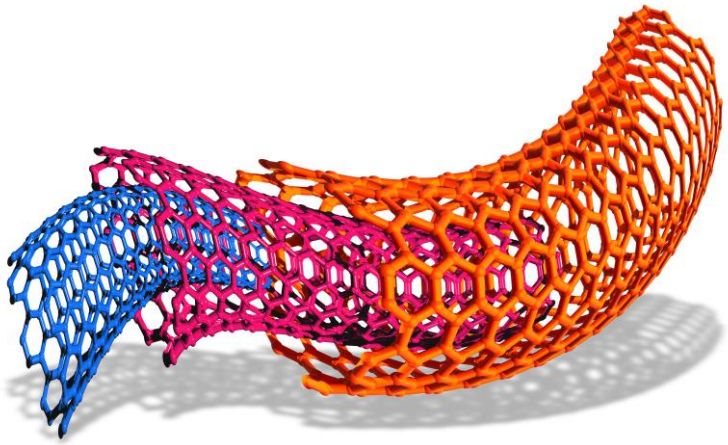
Cambridge Assessment International Education

Next Steps

Cambridge IGCSE™ Chemistry 0620 and Cambridge International AS & A Level Chemistry 9701

For Cambridge IGCSE examination from 2020

For Cambridge International AS & A Level examination from 2022



Version 1

Cambridge Pathway

In order to help us develop the highest quality resources, we are undertaking a continuous programme of review; not only to measure the success of our resources but also to highlight areas for improvement and to identify new development needs.

We invite you to complete our survey by visiting the website below. Your comments on the quality and relevance of our resources are very important to us.

www.surveymonkey.co.uk/r/GL6ZNJB

Would you like to become a Cambridge consultant and help us develop support materials?

Please follow the link below to register your interest.

www.cambridgeinternational.org/cambridge-for/teachers/teacherconsultants/

Contents

Introduction

The focus of this guide is on moving on from teaching and studying the **Cambridge IGCSE™ Chemistry 0620** syllabus to the **Cambridge International AS & A Level Chemistry 9701** syllabus.

This guide will help you and your learners:

- understand better what to expect when you start the AS & A Level course
- prepare for the AS & A Level course
- think about ways to achieve success and gain confidence.

You may be using this document at the end of the academic year for Cambridge IGCSE Chemistry, or at the start of the academic year for Cambridge International AS & A Level Chemistry. Either way, the aim is to motivate and inspire learners. If there is to be a time gap between delivering this session and starting the AS & A Level course, then the aim is for every learner to 'look forward' to the new course positively.

This Introduction, the Resources and Suggested classroom activity sections of this guide are written directly for you, the teacher. The rest of this guide has been written to make it easy for you to adapt and reproduce the content for use by your learners.

Frequently asked questions by learners

Listed below are some questions which learners frequently ask. The answers to each of the questions below are written as a direct communication to your learners. You could copy and paste these to make a PowerPoint, read them out to your group, or produce a booklet for them to read through and discuss.

Is it helpful to have taken the Cambridge IGCSE Chemistry course?

Yes. The move from Cambridge IGCSE to Cambridge International AS & A Level has been designed to be as smooth a transition as possible. Many of the topic headings are the same so you will already be familiar with the topic and will just progress from there. The style of questions may be similar and the skills you have developed will be useful.

What extra work will I have to do, if I have not taken Cambridge IGCSE Chemistry?

This will depend on the course you have taken. Many learners without a Cambridge IGCSE background have the same skills and subject knowledge and generally adjust quickly to the 'Cambridge' style when they start their AS & A Level.

You may not have covered some topics that are a useful base for AS & A Level. This is not a problem – you will probably find that your teacher goes over some IGCSE work as a start to a new AS & A Level topic, or if not, you can easily develop your research skills and read up what you need to know. You will find that teaching yourself subject matter at IGCSE Level is much easier when you are working to a higher level.

What is the syllabus?

The syllabus for Cambridge International Chemistry AS & A Level 9701 is a complete description of the content, examinations and what you need to do to be successful in the qualification. `9701' is the reference number of the Chemistry syllabus.

An important part of the syllabus for you is the subject content, which details all the subject material you should cover during the course. This content is divided into topics, each of which has an introductory text and is divided further into 'learning outcomes'. These are manageable statements explaining further what you should know and understand about the topic.

Your teacher may give you a copy of the subject content of the syllabus. Or go to the Cambridge website at http://www.cambridgeinternational.org/9701, for the full copy of the syllabus.

How do I make the transition from Cambridge IGCSE Chemistry to Cambridge International AS & A Level Chemistry?

This guide will help you prepare for the transition, so there are no surprises in what to expect.

You may find you hardly notice the transition to AS & A Level, or you may find it more difficult to adjust at first and need a bit of time to settle into the new course. Try and assess your own situation and then decide your best course of action.

What are the differences?

Some of the main differences you will find when you study Cambridge International AS & A Level compared to Cambridge IGCSE are listed in the table below.

Fewer subjects	We hope that you will have chosen the subjects that you really enjoy, are really good at or those which you need to take you onto university and/or your chosen career.
Smaller classes	You will have an opportunity to contribute more to lessons and have more one-to-one interaction with your teacher. You will have more lessons each week: the recommended guided learning hours for IGCSE Chemistry is 130 compared with 180 guided learning hours for AS and 360 learning hours for the full A Level qualification.
Detailed and specialist content	You will find increased challenge as you study in greater depth, work more independently and begin to develop your own ideas. You will be able to explore topics in much more depth than at IGCSE, maybe finding answers to unanswered questions and learning about certain topics which are completely new.
Independent study	Greater independence is a key part of AS & A Level qualifications which helps prepare you for study at university. It is important that you use this independent study time well. You can use this time in a variety of constructive ways – for completion of homework tasks, assignments, research or for completing additional reading around the subject.
Revision	Try to build in some time for revision throughout the course – consolidating and learning notes as you go along makes it much easier to remember when it comes to examination time.
Read around your subject	Use a range of textbooks and internet sites, though you will probably find the Cambridge endorsed textbooks the most helpful.
Take notes	When you take notes, try to summarise the main information that you need. Use headings and bullet points to reduce the content and colours to highlight key pieces of information. If using the internet, don't just print pages of information, make notes from them or highlight text to show the key points. Always use your own words where possible.
Independent research	You might have completed some research tasks at IGCSE but you can expect this to be a more regular feature of homework tasks. Ask your teacher for a recommended list of textbooks and websites that you can use so you have a good starting point. Save useful websites to your favourites bar so you know where to find them again.

Folders	You will probably move from exercise books to folders to record your learning and it is important to be organised. Divide your folder into topic sections and keep your notes in date order. Keep copies of past questions, mark schemes and example answers alongside any completed assessed work. Highlight examination tips in your notes and keep key documents about examinations in a separate section of your folder.
Key information	Mathematical requirements and a summary of key quantities, symbols and units for use with the course can be found in the Additional Information section of the syllabus.
Command words	These are the words in an exam question that explain to you what you need to do such as describe, explain, state, evaluate. You may well have underlined these when looking at example examination questions. At Cambridge International AS & A Level, you may be introduced to some new command words. There is a helpful list of command words in the syllabus.
Assessment	You need to know what examinations you will sit, how long each examination is; whether you have a choice of questions or not; how many marks each question/paper carries and what the structure of the questions is like. It is a good idea to have an assessment overview and copies of past papers and mark schemes.
Key concepts	The key concepts for Cambridge International AS & A Level Chemistry are: • **Atoms and forces** – Matter is built from atoms interacting and bonding through electrostatic forces. The structure of matter affects its physical and chemical properties, and influences how substances react chemically. • **Experiments and evidence** – Chemists use evidence gained from observations and experiments to build models and theories of the structure and reactivity of materials. Theories are tested by further experiments and an appreciation of accuracy and reliability is gained. • **Patterns in chemical behaviour and reactions** – Patterns in chemical behaviour can be identified and used to predict the properties of substances. By applying these patterns, useful new substances can be designed and synthetic routes created. • **Chemical bonds** – The understanding of how chemical bonds are made and broken by the movement of electrons allows us to predict patterns of reactivity. Appreciation of the strength of chemical bonds leads to the understanding of a material's properties and its uses. • **Energy changes** – The energy changes that take place during chemical reactions can be used to predict the extent, feasibility and rate of such reactions. An understanding is gained of why and how chemical reactions happen. These key concepts will help you to develop a deeper understanding of chemistry and make links between the different topics.

Skills, topics and assessment

What are the skills needed for the Cambridge International AS & A Level course?

For the examinations taken at AS & A Level, you will be assessed on assessment objectives (AOs) which detail the skills and knowledge you need to display in order to fulfil the requirements of the assessment. These skills are divided into three main groups:

AO1 Knowledge and understanding	**AO2** Handling, applying and evaluating information	**AO3** Experimental skills and investigations

Each of AO1, AO2 and AO3 is divided further into specific knowledge and skills.

How will I be assessed?

Each of the three AS Level papers are different in style. As part of your assessment, you will have multiple choice questions and structured questions, including data response questions. You may be asked to produce diagrams and graphs. You will also have a practical test.
At A Level there are an additional two papers. Paper 4 contains structured questions and Paper 5 is based on the practical skills of planning, analysis and evaluation.

What topics will be studied?

The extended subject content for Cambridge IGCSE Chemistry 0620 serves as a foundation for Cambridge International AS & A Level Chemistry 9701 which prepares learners for the study of chemistry at university. There are some areas of the Cambridge International AS & A Level syllabus which you will already have studied and some areas that will be new to you. The table below shows the similarities and main areas of progression between the IGCSE and the International AS & A Level syllabus.

Where topics are completely new, there may be more key words and you may need to read around these topics more widely to consolidate your knowledge and understanding.

Six areas of progression from Cambridge IGCSE Chemistry 0620
Atomic structure For IGCSE you drew atom diagrams and wrote electron configurations of atoms and ions for the main energy levels/ shells. You only considered the electron filling of atoms and ions up to Z = 20. At AS Level, this theory is advanced to consider sub-shells (s, p and d electrons) and the shapes of orbitals. In the second year, you use these more detailed electron configurations to explain the properties of the first row transition metals.
Chemical Bonding At IGCSE level, you concentrated on the major differences between ionic and covalent bonding and how this affects the properties of the substances. This study also includes the differences between macromolecular and simple molecular substances. At A Level, the emphasis is placed on the trends in the electronegativity value of elements. You will learn to recognise that the type of bonding present is related to differences between the electronegativity values of elements. You will appreciate that there is not a clear-cut distinction between covalent and ionic bonding, and as such, for example, an ionic substance may have a degree of covalent character. Dative (coordinate) bonding is also introduced at A Level.

Six areas of progression from Cambridge IGCSE Chemistry 0620
Understanding of intermolecular forces is developed in greater depth at A Level. Different types are discussed, and how they affect the physical properties of substances is explored.
Organic chemistry In organic chemistry at IGCSE level, the properties and reactions of the following homologous series are considered: alkanes, alkenes, alcohols, carboxylic acids and esters. At A Level, many more functional groups and their reactions are added: halogenoalkanes, aldehydes and ketones, amines, nitriles and hydroxynitriles, acyl chlorides, amides and amino acids. Additionally, aromatic chemistry is introduced and the bonding and shape of benzene and its derivatives are detailed. Several different reaction types are explored, revealing the scope of aromatic compounds in nature and their frequency in many useful organic molecules.
Reversible reactions and equilibrium At IGCSE level, you appreciate that some reactions are reversible in nature, and that in a closed system equilibrium is reached. They predict the effects of changing the temperature, pressure and concentration qualitatively. At AS Level, you derive equilibrium expressions for chemical systems, enabling you to explore quantitatively the effects of changing the concentration and pressure. Later on, in A Level, you apply the concepts learnt in AS Level to perform calculations on pH, buffer solutions, solubility product and partition coefficients.
Reaction kinetics Fundamental ideas concerning collision theory, and broadly which factors affect the rate of a chemical reaction are discussed at IGCSE level (concentration, temperature, surface area, pressure and the use of catalysts). Activation energy is a term briefly mentioned but is extended at AS Level to include the Boltzmann distribution which explains in more detail the way in which chemical reactions are affected by increasing temperature and by catalysts. At A Level, the way in which the concentration of specific reactants in a chemical reaction is approached mathematically by inspecting the rate equation for each reaction system. It is also observed that many reactions occur in several steps (the reaction mechanism) leading to the formation of the final product. Reaction mechanisms help chemists understand which bonds are broken and in which order. They also help determine which steps are faster or slower. Knowledge of reaction kinetics help chemists control the overall rate of chemical reactions which is very important in an industrial setting.
Electrochemistry At IGCSE level you use a set of simple rules to qualitatively predict the products of electrolysis of molten and aqueous solutions using inert and active electrodes. Whether or not a metal will be liberated at the cathode, you relate to the positions of these metals in the reactivity series. There is only a brief mention of electrochemical cells at this level. A more mathematical approach to electrochemistry is utilised at A Level. You calculate the quantity of charge passed during electrolysis and the mass and/or volume of substances liberated. At A Level, you are introduced to standard electrode potentials and how they are measured. You learn how to calculate them and find overall standard cell potentials. You also predict the feasibility of reactions

Six areas of progression from Cambridge IGCSE Chemistry 0620
and construct and balance redox equations. At A Level a quantitative treatment is made of how the value of an electrode potential varies with the concentrations of the aqueous ions. (Nernst equation).

Six new topics or skills at Cambridge International AS & A Level Chemistry 9701
The shapes of molecules The shapes of molecules are not formally discussed at IGCSE level. Learners sometimes build models and see molecules in videos and other resources, but do not fully appreciate how these shapes arise. At A Level you study VSEPR theory in order to show the variety of three-dimensional shapes commonly formed by molecules. By considering these shapes, rather than treating molecules as flat structures on a page, you will take a fresh look at chemical substances and the way they are bonded. Computer simulations and model building are most helpful in the visualisation of this topic. Additionally, you will also forge links with other Science areas of study, e.g. the lock and key analogy of an enzyme fitting an active site in Biology.
Organic synthesis Learners at IGCSE level encounter only a few functional groups. However, after covering more functional groups and reaction types, you are able to start planning stepwise synthetic pathways. The complexity of the syntheses depends on the level (AS or A Level). However, you are generally required to suggest routes to target compounds via two-step syntheses, using the types of reactions covered in the syllabus. At this stage of the course, you also need to quote reaction conditions.
Spectroscopic instruments for analysis At IGCSE level, the main method of analysis of substances is by qualitative analysis in inorganic chemistry, plus one or two tests performed on organic compounds to identify functional groups. At A Level, you find out how infrared, mass spectrometry, nuclear magnetic resonance and types of chromatography are used to elucidate the structures of organic compounds. You should not study this topic alone, but should try to apply it to applicable areas of the syllabus. Very often, spectroscopic methods are combined and used to identify an unknown product or an impurity arising during synthesis.
Transition metals Once you have mastered the unit on atomic structure in the A Level syllabus, you should be able to write down the full electron configurations for the transition metals and their ions. From this, you will be able to appreciate why they have variable oxidation states, behave as catalysts and form complex ions. There is large section in the syllabus devoted solely to the study of complex ions, and you will cover the types and variety of ligands that form dative bonds to the central transition metal ion and some of the possible shapes that result. You will also explore ligand exchange reactions and why transition metal complex ions have different colours. Finally, you will delve into stereochemistry in transition metal complexes and stability constants.
Hess's law and Born-Haber Cycles You briefly considered the making and breaking of bonds at IGCSE level in Energetics of a reaction, and you touched upon the summation of bond energies to discover if a reaction is endothermic or exothermic overall.

Six new topics or skills at Cambridge International AS & A Level Chemistry 9701
At AS Level, you make use of Hess's law energy cycles to calculate enthalpy changes for reactions in which the enthalpy of reaction cannot be measured directly. During the A Level part of the syllabus, you advance to performing calculations on individual steps in the formation of an ionic crystal, leading to an understanding of the overall strength of a crystal lattice. Finally, you find out about entropy and use this to calculate the Gibbs free energy of chemical reactions. This allows you to make predictions as to whether a reaction is likely to be feasible at a certain temperature.
The Periodic Table In IGCSE, Groups 1, 17 and 18 (and the transition metals) are briefly studied. At A Level you study the periodicity of physical and chemical properties of the elements in Period 3. This is an in-depth, data-based study in which you consider atomic and ionic radii, melting point and electrical conductivity of the elements. Chemically, you explore the reactions of the elements of Period 3 with oxygen, water and look at their acid-base behaviour. The similarities and trends in the properties of the Group 2 elements are analysed and the reactions of their compounds are compared (Specifically the oxides, hydroxides, carbonates and nitrates). You become much more competent at predicting the products of these reactions and in writing balanced chemical equations for these reactions.

Resources

Although some of the resources for AS & A Level are similar to those for Cambridge IGCSE such as past papers and endorsed textbooks, your learners may not have much experience of looking for themselves on websites or reading around a topic for interest and understanding. Learning new skills and tackling new resources is all part of the challenge for learners of stepping up to Cambridge International AS & A Level Chemistry.

Past/specimen papers and mark schemes

Past examination papers and specimen papers provide opportunities for learners to become familiar with the assessment requirements of the course. Learners should try to get as much practice in as they can before their final exams. You can refer to the accompanying mark schemes to guide your learners as to how they will be assessed and how they can improve their responses.

Textbooks

There is a wide variety of textbooks available, some which cover the entire course and others which specialise in certain topics. Give your learners a list of suggested reading materials. There are several endorsed textbooks which are available for this course.

To find a list of the endorsed textbooks go to www.cambridgeinternational.org

Websites

There are some specific AS & A Level Chemistry revision sites which are great to use. You can also use general search engines to find information although some sites might be more relevant than others. Sometimes, teachers put lesson presentations on the internet that you can use. Remember to check all internet resources for suitability, making sure that the content is relevant for your syllabus. Also, some websites tend to match a certain syllabus. That does not mean that they are not useful, you will just need to be selective about the topics that you choose from them.

www.cambridgeinternational.org
Access to syllabus; past papers and mark schemes.

www.rsc.org
Particularly useful for experiments.

www.chemguide.co.uk
General reference on all topics

www.docbrown.info
General reference on all topics

https://phet.colorado.edu/en/simulations/category/html
Interactive simulations

www.webelements.com
Interactive periodic table

www.khanacademy.org/science
General reference

https://chemrevise.org/international-a-level/
General reference

www.chemspider.com
General reference

Suggested classroom activity

You could use the plan below to deliver a lesson that supports the transition to AS & A Level study.

Subject: Chemistry	Syllabus reference: Reaction kinetics
Lesson objectives: To perform a small number of chemical tests to remind the students about the factors that affect rate of reaction.	**Lesson outcomes:** The student should understand that rate is affected by concentration, temperature, surface area, the presence of a catalyst (including enzymes).
Introduction: Each group is to perform the experiments in the small circus of activities provided. (They could be given all the tasks at one work station). They should record their results and use the suggested video clips to help them understand what is happening in each case.	**Resources:** The equipment provided for each activity and any endorsed A Level textbook. The following YouTube clips to help understand what is happening in each activity: 'Factors affecting the rate of reaction and collision theory' by Get to Know Science. https://youtu.be/jd6U5nQcqKc '6.2.4/6.2.5 Factors that affect the rate of reaction/Maxwell-Boltzmann distribution curves' by Mike Sugiyama Jones https://youtu.be/GwcF3K_-WeY '6.1 Catalysts (SL)' by Mike Sugiyama Jones https://youtu.be/nw8bg7vkezY 'The Maxwell Boltzmann Distribution/A-level Chemistry' by Snap Revise https://youtu.be/FESOvWBVzno

Main activities:

Activity 1

Equipment: Two test-tubes or boiling tubes, a 10.0 cm^3 measuring cylinder and a dropping pipette.

Two similar sized pieces of granulated zinc **[F] [N]**. Dilute sulfuric acid (0.5 mol dm^{-3}) **[MH]** and aqueous copper (II) sulfate (0.5 mol dm^{-3}) **[MH] [N]**.

Instructions:

- Put a piece of granulated zinc into each test-tube.
- Add 5.0 cm^3 of dilute sulfuric acid into the first test-tube.
- Add 5–6 drops of aqueous copper (II) sulfate to the second tube, followed by 5.0 cm^3 of dilute sulfuric acid.
- Observe the effervescence in each case and determine whether the rate is faster in the first or second test-tube.
- What is the function of the copper (II) sulfate in the second test-tube?

Activity 2

Equipment: Two test-tubes or boiling tubes, a 10.0 cm^3 measuring cylinder and a stop watch. Two pieces of magnesium ribbon **[F]**, 1.0 cm long. Dilute hydrochloric acid solutions (1.0 mol dm^{-3} and 0.5 mol dm^{-3}) **[MH]**

Instructions:

- Put 5.0 cm^3 of 1.0 mol dm^{-3} hydrochloric acid into a test-tube.
- Drop a piece of magnesium ribbon into the test-tube and at the same time start the stop watch.
- Stop timing when the magnesium ribbon has just finished reacting.
- Record the time.
- Repeat the test with the more dilute acid. (0.5 mol dm^{-3} hydrochloric acid)
- What is the independent variable in this reaction?
- Compare the time for the two tests.
- What conclusion can be drawn about the effect of concentration on the rate of the reaction?

Activity 3

Equipment: Two test-tubes or boiling tubes and a 10 cm^3 measuring cylinder. Dilute hydrochloric acid solution (1.0 mol dm^{-3}) **[MH]**, a small piece of marble chip and a similar mass of calcium carbonate powder **[Low hazard]**.

Instructions:

- Put 5.0 cm^3 of hydrochloric acid solution into each test-tube.
- Add the marble chip to the first test-tube.
- Add the calcium carbonate powder to the second test-tube.
- Compare the vigour/violence of the effervescence.
- Which reaction has the greater rate? Explain why.

Activity 4

Equipment: Two test-tubes or boiling tubes, a 100.0 cm^3 beaker, a thermometer (−10 to 110 °C), a 10.0 cm^3 measuring cylinder and a stop watch. Two pieces of magnesium ribbon **[F]**, 1.0 cm long, dilute hydrochloric acid solution (1.0 mol dm^{-3}) **[MH]** and some ice.

Instructions:

- Put 5.0 cm^3 of hydrochloric acid solution into each test-tube.
- Measure the temperature of the solution in the first test-tube.
- Make an ice bath in the beaker by combining water and ice.
- Put the second test-tube into the ice bath.
- Measure the temperature of the acid in the second test-tube.
- Drop a piece of magnesium ribbon into the first test-tube and at the same time start the stop watch.
- Stop timing when the magnesium ribbon has just finished reacting.
- Record the time.
- Repeat with the second test-tube.
- What is the independent variable in this reaction?
- Compare the time for the two tests.
- What conclusion can be drawn about the effect of temperature on the rate of the reaction?

Activity 5

Equipment: Two test-tubes or boiling tubes and a 10.0 cm^3 measuring cylinder. 15.0 cm^3 of pasteurised milk and access to rennet* **[MH HH C]** and hot water.

*vegetarian rennet (also known as rennin) can be used as a suitable source of the enzyme.

Instructions:

- Put 5.0 cm^3 of milk into each test-tube.
- Add 5 drops of rennet to each test-tube.
- Make a water bath at 40 °C using the hot water (Hazard: Risk of burning from hot water).
- Leave one test-tube at room temperature (25 °C) and put the other in the water bath.
- Check occasionally until the milk is set (looks to be solid).
- In which test-tube does the milk set first?
- What is the function of the rennet in this reaction?
- For the test-tube where the milk has set quicker, give two reasons why this has happened.

Homework: Record the results of each test in an appropriate format, this may include constructing a table, with headings and units, where necessary. Produce an evaluation of the results.	
Organisation: Preparation of suitable apparatus and chemicals to be available during the lesson. Information for the students to carry out the tests.	**Plenary:** Discussion of the results.
Challenge: Ask the students to explain, in terms of the collision theory, why each variable has affected the rate.	**Assessment opportunities:** Assessing the student's handling of apparatus. Checking the written work produced. Answers to directed questions in the plenary discussion.

Bridging exercise

Note for teachers

This activity is designed to follow on from the learning in the classroom activity. It makes use of a specimen question to give an indication of the how each learner has gained knowledge and understanding from completing the earlier activity. Learners will need access to at least one of the endorsed textbooks. They will also need a copy of Question 2 from the 2016 Specimen Paper (9701/2) and accompanying mark scheme. These are available from the School Support Hub. As this is the first activity they have attempted, it would be a good idea to pair learners together, providing each with a lab partner for support.

Learner task

You will now have completed your classroom activity and hopefully you have enjoyed learning about the factors that affect the rate of a reaction. You are going to complete the following activity to give you an idea of how you might work independently as part of the AS & A Level Chemistry course. Make sure that you first use your resources and then your lab partner before seeking the support of your teacher.

Task: Plan an experiment to find out which metal oxide is the most effective at catalysing the decomposition of aqueous hydrogen peroxide.

Preliminary work: Place 5 cm^3 of hydrochloric acid solution into a test-tube. Add one/two drop(s) of liquid detergent. Drop a 1 cm length of magnesium ribbon into the tube. Measure the height of the foam/froth above the liquid.

Using the internet research the equation for the decomposition of hydrogen peroxide.

Equipment: Test-tubes or boiling tubes, a 10 cm^3 measuring cylinder, a dropping pipette, a ruler, a stop watch and access to a balance.
Chemicals: 10% (by volume) aqueous hydrogen peroxide **[MH]**, liquid detergent, aluminium oxide **[Low hazard]**, copper(II) oxide **[MH] [N]**, iron(II) oxide **[MH]**, magnesium oxide **[Low hazard]**, manganese(IV) oxide **[MH]** and zinc oxide **[N]**.

Aim: We want you to:

- Plan an experiment to find out which of the six named oxides is most effective at decomposing hydrogen peroxide.
- Read the chapters on reaction kinetics and transition metals in an endorsed textbook to consolidate your understanding of catalysis and the properties of transition metals.
- Use internet research to add some extra ideas to your notes. It is a good idea to keep a note of the websites that you used in case you want to return to them later. Try the chemguide website and see if you can find some others that you can share with your lab partner and add to your useful website list.
- Begin by predicting which oxide or oxides would be most effective and give an explanation for your choice.
- Write a method for the experiment, giving details of volumes of solutions used, amount of oxide used and how you would monitor each reaction to enable you to decide which oxide is most effective.
- Produce a table which is suitable to record your results.
- Perform the experiment and evaluate your results.
- Work with your lab partner to compare your ideas and support each other's note taking. Add in any extra information that you have learned from your discussion with each other in a different colour pen.

Next:

- Now look at the past question you have been given – Question 2 from the 2016 Specimen Paper 2 parts (a), (b) and (c) and underline the key terms and command words. Make sure that you understand what the question is asking you to do before you start.
- Work with your lab partner to plan your answer and to write a first draft in response to the question. Remember, this is the first time that you have seen an AS Level question so don't worry if you find it challenging at this stage.
- Now look at the mark scheme provided to self-assess your first draft. Answer these questions: what has gone well and what could be improved? Add any additional ideas you might have into your answer in a different colour. If there is anything that you are not sure about? Do some extra note taking, chat to your lab partner about it or ask your teacher.
- Bring all your work together and submit it to your teacher. You have successfully completed an independent research task and your first AS Level standard question. Great work!

Your completed activity will include: note taking; internet research, table; question plan, first draft and self-assessment.

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