OCR (B) Chemistry GCSE

C5 - Chemical Analysis

Flashcards

What does the term formulation mean?

What does the term formulation mean?

A mixture that contains specific proportions of certain substances.

What does the term pure mean?

What does the term pure mean?

A substance containing only one element or compound.

What is the difference between the scientific and everyday use of the term pure?

What is the difference between the scientific and everyday use of the term pure?

Pure substances in chemistry only contain one element or compound while pure substances in everyday life contain only one substance (e.g. orange juice) which is a mixture of compounds.

What is a mixture?

What is a mixture?

Something that contains two or more different substances that aren't bonded together.

What is an impurity?

What is an impurity?

A small quantity of another substance which is found in an otherwise pure substance.

How can you use melting point data to distinguish between pure and impure substances?

How can you use melting point data to distinguish between pure and impure substances?

Pure substances have a sharp exact melting point whereas mixtures melt over a range of temperatures since they consist of several different elements / compounds.

What process can be used to identify substances in a mixture?

What process can be used to identify soluble substances in a mixture?

Chromatography

Fill in the blanks: ‘During chromatography, separation depends on the ___ ___ ___’

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Distribution between phases

What are the two phases in chromatography?

What are the two phases in chromatography?

- Mobile phase (e.g. the solvent).
- Stationary phase (e.g. chromatography paper).

How does paper chromatography work to separate a mixture?

How does paper chromatography work to separate a mixture?

- The mobile phase (solvent) moves through the stationary phase (paper) so anything dissolved in the mobile phase will move with up the paper.
- Compounds interact differently with each phase so will move different distances through the stationary phase meaning they will be separated.

How can paper chromatography show the composition of a mixture?

How can paper chromatography show the composition of a mixture?

Different coloured substances in the mixture will separate as they have different solubilities in the solvent so will travel at different rates.

Why should pencil be used to draw the line along the bottom of the chromatography paper?

Why should pencil be used to draw the line along the bottom of the chromatography paper?

It will not affect the experiment as it is insoluble in the solvent.

Why should the water solvent in the beaker for paper chromatography be below the line where the mixture being tested is placed?

Why should the water solvent in the beaker for paper chromatography be below the line where the mixture being tested is placed?

If it is deeper it will wash away the substances on the line on the chromatography paper.

How many spots will a pure substance produce on a chromatogram? How would this be different for an impure substance?

How many spots will a pure substance produce on a chromatogram? How would this be different for an impure substance?

Pure substances produce one spot.

An impure substance contains more than one compound so will produce more spots (one spot for each chemical).

What is an Rf value?

What is an Rf value?

The Rf value is the ratio between the distance travelled by the dissolved substance (the solute) and the distance travelled by the solvent.

How do you calculate Rf values?

How do you calculate Rf values?

$$Rf = \frac{\text{Distance travelled by substance}}{\text{Distance travelled by solvent}}$$

When measuring the distance moved by a substance on the chromatography paper, where should you measure between?

When measuring the distance moved by a substance on the chromatography paper, where should you measure between?

Measure from the pencil baseline to the middle of the spot of the substance.

True or false?

‘Substances with a higher solubility in the solvent will travel further up the chromatography paper’

True or false?
'Substances with a higher solubility in the solvent will travel further up the chromatography paper'

TRUE

They will stay dissolved in the mobile phase (solvent) for longer.

When are aqueous and non-aqueous solvents used in chromatography?

When are aqueous and non-aqueous solvents used in chromatography?

An aqueous solvent contains water so is a suitable mobile phase when the substance is soluble in water. If the substance is insoluble in water, a non-aqueous solvent must be used.

What is a locating agent and when is it used in chromatography?

What is a locating agent and when is it used in chromatography?

A locating agent is a compound that reacts with substances to form coloured compounds or compounds that glow under ultraviolet light and is used to analyse substances that are colourless.

State which process can be used to separate an insoluble salt from a solution. How does it work?

State which process can be used to separate an insoluble salt from a solution. How does it work?

Filtration:

- Put filter paper in a funnel and place it over an empty conical flask.
- Pour the mixture of the insoluble salt and solution through the funnel. Use distilled water to wash any of the salt left in the beaker through the funnel.
- Remove the filter paper and evaporate the water from the residue if this is the substance being collected. The pure solution will have collected in the conical flask.

What process can be used to separate a soluble salt from a solution? How does it work?

What process can be used to separate a soluble salt from a solution? How does it work?

Crystallisation:

- Gently heat the solution in an evaporating basin to increase the concentration of the solution (as solvent will evaporate).
- Remove from the heat and allow the solution to cool.
- Slowly the salt crystals will form as the rest of the solvent slowly evaporates.

When is simple distillation used as a separation technique?

When is simple distillation used as a separation technique?

Simple distillation is used to separate a pure liquid from a mixture of liquids.

It can only be used when the liquids have different boiling points.

Describe the process of separating ethanol from a mixture of ethanol and water using simple distillation

Describe the process of separating ethanol from a mixture of ethanol and water using simple distillation

The mixture is placed in a round bottom flask which is connected to a condenser with a beaker underneath it. The condenser has cold water flowing in at the bottom and out the top.

The mixture in the flask is heated. Ethanol has a lower boiling point than water so it evaporates first and enters the condenser. The vapours cool in the condenser and slowly drip into the beaker where pure ethanol is collected.

What substance is the process of fractional distillation commonly used to separate? Why?

What substance is the process of fractional distillation commonly used to separate? Why?

Crude oil.

Fractional distillation can separate multiple different substances in the mixture if they have different boiling points. This is useful for crude oil as it allows separation of the various hydrocarbons it contains.

How does the process of fractional distillation work to separate crude oil?

How does the process of fractional distillation work to separate crude oil?

1. The oil is heated so that it evaporates.
2. The vapours enter the fractionating column. The column has a temperature gradient so the temperature decreases up the column.
3. The vapours have different boiling points. The vapours slowly rise up the column and condense at different fractions depending on their boiling point.
4. Different hydrocarbons tapped off at each level are converted into products for the petrochemical industry.

What does the term qualitative mean?

(Chemistry only)

What does the term qualitative mean? (Chemistry only)

Results not expressed as numbers.

Why should sampling be representative in qualitative analysis?

(Chemistry only)

Why should sampling be representative in qualitative analysis? (Chemistry only)

To ensure the sample represents the whole material without having to test all of it.

Describe how you would carry out a flame test of metal ions (Chemistry only)

Describe how you would carry out a flame test of metal ions (Chemistry only)

- Turn the Bunsen burner onto the blue flame.
- Clean a nichrome wire using hydrochloric acid, placing it in the Bunsen flame until the flame returns to blue.
- Dip the wire into a solution of the substance being tested and place in the flame.
- Record the colour of the flame.

What is the result of the flame test on lithium ions?

(Chemistry only)

What is the result of the flame test on lithium ions? (Chemistry only)

Bright red flame

What is the result of the flame test on sodium ions?

(Chemistry only)

What is the result of the flame test on sodium ions? (Chemistry only)

Yellow flame

What is the result of the flame test on potassium ions?

(Chemistry only)

What is the result of the flame test on potassium ions? (Chemistry only)

Lilac flame

What is the result of the flame test on calcium ions?

(Chemistry only)

What is the result of the flame test on calcium ions? (Chemistry only)

Orange-red flame

What is the result of the flame test on copper ions?

(Chemistry only)

What is the result of the flame test on copper ions? (Chemistry only)

Blue-green flame

Why must the wire be cleaned before carrying out a flame test?

(Chemistry only)

Why must the wire be cleaned before carrying out a flame test? (Chemistry only)

To remove any unwanted ions that might obscure the colour of the flame.

Why can a flame test not be used when a compound contains a mixture of metal ions?

(Chemistry only)

Why can a flame test not be used when a compound contains a mixture of metal ions? (Chemistry only)

The flame colours of the ions will blend together so the colour produced by each ion will not be seen.

What is a precipitate?

(Chemistry only)

What is a precipitate? (Chemistry only)

An insoluble solid suspended in a liquid.

Without using the flame test, how can you test for aqueous metal ions? (Chemistry only)

Without using the flame test, how can you test for aqueous metal ions? (Chemistry only)

Add sodium hydroxide solution to the metal ions. Observe the colour of the precipitate.

What colour precipitate forms when sodium hydroxide reacts with calcium ions?

(Chemistry only)

What colour precipitate forms when sodium hydroxide reacts with calcium ions? (Chemistry only)

White precipitate

What colour precipitate forms when sodium hydroxide reacts with copper(II) ions?

(Chemistry only)

What colour precipitate forms when sodium hydroxide reacts with copper(II) ions? (Chemistry only)

Blue precipitate

What colour precipitate forms when sodium hydroxide reacts with iron(II) ions?

(Chemistry only)

What colour precipitate forms when sodium hydroxide reacts with iron(II) ions? (Chemistry only)

Green precipitate

What colour precipitate forms when sodium hydroxide reacts with iron(III) ions?

(Chemistry only)

What colour precipitate forms when sodium hydroxide reacts with iron(III) ions? (Chemistry only)

Brown precipitate

What colour precipitate forms when sodium hydroxide reacts with zinc ions?

(Chemistry only)

What colour precipitate forms when sodium hydroxide reacts with zinc ions? (Chemistry only)

White precipitate

How can you distinguish between zinc and calcium ions?

(Chemistry only)

How can you distinguish between zinc and calcium ions? (Chemistry only)

Add a few drops of sodium hydroxide solution to both ions to form the white precipitates. Add excess sodium hydroxide solution. Zinc hydroxide precipitate dissolves to form a colourless solution while calcium hydroxide precipitate remains the same.

How can you test for carbonate ions? (Chemistry only)

How can you test for carbonate ions? (Chemistry only)

- Add a few drops of HCl to the sample in a test tube.
- Bubble the sample through a test tube of limewater.
- If carbonate ions are present, they will react with the acid to produce carbon dioxide which will turn the limewater cloudy when it is bubbled through.

Write the chemical equation for the reaction between HCl and Na_2CO_3

(Chemistry only)

Write the chemical equation for the reaction between HCl and Na_2CO_3 (Chemistry only)

$$Na_2CO_3 + 2HCl \rightarrow CO_2 + 2NaCl + H_2O$$

How can you test for sulfate ions?
(Chemistry only)

How can you test for sulfate ions? (Chemistry only)

- Add HCl to remove any CO_3^{2-} ions that would obscure the result.
- Add a couple of drops of barium chloride or barium nitrate.
- If sulfate ions are present a white precipitate of barium sulfate will form.

Write the chemical equation for the reaction between $BaCl_2$ and $MgSO_4$

(Chemistry only)

Write the chemical equation for the reaction between $BaCl_2$ and $MgSO_4$ (Chemistry only)

$$BaCl_2 + MgSO_4 \rightarrow BaSO_4 + MgCl_2$$

$BaSO_4$ is a white precipitate

How do you carry out a test for halide ions?

(Chemistry only)

How do you carry out a test for halide ions? (Chemistry only)

- Add a couple of drops of nitric acid to react with any carbonate ions which might obscure the result.
- Add a few drops of silver nitrate.
- Observe the colour of the precipitate.

What colour precipitate is formed when silver nitrate is added to a chloride solution?

(Chemistry only)

What colour precipitate is formed when silver nitrate is added to a chloride solution? (Chemistry only)

White precipitate of silver chloride

What colour precipitate is formed when silver nitrate is added to a bromide solution?

(Chemistry only)

What colour precipitate is formed when silver nitrate is added to a bromide solution? (Chemistry only)

Cream precipitate of silver bromide

What colour precipitate is formed when silver nitrate is added to an iodide solution?

(Chemistry only)

What colour precipitate is formed when silver nitrate is added to an iodide solution? (Chemistry only)

Yellow precipitate of silver iodide

What is emission spectroscopy?
(Chemistry only)

What is emission spectroscopy? (Chemistry only)

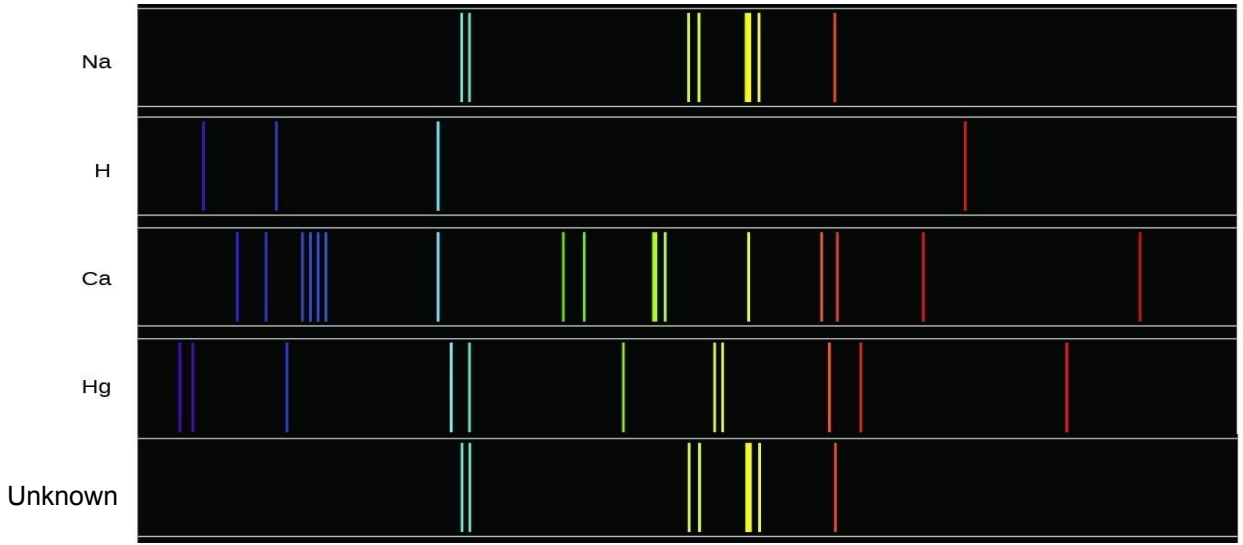
Using an emission spectrometer to record the wavelengths of light emitted by a hot sample.

How can an element or ion be identified using emission spectroscopy? (Chemistry only)

How can an element or ion be identified using emission spectroscopy? (Chemistry only)

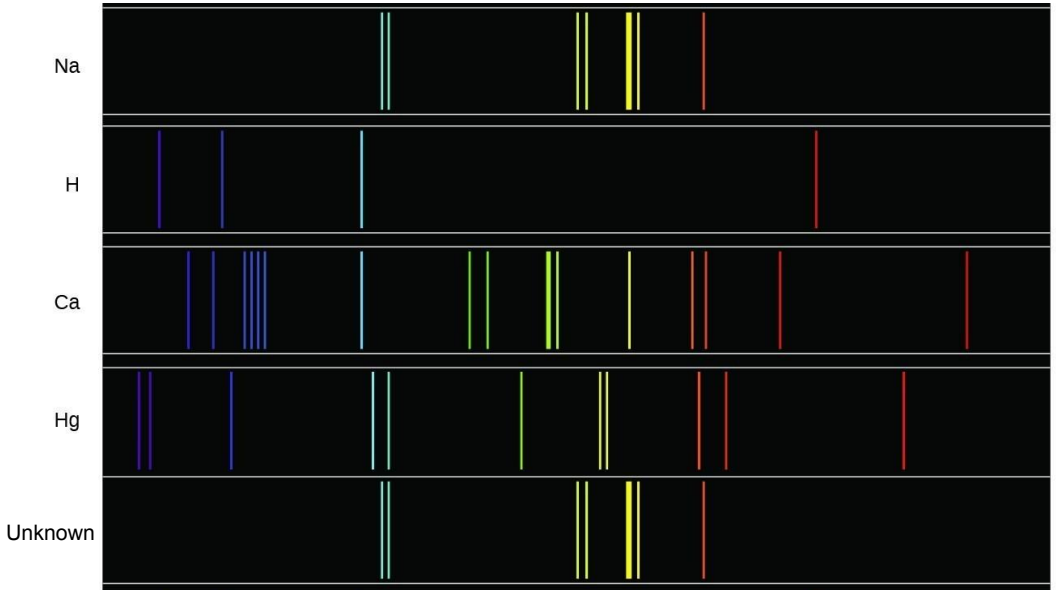
By matching the pattern and wavelengths in the spectrum to reference data.

Identify the unknown element using the emission spectra below (Chemistry only)



Identify the unknown element using the emission spectra below (Chemistry only)

Sodium (Na)



What are instrumental analysis methods?

(Chemistry only)

What are instrumental analysis methods? (Chemistry only)

Analysis methods that need machines.

What are the advantages of instrumental analysis methods?

(Chemistry only)

What are the advantages of instrumental analysis methods? (Chemistry only)

- Speed
- Accuracy
- Sensitivity

What are the disadvantages of instrumental analysis methods? (Chemistry only)

What are the disadvantages of instrumental analysis methods? (Chemistry only)

Very expensive compared with laboratory tests.

What is the law of conservation of mass?

What is the law of conservation of mass?

The total mass of reactants is the same as the total mass of products. Atoms are can not be created or destroyed.

For a non-enclosed reaction, why might mass change? Explain using the particle model.

For a non-enclosed reaction, why might mass change? Explain using the particle model.

Substances can enter or leave the system so mass will be gained or lost.

For example, if a gaseous product is made, it will be able to escape and mass will decrease. This is because the particle model states that gaseous particles are far apart and free to move position.

What is relative atomic mass and how can it be used to calculate relative formula mass?

What is relative atomic mass and how can it be used to calculate relative formula mass?

Relative atomic mass - the mean mass of an atom of an element compared with 1/12 of the mass of an atom of carbon-12.

Relative formula mass - sum of relative atomic masses of elements in a molecules.

Calculate the relative formula mass (Mr) of $CaCl_2$

Calculate the relative formula mass (Mr) of $CaCl_2$

Relative atomic masses: Ca = 40.1 and Cl = 35.5

Mr = 40.1 + (35.5 x 2) = 111.1

Define the mole
(Higher)

Define the mole (Higher)

The amount of any substance containing the same number of particles as there are atoms in exactly 12 g of carbon-12 (6.02×10^{23} particles).

Define Avogadro's constant (Higher)

Define Avogadro's constant (Higher)

The number of particles in one mole of a substance.

This is 6.02×10^{23} particles.

How can the amount of a substance (moles) be calculated from mass? (Higher)

How can the amount of a substance (moles) be calculated from mass? (Higher)

$$\text{Number of moles (mol)} = \frac{\text{mass of substance (g)}}{\text{relative formula mass}}$$

Calculate the number of moles in 10 g of NaCl

(Higher)

Calculate the number of moles in 10g of NaCl (Higher)

Mass = 10 g

Relative formula mass = 23 + 35.5 = 58.5

Number of moles = 10 ÷ 58.5 = 0.171 mol

Calculate the number of atoms in 3 moles of oxygen (O_2)

(Higher)

Calculate the number of atoms in 3 moles of oxygen (O_2) (Higher)

Avogadro constant = 6.02×10^{23}

Number of atoms = $3 \times (6.02 \times 10^{23})$

$= 1.806 \times 10^{24}$

What is a limiting reagent?
(Higher)

What is a limiting reagent? (Higher)

The reactant that is completely used up first in a reaction. The limiting reagent prevents the reaction from continuing.

Fill in the blank: ‘A reactant that is left over at the end of a reaction was in ’

_____

(Higher)

Fill in the blank: ‘A reactant that is left over at the end of a reaction was in _____’ (Higher)

Excess

1.05 g of lithium reacts completely with excess sulfuric acid:

$$2Li + H_2SO_4 \rightarrow Li_2SO_4 + H_2$$

Calculate the maximum mass of hydrogen produced by this reaction

(Higher)

1.05g of lithium reacts completely with excess sulfuric acid: $2Li + H_2SO_4 \rightarrow Li_2SO_4 + H_2$. Calculate the maximum mass of hydrogen produced by this reaction (Higher)

Relative atomic masses:

Li	H	S	O
7	1	32	16

Number of mole of Li = 1.05 ÷ 7 = 0.15 mol

Using ratio in equation:

Number of moles of hydrogen = 0.15 ÷ 2 = 0.075 mol

Mass of hydrogen = (1 x 2) x 0.075 = 0.15 g

To produce magnesium oxide, 3.04 g of magnesium and 2.00 g of oxygen is needed. Deduce the balanced equation for this reaction

(Higher)

To produce magnesium oxide, 3.04g of magnesium and 2g of oxygen is needed. Deduce the balanced equation for this reaction (Higher)

Formulae of reactants	Mg	O_2
Number of moles	3.04 ÷ 24.3 = 0.125	2 ÷ (16 x 2) = 0.0625
Ratio (divide by smallest number of moles)	0.125 ÷ 0.0625 = 2	0.0625 ÷ 0.0625 = 1

Ratio of magnesium to oxygen is 2:1 so:

$2Mg + O_2 \rightarrow 2MgO$

What is the actual yield and theoretical yield of a reaction?

(Chemistry only)

What is the actual yield and theoretical yield of a reaction? (Chemistry only)

Theoretical yield - maximum mass of product that could be made.

Actual yield - mass of product obtained from a reaction.

How can the percentage yield of a reaction be calculated?

(Chemistry only)

How can the percentage yield of a reaction be calculated? (Chemistry only)

Percentage yield = (actual yield ÷ theoretical yield) x 100

Why is percentage yield usually less than 100%?

(Chemistry only)

Why is percentage yield usually less than 100%? (Chemistry only)

- Incomplete reactions (some reactants remain at the end).
- Losses during the experiment, e.g. when transfering solutions.
- Unwanted side reactions.
- Reversible reactions.
- Impure reactants.

What is the volume of one mole of gas at room temperature and pressure?
(Chemistry only) (Higher)

What is the volume of one mole of gas at room temperature and pressure?
(Chemistry only) (Higher)

$24\ dm^3$

What is the relationship between molar amounts of gases and volume at RTP? (Chemistry only) (Higher)

What is the relationship between molar amounts of gases and volume at RTP?
(Chemistry only) (Higher)

Number of moles = volume of gas (dm^3) ÷ 24 (dm^3)

What is the difference between qualitative and quantitative analysis? (Chemistry only)

What is the difference between qualitative and quantitative analysis? (Chemistry only)

- Qualitative - doesn't use numbers
- Quantitative - uses numbers

How can the concentration of a solution be calculated from volume and the mass of solute? (Higher)

How can the concentration of a solution be calculated from volume and the mass of solute? (Higher)

$$\text{Concentration (g/dm}^3\text{)} = \frac{\text{mass of solute (g)}}{\text{volume (dm}^3\text{)}}$$

How can the concentration of a solution be calculated in mol/dm^3? (Higher)

How can the concentration of a solution be calculated in mol/dm^3? (Higher)

$$\text{Concentration} = \frac{\text{number of moles of solute (mol)}}{\text{volume } (dm^3)}$$

What is neutralisation?

What is neutralisation?

The reaction between an acid and an alkali, forming a salt and water.

List common laboratory acids and alkalis

List common laboratory acids and alkalis

Acids:

- Hydrochloric acid(HCl)
- Nitric acid (HNO_3)
- Sulfuric acid (H_2SO_4)

Alkalis:

- Sodium hydroxide (NaOH)
- Potassium hydroxide (KOH)
- Calcium hydroxide ($Ca(OH)_2$)

What do acids form when dissolved in water?

What do acids form when dissolved in water?

Hydrogen ions (H^+)

What do solutions of alkalis contain?

What do solutions of alkalis contain?

Hydroxide ions (OH^-)

How can aqueous neutralisation reactions be generalised?

How can aqueous neutralisation reactions be generalised?

Hydrogen ions reacting with hydroxide ions to form water.

$$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$$

During a neutralisation reaction, what is used to identify the point of neutralisation?

During a neutralisation reaction, what is used to identify the point of neutralisation?

An indicator

What equipment is required for a standard titration?

What equipment is required for a standard titration?

- Burette
- Conical flask
- Pipette and pipette filler
- White tile
- Funnel
- Clamp and stand

How is a standard acid/alkali titration carried out?

How is a standard acid/alkali titration carried out?

- Add the solution with known concentration to the burette. Add 25 cm^3 of a solution with unknown concentration to a conical flask.
- Add a few drops of indicator to the conical flask.
- Record the initial burette reading. Add the solution from the burette into the conical flask, swirling constantly. This is a rough trial to find the end point.
- When the solution in the conical flask changes colour stop adding from the burette and record the final volume in the burette.
- Repeat, adding drop by drop near the end point, until 2 concordant results are obtained.

Why must the conical flask be swirled during a titration?

Why must the conical flask be swirled during a titration?

To ensure the reaction is complete.

Why is a white tile used in a titration?

Why is a white tile used in a titration?

The white tile is placed under the conical flask to make the colour change of the indicator is easier to see.

How is the quality of data obtained from a titration increased?

How is the quality of data obtained from a titration increased?

- Complete a rough trial titration.
- Repeat and calculate a mean.
- Use a white tile to make colour change easier to see.
- Add burette solution drop by drop near end point.
- Take readings from the burette at the bottom of the meniscus (curve of the liquid) and at eye level.

After completing an acid/alkali titration, how can you calculate the concentration of the alkali if you know the concentration of the acid?

(Chemistry only) (Higher)

After completing an acid/alkali titration, how can you calculate the concentration of the alkali if you know the concentration of the acid?

(Chemistry only) (Higher)

- Calculate the number of moles of acid by multiplying concentration by the volume from the burette.
- Use the balanced equation to work out the ratio of acid:alkali then calculate the number of moles of alkali that reacted.
- Divide the number of moles of alkali by the initial volume added to the conical flask to calculate the concentration of the alkali.