WJEC (Wales) Chemistry A-level

SP 3.9 - Titration Using a pH Probe

Flashcards

What are the benefits of carrying out a titration with a pH probe instead of a chemical indicator?

What are the benefits of carrying out a titration with a pH probe instead of a chemical indicator?

- A pH probe can be used throughout a titration to regularly detect the pH. A chemical indicator is only able to identify the point of neutralisation.
- A pH probe is very precise and much more accurate. The colour change of a chemical indicator can be subjective since people may disagree about the point of colour change.

Why is it important that a pH probe is calibrated before titration?

Why is it important that a pH probe is calibrated before titration?

The pH probe must be calibrated in order for the measurements of the pH probe to be accurate.

How is a pH probe calibrated?

How is a pH probe calibrated?

The pH probe is calibrated using buffer solutions of a known pH. For example, the pH probe is first placed in a pH 4 buffer solution and the reading is adjusted to read 4.0. The probe is then removed and washed with distilled water. The probe is then placed in a pH 9 buffer solution. This is to check that the pH probe now accurately reads 9.0.

What is a buffer solution?

What is a buffer solution?

A buffer solution is a solution which is able to resist changes in pH when small volumes of acid or base are added.

A buffer solution is commonly formed from a weak acid and its salt or a weak base and its salt. This produces a mixture containing H^+ ions and a large pool of OH^- ions which helps to resist any change in pH.

Describe the difference between a strong acid and a weak acid

Describe the difference between a strong acid and a weak acid

A strong acid dissociates almost completely in water which means nearly all the H^+ ions are released.

A weak acid only partially dissociates in water so only a small number of H^+ ions are released.

Describe the difference between a strong alkali and a weak alkali

Describe the difference between a strong alkali and a weak alkali

A strong alkali dissociates almost completely in water so nearly all the OH^- ions are released.

A weak alkali only partially dissociates in water so only a small number of OH^- ions are released.

Give examples of strong and weak acids

Give examples of strong and weak acids

Strong acids:

HCl, H_2SO_4, HNO_3

Weak acids:

Any carboxylic acid, e.g. ethanoic acid (CH_3COOH)

Give examples of strong and weak alkalis

Give examples of strong and weak alkalis

Strong alkalis:

NaOH, KOH

Weak alkalis:

NH_3, NH_4OH

What apparatus is required to carry out a pH probe titration between various strong and weak acids and alkalis?

What apparatus is required to carry out a pH probe titration between various strong and weak acids and alkalis?

- pH probe
- 25 cm^3 volumetric pipette with filler
- 50 cm^3 burette
- Funnel
- Burette clamp and stand
- 100 cm^3 beaker
- 250 cm^3 conical flask

Outline the experimental procedure of a pH probe titration between various strong and weak acids and alkalis

Outline the experimental procedure of a pH probe titration between various strong and weak acids and alkalis

1. Calibrate the pH probe using buffer solutions of known pH.
2. Using the pipette, place 25.0cm^3 of acid in the conical flask. Measure the pH.
3. From the burette, add the alkali, 5cm^3 at a time up to 50cm^3. Measure the pH after each 5cm^3 addition. Wash the electrode with distilled water between each measurement.
4. Repeat the procedure for various combinations of strong and weak acids and alkalis.
5. Plot graphs of volume of alkali against pH.

Why is the pH probe washed with distilled water between measurements?

Why is the pH probe washed with distilled water between measurements?

Washing the pH probe ensures any ions on the probe are removed which helps to avoid the pH probe cross contaminating the solutions. This ensures the pH readings are as accurate as possible.

Why should the burette be filled below eye level?

Why should the burette be filled below eye level?

The burette should be filled below eye level so that if any of the alkali spills whilst being poured in, it will not splash into the person's face.

Why should measurements from the burette be read at eye level?

Why should measurements from the burette be read at eye level?

Reading the measurements at eye level ensures the readings are as accurate as possible as it avoids any parallax errors.

Why is the acid solution placed in a conical flask?

Why is the acid solution placed in a conical flask?

The conical flask allows the mixture to be swirled without losing any of the contents.

Why must the reaction mixture be swirled during the titration?

Why must the reaction mixture be swirled during the titration?

Swirling ensures all the reacting particles collide and react. This helps to ensure the pH of the reaction mixture is consistent throughout the flask.

Why are burettes and pipettes always used in titrations?

Why are burettes and pipettes always used in titrations?

Burettes and pipettes measure volumes of solutions very precisely.

Why might the pipette be rinsed with the acid before use and the burette be rinsed with the alkali before use?

Why might the pipette be rinsed with the acid before use and the burette be rinsed with the alkali before use?

Rinsing the equipment with the solutions which they will hold removes any water which may be in the equipment. This is important because the water will affect the concentrations of the solutions. Therefore, rinsing ensures a more accurate titration experiment.

Give the chemical equation for the reaction between hydrochloric acid and sodium hydroxide

Give the chemical equation for the reaction between hydrochloric acid and sodium hydroxide

Hydrochloric acid + sodium hydroxide → sodium chloride + water

$$HCl + NaOH \rightarrow NaCl + H_2O$$

Give the chemical equation for the reaction between ethanoic acid and sodium hydroxide

Give the chemical equation for the reaction between ethanoic acid and sodium hydroxide

Ethanoic acid + sodium hydroxide → sodium ethanoate + water

$$CH_3COOH + NaOH \rightarrow CH_3COO^-Na^+ + H_2O$$

Give the chemical equation for the reaction between hydrochloric acid and ammonia

Give the chemical equation for the reaction between hydrochloric acid and ammonia

Hydrochloric acid + ammonia → ammonium chloride

$$HCl + NH_3 \rightarrow NH_4Cl$$

Give the chemical equation for the reaction between ethanoic acid and ammonia

Give the chemical equation for the reaction between ethanoic acid and ammonia

Ethanoic acid + ammonia → ethanamide + water

$$CH_3COOH + NH_3 \rightarrow CH_3CONH_2 + H_2O$$

What is a pH curve?

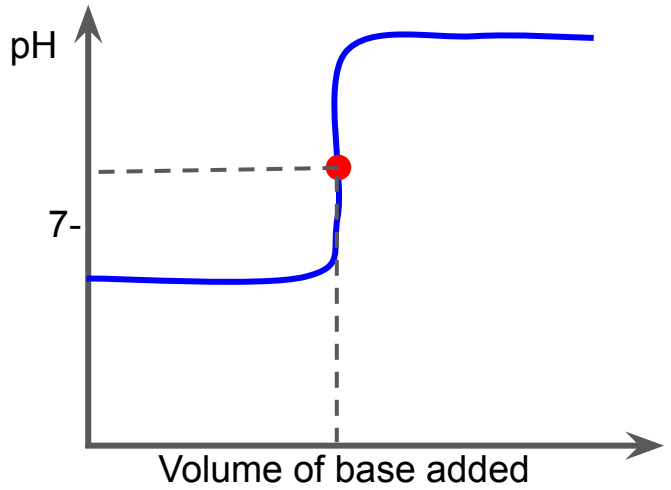
What is a pH curve?

Graphs which plot pH against volume of acid or base added are called pH curves and can be used to help identify the point of neutralisation of a solution.

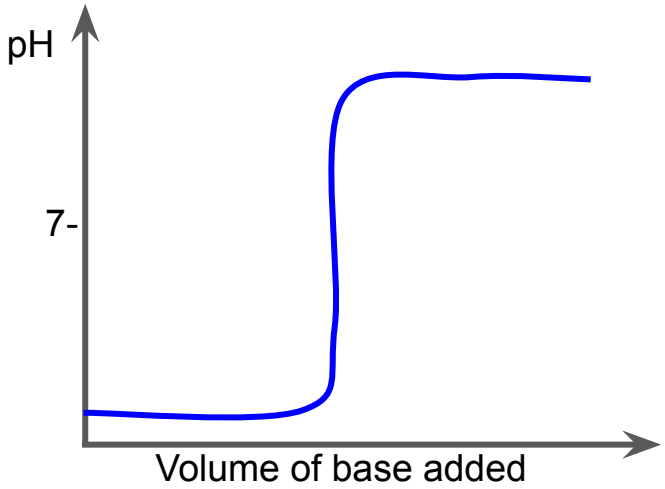
What is the equivalence point on a pH curve?

What is the equivalence point on a pH curve?

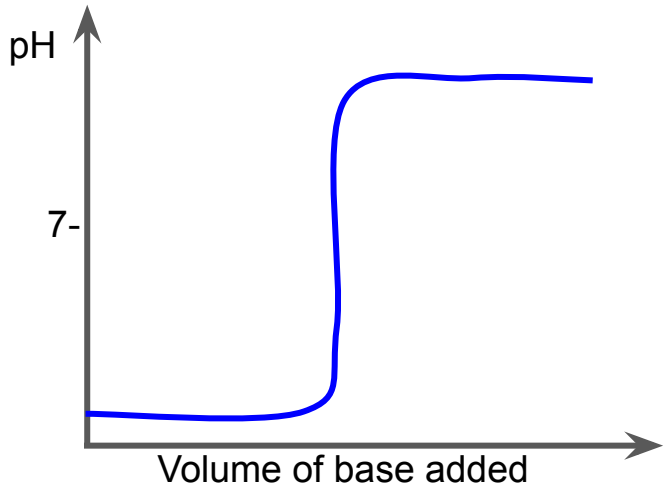
The equivalence point is also called the end point and is the point at which the pH curve is vertical. This is the point at which the solution has been neutralised.



Use the pH curve to identify the type of reactants involved in the reaction



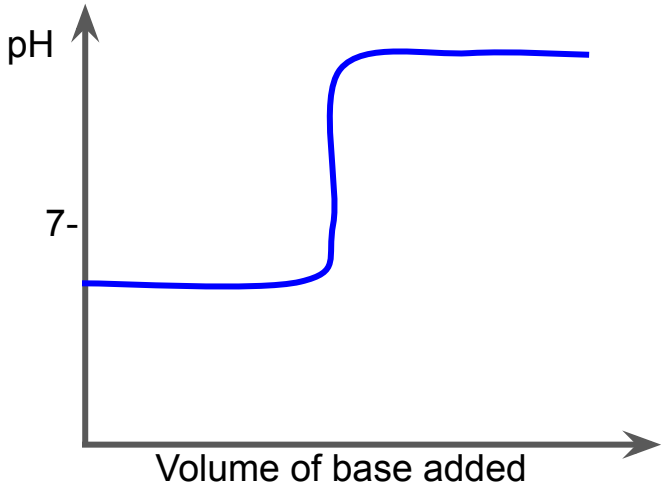
Use the pH curve to identify the type of reactants involved in the reaction



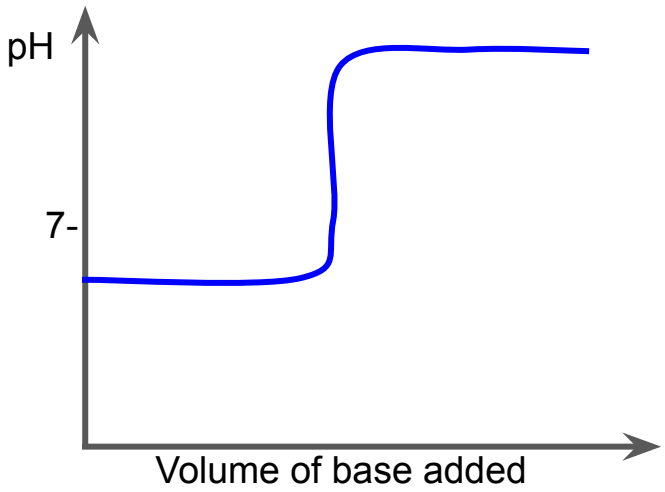
Strong base added to strong acid:

The pH is initially at around 1 as the strong acid is in excess. The pH ends up being very high, indicating a strong base is in excess.

Use the pH curve to identify the type of reactants involved in the reaction



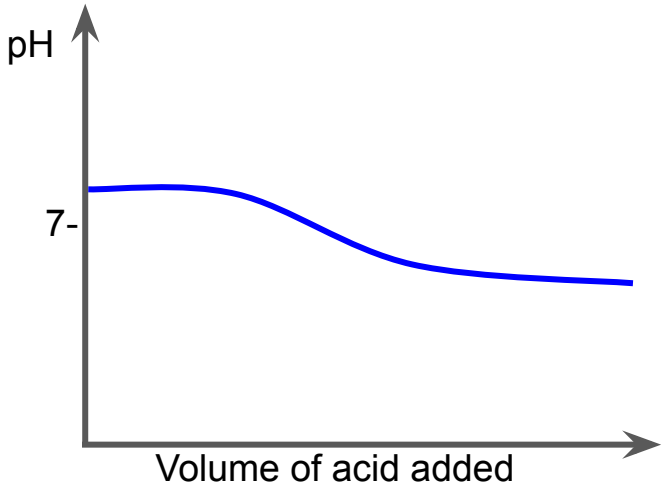
Use the pH curve to identify the type of reactants involved in the reaction



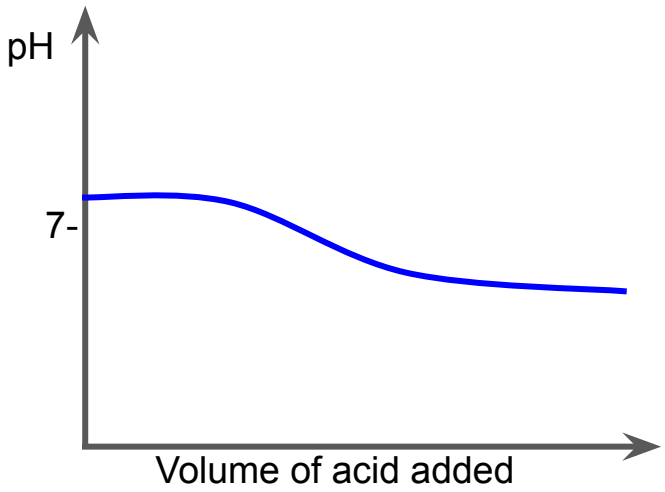
Strong base added to weak acid:

The pH starts about 5 where there's an excess of weak acid. It finishes with a high pH where there's an excess of strong base.

Use the pH curve to identify the type of reactants involved in the reaction



Use the pH curve to identify the type of reactants involved in the reaction



Weak acid added to weak base:

The pH starts about 8-9 where there's an excess of weak base. It finishes with a pH around 5 when there's an excess of weak acid.