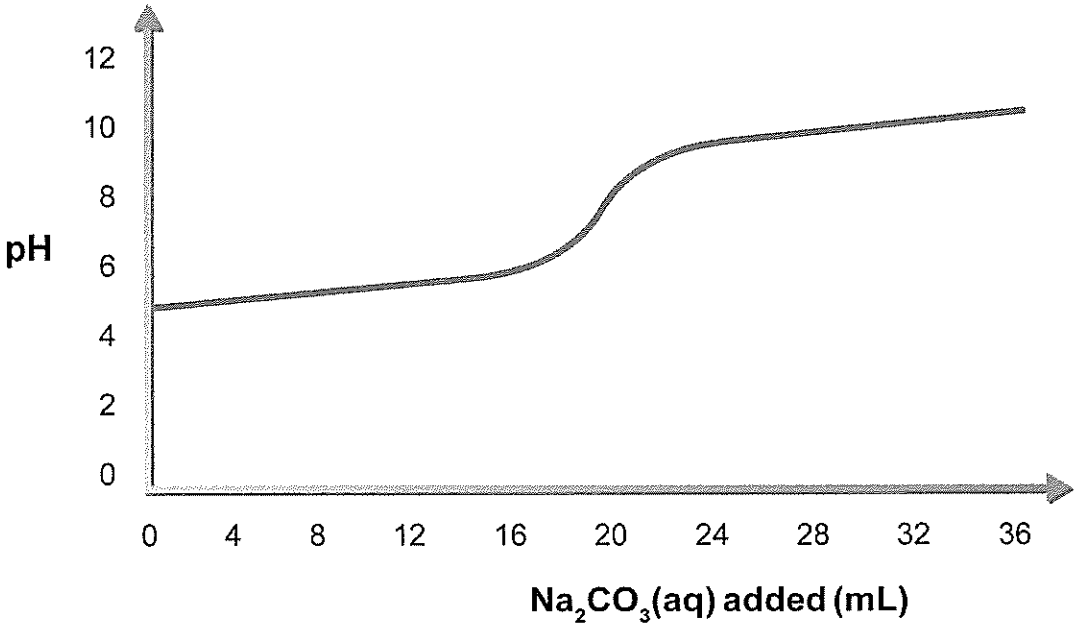

Use this titration curve to explain why titrations are not normally carried out between a weak base and a weak acid.

There would not be a significant pH change at the equivalence point. Therefore it will be difficult to accurately measure the volume of the solution added at this point.