

CAIE Chemistry A-Level

4.3.2 - Practical Skills for Paper 5

Analysis, Conclusions and Evaluations

Flashcards

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What is needed to draw conclusions from data?



What is needed to draw conclusions from data?

Calculations

Appropriate presentation of data



What is the difference between qualitative and quantitative data?



What is the difference between qualitative and quantitative data?

Qualitative - non-numerical data that is collected by observation

Quantitative - data that can be measured



Give examples of qualitative data



Give examples of qualitative data

- Colour of a solution
- Observations of precipitates
- pH when using an acid-alkali indicator



Give examples of quantitative data



Give examples of quantitative data

- Height
- Temperature
- Mass
- Age



What are anomalies?



What are anomalies?

Data that does not fit the trend



Why does repeating an experiment increase the accuracy?



Why does repeating an experiment increase the accuracy?

Gaining more data allows easy identification of anomalies which can be removed, making the results more accurate.



Why is it important that all observations are written down during an experiment?



Why is it important that all observations are written down during an experiment?

Observations help explain the reactions occurring in an experiment and they are used to draw conclusions.



What is an estimation? Why are they used in experiments?



What is an estimation? Why are they used in experiments?

Estimations are rough calculations of values.

Estimations are useful in experiments because they quickly show if there is a general relationship between variables.



How are approximations used during a titration?



How are approximations used during a titration?

The point at which neutralisation occurs is estimated when a trial titre is completed. This shows the approximate volume of solution that needs to be added from the burette. As a result, the burette solution can be added dropwise close to end point in future titrations, increasing accuracy.



How is the mean titre calculated after a titration?



How is the mean titre calculated after a titration?

Two concordant results are used (within 0.1 cm^3 of each other). The rough trial should not be included in this calculation.

Mean = sum of results \div number of results



Calculate the mean titre for the data below:

Titre	Volume of acid added (cm ³)
Rough titre	26.45
1	25.60
2	25.45
3	25.40
Mean	?



Calculate the mean titre for the data below:

The rough titre should not be included in the calculation because it usually goes beyond the endpoint of the reaction and is an outlier.

Titre 2 and titre 3 are concordant so the mean should be calculated from these two values:

Titre	Volume of acid added (cm ³)
Rough titre	26.45
1	25.60
2	25.45
3	25.40
Mean	?

$$\text{Mean} = (25.45 + 25.40) / 2 = 25.425 \text{ cm}^3$$



What are the median and mode of a set of data?



What are the median and mode of a set of data?

Median - the middle value when all values are placed in numerical order

Mode - the most common value in the data



How can the percentage change in mass be calculated?



How can the percentage change in mass be calculated?

Percentage change =

$(\text{Change in mass} \div \text{original mass}) \times 100$



What is interpolation?



What is interpolation?

If the value being measured does not fall exactly on a scale division, you can interpolate and estimate a more precise reading.

E.g. If you were measuring a distance with a ruler with millimetre divisions and the length fell evenly between 77 mm and 78 mm, it could be recorded as 77.5 mm.



How are observations most commonly recorded in chemistry?



How are observations most commonly recorded in chemistry?

In data tables



When creating a table to display results,
where should the units go?



When creating a table to display results, where should the units go?

In the column heading with the quantity

E.g.

Mass of copper carbonate/ g	Volume of CO ₂ produced/ cm ³
1.0	5
1.5	10

Notice that values in each column are given to the same number of decimal places



What degree of precision should results be given to?



What degree of precision should results be given to?

The degree of precision should be the reflect the measuring apparatus used.

E.g. if a measuring cylinder is calibrated at 1.0cm^3 , volumes should be recorded to the nearest 0.5cm^3 .



How many significant figures should
calculated results be given to?



How many significant figures should calculated results be given to?

The same number of significant figures as (or one more than) the least accurate measured quantity



How are the independent and dependent variables laid out in a table?



How are the independent and dependent variables laid out in a table?

The independent variable is always in the first column with the dependent variable in the next column.



When plotting a graph, what key points should be remembered?



When plotting a graph, what key points should be remembered?

- Draw in pencil
- Must fill at least half the available space
- Appropriate scale must be used
- Label axes (including units)
- Plot each point as a cross
- Draw a ring around outliers
- Line/ curve of best fit



What type of data is suitable for displaying on a graph?



What type of data is suitable for displaying on a graph?

Quantitative data



Why are graphs often used to display data?



Why are graphs often used to display data?

They clearly show patterns and trends in the data and make anomalous results easy to spot.



When graphing results, on which axis do the independent and dependent variables go?



When graphing results, on which axis do the independent and dependent variables go?

Dependent variable - y axis

Independent variable - x axis



How can an anomalous result be identified from a scatter diagram?



How can an anomalous result be identified from a scatter diagram?

The anomalous data value will fall outside the trend of all the other data values and will not lie on or near the line of best fit.



What information should be included in a conclusion?



What information should be included in a conclusion?

- The hypothesis
- Whether or not the data supports the original hypothesis
- Scientific knowledge to explain the shapes/ trends of graphs and data
- An evaluation of the results
- Relevant improvements



What might be included in an evaluation of an experiment?



What might be included in an evaluation of an experiment?

- Improvements to the proposed method
- Improvements to the apparatus
- Improvements to the way the control variables were controlled
- Identification of any erroneous steps



How could you confirm that a result is anomalous?



How could you confirm that a result is anomalous?

Repeat the experiment for that value twice more. If the two new values match, it can be concluded that the original reading was an anomaly.



What general experimental errors may produce an anomalous result?



What general experimental errors may produce an anomalous result?

- Incomplete reaction
- Control variables not controlled properly
- Human error in measuring quantities and reading measurements
- Evaporation of some of the products/ reactants



How can experimental apparatus be improved?



How can experimental apparatus be improved?

Use apparatus with a higher resolution to improve the precision of the results.

For example, use a pH probe rather than universal indicator.



In an experiment, 20 cm^3 of HCl is measured in a 50 cm^3 measuring cylinder. How could this be improved?



In an experiment, 20 cm^3 of HCl is measured in a 50 cm^3 measuring cylinder. How could this be improved?

Use a 25 cm^3 measuring cylinder.

If you want a very accurate reading, a burette or 20 cm^3 pipette could be used.



A standard titration is carried out where acid is added from a burette to a beaker of alkali until neutralisation occurs. Suggest ways in which this method could be improved



A standard titration is carried out where acid is added from a burette to a beaker of alkali until neutralisation occurs. Suggest ways in which this method could be improved

- Use a conical flask instead of a beaker to allow for the mixture to be swirled.
- Put a white tile under the reaction mixture to observe the colour change more easily.
- Do an initial rough titration to find the approximate end point.
- Make sure there is no air bubble in the end of the burette before starting.



Hydrochloric acid reacts with sodium thiosulfate. The time taken for a black cross to disappear beneath the reaction mixture is measured. What must be controlled in this experiment?



Hydrochloric acid reacts with sodium thiosulfate. The time taken for a black cross to disappear beneath the reaction mixture is measured. What must be controlled in this experiment?

The point at which the black cross disappears is subjective so the same person must observe the cross each time.

The black cross must stay the same (same size and shade).

Temperature, concentration of solutions and volume of solutions should also be controlled (with the exception of the independent variable).



The temperature change of an acid-alkali neutralisation reaction is being measured in a beaker. How can this experiment be improved?



The temperature change of an acid-alkali neutralisation reaction is being measured in a beaker. How can this experiment be improved?

Use a polystyrene cup instead of a glass beaker as it is a better thermal insulator. A lid can also be placed on the cup to minimise heat loss.



How might the range of intervals used in an experiment be changed to allow more valid conclusions to be drawn?



How might the range of intervals used in an experiment be changed to allow more valid conclusions to be drawn?

If the trend is difficult to see, broader or narrower intervals can be used (depending on the results).

If there is little change across the data, the intervals should be broadened to investigate a larger range of values.

If there is lots of quick abrupt change across the data, the intervals should be narrowed to see the trend in more detail.



The mass of calcium carbonate powder is measured on a digital mass balance before being added to a solution. How can this mass measurement be improved?



The mass of calcium carbonate powder is measured on a digital mass balance before being added to a solution. How can this mass measurement be improved?

Using the weigh- by-difference method gives a more accurate result. The mass is weighed in a weighing boat. Calcium carbonate is then added to the solution and the empty weighing boat is reweighed. The mass of calcium carbonate added is the difference between these values.



What are control variables?



What are control variables?

Factors that need to be kept constant in the experiment to make it a fair test.



Temperature is a control variable in an experiment. How could temperature be kept constant?



Temperature is a control variable in an experiment.
How could temperature be kept constant?

Place the reaction vessel in a water bath.
Water temperature changes much slower
than air temperature meaning it is more
constant.



Which variables need to be controlled if the rate of reaction between sodium and hydrochloric acid is being investigated at different temperatures?



Which variables need to be controlled if the rate of reaction between sodium and hydrochloric acid is being investigated at different temperatures?

- Concentration of acid
- Volume of acid
- Surface area of sodium
- Mass of sodium



An acid-alkali titration is carried out using 0.5 mol dm^{-3} HCl and 25 cm^3 of NaOH.

What effect would increasing the concentration of NaOH have on the volume of HCl required for neutralisation?



An acid-alkali titration is carried out using 0.5 mol dm^{-3} HCl and 25 cm^3 of NaOH. What effect would increasing the concentration of NaOH have on the volume of HCl required for neutralisation?

A larger volume of HCl would be required for neutralisation.



What is the qualitative test for an alkene
 $C=C$ functional group?



What is the qualitative test for an alkene C=C functional group?

Add bromine water.

The orange solution decolourises.



What is the qualitative test for an alcohol
-OH functional group?



What is the qualitative test for an alcohol -OH functional group?

Add a few drops of ethanoyl chloride.

The fumes will turn blue litmus paper red. A white precipitate will be produced if silver nitrate is added to the product.



A solution is known to be an alcohol.
How can you distinguish whether it is a
primary, secondary or tertiary alcohol?



A solution is known to be an alcohol. How can you distinguish whether it is a primary, secondary or tertiary alcohol?

Add acidified potassium dichromate. For primary and secondary alcohols, the solution will turn from orange to green. For tertiary alcohols the solution will remain orange.

To distinguish between primary and secondary alcohols, test the product of the reaction above with Tollens' reagent. If a silver mirror is formed then the original solution was a primary alcohol. If no reaction takes place then the original solution was a secondary alcohol.



Which qualitative test can be used to distinguish an aldehyde from a ketone?



Which qualitative test can be used to distinguish an aldehyde from a ketone?

- Add Tollen's reagent. Silver mirror formed on the test tube for an aldehyde. No change for ketone.
- Add Fehling's reagent. Blue solution turns brick red for an aldehyde. No change for ketone.

