Chemistry Paper 2

Model Exam Question Booklet

Essential Content for the Higher Separate Science Exam (PBT/FKI)

Chemistry Paper 2	
Topics in the Paper:	
C8	Rates and Equilibrium
C9	Crude Oil and Fuels
C12	Chemical Analysis
C13	The Earth's Atmosphere
C14	The Earth's Resources
C15	Using Our Resources
RP5	Rates of Reaction
RP7	Chemical Tests

This booklet is split into 3 parts:

Part 1
The first part is a selection of short response questions and answers that are likely to come in your Chemistry exams this summer. Spend time learning the answers to these questions, for example you could produce flash cards. You should self quiz yourself on these questions regularly!

Part 2
Selection of extended response questions (4 to 6 marks) that are likely to be on your paper this year, either because they have not been assessed in the last couple of years, or because they come up most years in exams. Prepare and practice your responses to these questions.

Part 3
Required practical section. In this section you will find step by step guidance for each practical. This is followed by a page of short response questions and answers to learn for each of the practicals. There are also some extended response questions (4 to 6 marks) that are very likely to be on the exam paper this year.

C8: Rates of Reaction

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1. How can the rate of reaction be found?
2. What formula would you use if you were finding the rate of reaction by measuring the **quantity of reactant used**?
3. What formula would you use if you were finding the rate of reaction by measuring the **quantity of product formed**?
4. What factors affect the rate of chemical reactions?
5. How can we use a gas syringe to calculate the rate of reaction of a reaction in which a gas is formed?
6. How can we use a balance to calculate the rate of reaction of a reaction in which a gas is formed?
7. How can we use apparatus to calculate the rate of reaction in which a solid is formed?
8. What is a precipitate?
9. What state symbol would you find for a precipitate?
10. What is collision theory?
11. What is activation energy?
12. Why does increasing pressure increase the rate of reaction?
13. Why does increasing pressure of reacting gases increase the rate of reaction?
14. Why does increasing surface area of reacting solids increase the rate of reaction?
15. Why does increasing temperature increase the rate of reaction?
16. Why does the use of a catalyst increase the rate of reaction?
17. What is a catalyst?
18. What symbol represents a reversible reaction?
19. What is a reversible reaction?
20. How can the direction of a reversible reaction be changed?
21. What is equilibrium?

1. By measuring the quantity of reactant used or the quantity of product formed over time.
2. Mean Rate of Reaction = Quantity of Reactant Used/Time Taken
3. Mean Rate of Reaction = Quantity of Product Formed/Time Taken
4. Concentration of Reactants, Pressure of Reacting Gases, Surface Area of Solid Reactants, Temperature and Presence of Catalysts.
5. Add the reactants in a conical flask, seal with a bung and collect the gas in a gas syringe. Record how much gas has been made in a given time.
6. Weigh the reactants beforehand, add them both to a conical flask and record the decrease in mass in a given time.
7. Add the reactants in a conical flask and time how long it takes for the cross to disappear.
8. A solid product in a chemical reaction.
9. (s)
10. It is a theory that states that chemical reactions can only occur when reacting particles collide with each other and with sufficient energy.
11. The minimum amount of energy that particles must have to react.
12. The frequency of collisions between reactants is increased which increases the rate of reaction.
13. The frequency of collisions between reactants is increased which increases the rate of reaction.
14. The frequency of collisions between reactants is increased which increases the rate of reaction.
15. The frequency of collisions between reactants is increased and the collisions are more energetic.
16. Catalysts provide a different pathway for the reaction that has a lower activation energy.
17. They are chemicals which change the rate of chemical reactions without being used up themselves.
18. ⇋
19. It is a reaction in which the products of a reaction can react to make the original reactants.
20. Changing the conditions.
21. It is when a reversible reaction occurs in apparatus it can't escape from and the forward and backward reaction happen at the same rate.

C9: Crude Oil

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1. What is crude oil?	1. It is a finite resource found in rocks. It is the remaining of ancient biomass made of plankton that was buried in mud. It is a mixture of a large number of compounds which are mostly hydrocarbons.
2. What is a hydrocarbon?	2. A compound containing hydrogen and carbon atoms only.
3. What is the general formula for an alkane?	3. C_nH_{2n+2}
4. What is the name of an alkane containing 1 carbon atom?	4. Methane
5. What is the name of an alkane containing 2 carbon atoms?	5. Ethane
6. What is the name of an alkane containing 3 carbon atoms?	6. Propane
7. What is the name of an alkane containing 4 carbon atoms?	7. Butane
8. How can the hydrocarbons in crude oil be separated?	8. Fractional Distillation
9. What uses do we have for the fractions of crude oil?	9. Fuels and the petrochemical industry.
10. What fuels are produced from crude oil?	10. Petrol, Diesel, Kerosene, Heavy Fuel Oil, Liquified Petroleum Gases.
11. What materials are produced by the petrochemical industry?	11. Solvents, lubricants, polymers, detergents.
12. Why are there lots of natural and synthetic carbon compounds?	12. The ability of carbon atoms to form families of similar compounds.
13. What happens during fractional distillation?	13. The crude oil is heated and evaporates. As the gas rises it cools and condenses at its boiling point where it can then collected.
14. What properties of a hydrocarbon depend on its size?	14. Flammability, viscosity and boiling points.
15. What happens to the flammability of a hydrocarbon as it becomes larger?	15. Decreases
16. What happens to the viscosity of a hydrocarbon as it becomes larger?	16. Increases
17. What happens to the melting and boiling point of a hydrocarbon as it becomes larger?	17. Increases
18. What happens during combustion of hydrocarbon fuels?	18. The carbon and hydrogen in the fuel are fully oxidised to make carbon dioxide and water. This releases energy.
19. What is the word equation for combustion of a fuel from crude oil?	19. Hydrocarbon + Oxygen → Carbon Dioxide + Water
20. How can hydrocarbons be broken down into smaller molecules?	20. Cracking
21. What happens during catalytic cracking?	21. The crude oil is vaporised and passed over a hot catalyst.
22. What happens during steam cracking?	22. The crude oil is vaporised and mixed with steam and heated to a high temperature.
23. What are the products of cracking?	23. Smaller useful alkanes and alkenes.
24. How can we test for alkenes?	24. Add bromine water and if the colour changes to clear an alkene is present.
25. What colour change happens when alkenes react with bromine?	25. The orange bromine water turns colourless.

C12: Chemical Analysis

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1. What can flame tests be used for?	1. Identify metal ions
2. What metal ions can flame tests be used for?	2. Lithium, sodium, potassium, calcium and copper
3. What colour flame do lithium compounds produce?	3. Crimson red
4. What colour flame do sodium compounds produce?	4. Yellow
5. What colour flame do potassium compounds produce?	5. Lilac
6. What colour flame do calcium compounds produce?	6. Orange-Red
7. What colour flame do copper compounds produce?	7. Green
8. Why can you not use a flame test to identify a mixture of metal ions?	8. Some flame colours can be masked by others
9. What can sodium hydroxide be used for?	9. Identify some metal ions
10. What metal ions can sodium hydroxide be used to identify?	10. Aluminium, calcium, magnesium, copper (II), iron (II) and iron (III)
11. What happens when sodium hydroxide is added to a solution containing aluminium ions?	11. A white precipitate is formed, the precipitate dissolves when an excess of sodium hydroxide is added.
12. What happens when sodium hydroxide is added to a solution containing calcium ions?	12. A white precipitate is formed
13. What happens when sodium hydroxide is added to a solution containing magnesium ions?	13. A white precipitate is formed
14. What happens when sodium hydroxide is added to a solution containing copper (II) ions?	14. Blue precipitate is formed.
15. What happens when sodium hydroxide is added to a solution containing iron (II) ions?	15. Green precipitate is formed.
16. What happens when sodium hydroxide is added to a solution containing iron (III) ions?	16. Brown precipitate is formed.
17. How can you test for carbonates?	17. React with dilute acids to make carbon dioxide gas. Use limewater to identify the carbon dioxide.
18. How can halide ions be identified?	18. Add silver nitrate and observe the colour of the precipitate formed.
19. What colour precipitate identifies chloride ions when silver nitrate is added?	19. White
20. What colour precipitate identifies bromide ions when silver nitrate is added?	20. Cream
21. What colour precipitate identifies iodide ions when silver nitrate is added?	21. Yellow
22. How can you test for sulfates?	22. Add barium chloride and dilute hydrochloric acid. A white precipitate will form

C13: Earths Atmosphere

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1. What is the percentage of nitrogen in our atmosphere?
2. What is the percentage of oxygen in our atmosphere?
3. What other gases are in the atmosphere is small proportions?
4. Why is evidence for the Earth's early atmosphere limited?
5. How long ago did the early atmosphere form?
6. How do we think the Earth's early atmosphere formed?
7. How do we think the oceans formed?
8. What other planets atmospheres may Earth's have been like in the past?
9. How do we think nitrogen got into the atmosphere?
10. What other gases could have been in the early atmosphere is small proportions?
11. Why did the formation of the oceans cause carbon dioxide levels to decrease?
12. How is oxygen released into the atmosphere?
13. What is the word equation for photosynthesis?
14. What is the formula equation for photosynthesis?
15. When did algae first appear on Earth?
16. How long did it take for oxygen levels to build up so that animals could evolve?
17. Why did the percentage of carbon dioxide decrease further when plants evolved?

1. 80%
2. 20%
3. Carbon dioxide, water vapour and noble gases.
4. Because it formed so long ago.
5. 4.6 Billion years
6. Volcanic activity that released gases
7. As the earth cooled water vapour condensed
8. Mars and Venus today
9. Volcanic activity
10. Methane and ammonia
11. Carbon dioxide dissolved in water and carbonates precipitated producing sediments.
12. Photosynthesis
13. Carbon Dioxide + Water → Glucose + Oxygen
14. $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_6$
15. 2.7 billion years
16. A billion years
17. Photosynthesis removed it from the atmosphere. It became locked in sedimentary locks and in fossil fuels.

C14: Earths Resources

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1. What do we use the Earth's resources for?
2. What is sustainable development?
3. What are finite resources?
4. What are renewable resources?
5. What is potable water?
6. Why is potable water not pure?
7. What does the method potable water is made depend on?
8. How is potable water made in the UK?
9. What can be used to sterilise water?
10. What method is used to make potable water is fresh water is limited?
11. What is a problem of desalination?
12. What produces large amounts of wastewater?
13. What needs to be removed from wastewater?
14. What may need to be removed from industrial wastewater?
15. What happens during sewage treatment?
16. What are ways of extracting copper from low grade ores?
17. What do phytomining and bioleaching both avoid?
18. What happens during phytomining?
19. What happens during bioleaching?
20. How can the copper compounds obtained through bioleaching and phytomining be processed?

1. Warmth, shelter, food and transport
2. Development that meets the needs of the current generation without compromising the ability of future generations to meet their own needs.
3. Resources that are used up quicker than they can be replaced, they will run out.
4. Resources that will not be used up.
5. Water that is safe to drink
6. It contains dissolved substances.
7. Available supplies of water and local conditions.
8. Rain provides water with low levels of dissolved substances. This collects in the ground and in lakes. This water is passed through filter beds and sterilised.
9. Chlorine, ozone or ultraviolet light
10. Desalination using distillation or reverse osmosis.
11. Needs large amounts of energy.
12. Urban lifestyles and industrial processes
13. Removal of organic matter and harmful microbes
14. Removal or organic matter and harmful chemicals
15. Screening and grit removal, sedimentation to produce sludge and effluent, anaerobic digestion of sludge and aerobic treatment of effluent.
16. Bioleaching and phytomining
17. Digging, moving and disposing large amounts of rock.
18. Plants are used to absorb metal compounds. The plants are harvested and then burned to produce an ash which contain copper compounds.
19. Bacteria are used. They produce a leachate solution that contain metal compounds.
20. The metal compound solutions are processed using scrap iron or electrolysis to displace the copper.

C15: Using Our Resources

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1. What is the Haber process?
2. What are the raw materials for the Haber Process?
3. What happens during the Haber process?
4. What is the temperature during the Haber process?
5. What is the pressure used during the Haber process?
6. What is the word equation for Haber Process?
7. What does the symbol ⇌ mean?
8. What catalyst is used during the Haber Process?
9. Why are catalysts used in the reaction?
10. What is the source of hydrogen in the Haber process?
11. What is the source of nitrogen in the Haber process?
12. What happens to the unreacted hydrogen and nitrogen during the Haber Process?
13. How is ammonia separated from the other gases?
14. What elements do NPK fertilisers contain?
15. What are NPK fertilisers?
16. What can ammonia be used to make?
17. How can potassium chloride, potassium sulfate and phosphate rock be obtained?
18. How can soluble salts for fertilisers be made?
19. What is the main use of ammonium nitrate?
20. What are fertilisers used for?
21. What acid is added to ammonia to make ammonium nitrate?

1. A process used to manufacture ammonia.
2. Nitrogen and hydrogen
3. The purified gases are passed over a catalyst of iron at 450°C and high pressure of 200 atmospheres.
4. 450°C
5. 200 atmospheres
6. Nitrogen + Hydrogen ⇌ Ammonia
7. Reversible
8. Iron
9. Reduce cost by reducing energy used
10. Natural gas
11. Air
12. Recycled to the reactor.
13. It is cooled and the ammonia condenses.
14. Nitrogen, Phosphorus and Potassium
15. Formulations of various alts containing appropriate percentages of the elements.
16. Ammonium salts and nitric acid
17. Mining
18. Treat phosphate rock with nitric or sulfuric acid.
19. Fertiliser
20. Put on soil for growth
21. Nitric acid

Topic	C8 Rates of Reaction
Qu	Describe and explain the effect an increase/decrease in _____ has on the rate of reaction.
Info	You need to be prepared to explain how temperature, pressure, surface area, concentration and the presence of catalysts affect the rate of reaction. Examples of questions that have come up in the past include: • State and explain the effect that increasing the temperature of the sodium thiosulfate solution has on the rate of the reaction. • State and explain the effect using magnesium powder instead of magnesium ribbon has on the rate of reaction. • Predict the effect of increasing the concentration of hydrochloric acid when you react hydrochloric acid and magnesium carbonate. To answer a question like these you need to: 1. Describe the effect. Include within this if there be an increase or decrease in rate of reaction. 2. Explain why this occurs.
Top Tip	**Make sure you link the idea of particles and collisions in your answer.**
Model Answer	**Describe and explain the effect an increase in temperature would have on the rate of reaction.** *If temperature were to increase, then the rate of reaction would increase also. This is because the particles will have more kinetic energy and so will be more likely to collide with each other. Not only are collisions more likely, but when the particles do collide, they are more likely to be colliding with enough activation energy for the reaction to occur.*
Practice	1. Learn and practice the model answer above. 2. Construct and learn model answers for the effect on rate of reaction when there is an increase in pressure, surface area and concentration. 3. Construct and learn model answers for the effect on rate of reaction when there is an decrease in pressure, surface area and concentration.

Topic	C9 Crude Oil
Qu	Explain how crude oil is separated by fractional distillation. Compare cracking and distillation. Describe what happens when an alkane burns.
Info	At least one of these questions is likely to come up. The examiner is going to be looking for a clear answer written in a logical sequence.
Top Tip	Be careful that you use key words/phrases accurately (these are in bold in your model answers below).
Model Answer	**Explain how crude oil is separated by fractional distillation** *Crude oil is heated and the hydrocarbons **vaporise**. The vapours enter the fractionating column near the bottom. The column is hotter at the bottom and cooler at the top. The vapours **rise** up the column and as they do they **cool**. The hydrocarbon **condense** to become liquid at their **boiling points**. Different substances have different boiling points and so the different fractions collect at different levels. The smallest hydrocarbon molecules have **lowest boiling points** and they collect as gases at top of the column where temperature is lower. Larger hydrocarbons have **higher boiling points** so collect nearer the bottom where the temperature is higher.*
Model Answer	**Compare cracking and distillation** *Cracking involves a **catalyst** while distillation does not. Distillation does not involve a **chemical change**, while cracking does.*
Model Answer	**Describe what happens when an alkane burns.** *When an alkane it combines with **oxygen** to make **carbon dioxide** and **water**. The reaction is **exothermic** and so **releases energy** into the environment.*
Practice	1. Learn and practice the model answers above.

Topic	C9 Crude Oil
Qu	Describe how crude oil is formed. Describe and explain the trend in the boiling points of the alkanes. Explain why cracking is used in the fuel industry.
Info	At least one of these questions is likely to come up. The examiner is going to be looking for a clear answer written in a logical sequence.
Top Tip	Be careful that you use key words/phrases accurately (these are in bold in your model answers below).
Model Answer	**Describe how crude oil is formed.** ***Biomass such as plankton*** *is buried in* ***mud*** *and* ***compressed*** *over a* ***long period of time****.*
Model Answer	**Describe and explain the trend in the boiling points of the alkanes.** *The* ***bigger the alkane*** *the* ***higher the boiling point****. This is because as the molecules get bigger the* ***intermolecular forces*** *between the molecules increase and so it takes more energy for these bong to be overcome when the alkane turns into a gas.*
Model Answer	**Explain why cracking is used in the fuel industry.** *Cracking involves braking large molecules into smaller ones. Large* ***hydrocarbons*** *are not very useful as they do not* ***ignite*** *easily, they are not* ***volatile*** *and they do not easily* ***flow****. By braking this larger hydrocarbons into smaller ones we get more useful smaller molecules that can be used as* ***fuels****. The smaller molecules are volatile and flow and ignite easily which are ideal properties for a fuel. Alkenes are also produced during cracking which are useful to make* ***polymers****.*
Practice	1. Learn and practice the model answers above.

Topic	C12 Chemical Analysis
Qu	Describe a test to show a substance contains _____
Info	You could be asked to describe a method to identify: • Compounds of lithium, sodium, potassium, calcium and copper • Hydroxides of aluminium, calcium, magnesium, copper (II), iron (II) and iron (III) • Carbonates • Halides • Sulfates When constructing an answer you need to: 1. Describe the test. 2. Describe what a positive result for the substance would be.
Top Tip	When describing the test remember to name any chemicals you will add. There are some problems with these tests. If you have a mixture when doing a flame test one compound can mask another. You also can't determine if a hydroxide is either calcium or magnesium because they both form white precipitates that don't dissolve when an excess of sodium hydroxide is added.
Model Answer	**Describe a test to show a substance contains aluminium hydroxide.** *To test for aluminium hydroxide, I would add sodium hydroxide. If a white precipitate formed this may mean aluminium hydroxide is present. To be sure I would continue to add sodium hydroxide in excess. If the white precipitate dissolved, aluminium hydroxide was present.*
Practice	1. Learn and practice the model answer above. 2. Construct and learn model answers for testing for: compounds of lithium, sodium, potassium, copper and calcium, magnesium hydroxide, copper hydroxide, iron (II) hydroxide, iron (III) hydroxide, copper carbonate, iron (II) chloride and calcium sulfate.

Topic	C13 The Earth's Atmosphere
Qu	Explain the problems that increased CO_2 in the atmosphere can cause. Describe the processes which remove CO_2 from the atmosphere. Explain how plants and other organisms have changed the atmosphere.
Info	At least one of these questions is likely to come up. The examiner is going to be looking for a clear answer written in a logical sequence.
Top Tip	Be careful that you use key words/phrases accurately (these are in bold in your model answers below).
Model Answer	**Compare the Earth's early atmosphere to the atmosphere today.** *The Earth's early atmosphere was a large amount of **carbon dioxide**, lots of **water vapour**, no oxygen and **trace amounts** of methane, ammonia and nitrogen.* *Today there is only trace amounts of carbon dioxide and water, while most of the atmosphere (78%) is nitrogen. Oxygen is also now present in the atmosphere and makes up 21%. There are still trace amounts of methane and ammonia present, but there is less of them.*
Model Answer	**Describe the processes which remove CO_2 from the atmosphere.** *Plants take in carbon dioxide and it is converted to **glucose and starch** in a process called **photosynthesis**. The carbon dioxide can then become **locked** up in **fossil fuels**. The carbon dioxide in the atmosphere can also **dissolve** in **sea water** and produce **hydrogencarbonates**. Marine animals use carbonates to make **shells** and over time these shells form **sedimentary rocks**.*
Model Answer	**Explain how plants and other organisms have changed the atmosphere.** *Plants take up CO_2 and release oxygen through **photosynthesis**. When they die carbon dioxide becomes trapped in **rocks and fossil fuels**. The oxygen then went on to react with other molecules. Oxygen molecules reacted together to form **ozone** and methane and ammonia also reacted with oxygen as its levels increased in the atmosphere. Nitrogen gas was produced by reaction between oxygen and ammonia. **Denitrifying bacteria** also produced nitrogen gas. The nitrogen builds up in the atmosphere because it is **unreactive**.*
Practice	1. Learn and practice the model answers above.

Topic	C13 The Earth's Atmosphere
Qu	Identify and explain the changes that have occurred since the Earth's early atmosphere.
Info	This question (or part of it) is a frequent long response question found on a Chemistry Paper 2. The examiner may provides charts or diagrams to interpret as part of the question. You may need to use the data they give; however, this question will mostly be looking for you to apply your knowledge. **Examples of questions in the past include:** 1. Describe and explain how the atmosphere today is different from the atmosphere of billions of years ago. 2. Describe and explain how the surface of the early Earth and its atmosphere have changed to form the surface of the Earth and its atmosphere today. 3. Explain what has happened to most of the water vapour in the Earth's early atmosphere. 4. Describe how the evolution of plants changed the Earth's atmosphere. 5. Describe **two** processes which reduced the proportion of carbon dioxide in the Earth's atmosphere over the period of three billion years. 6. Suggest what has caused the main gases in the Earth's atmosphere of millions of years ago to change to the present-day atmosphere.
Top Tip	Use a clear structure in your answer. Identify a gas in the Earth's early atmosphere, identify if there is now more or less in the atmosphere and explain why. Repeat this for each gas.
Model Answer	**Describe and explain how the atmosphere today is different from the atmosphere of billions of years ago.** *In today's atmosphere there is less carbon dioxide. This is because it has been absorbed by plants during photosynthesis and become locked in fossil fuels. It has also dissolved into oceans and become locked in rocks.* *Today there is much more oxygen in the atmosphere. This is because when plants evolved and started to photosynthesise oxygen was released.* *Today there is also much more nitrogen. This has been produced by the decay of organisms and the breakdown of ammonia. Nitrogen is unreactive and so has accumulated over time.* *Today there is less water vapour. This is because when the Earth cooled the water vapour condensed and formed oceans.*
Practice	1. Learn and practice the model answer above. 2. Construct and learn model answers for questions 2 -6.

Topic	C14 The Earth's Resources
Qu	Explain and justify the steps to treat water from reservoirs. Explain when seawater is used as a source of water for making potable water Describe how sewerage is treated.
Info	At least one of these questions is likely to come up. The examiner is going to be looking for a clear answer written in a logical sequence.
Top Tip	Be careful that you use key words/phrases accurately (these are in bold in your model answers below).
Model Answer	**Explain and justify the steps to treat water from reservoirs.** *The reservoir water would first be **filtered**. Filtering would **remove solids** such as small insoluble particles. The water would then have a chemical such as **chlorine** added to it. This would be to **sterilise** the water and reduce the number of **microbes** that was in it.*
Model Answer	**Explain when seawater is used as a source of water for making potable water** *Seawater is used as a source of water for making potable water when there is not a sufficient supply of ground water available. This is because to make seawater safe to drink you would need to **desalinate the water**, either by **reverse osmosis** or **distillation** which are both more **expensive** to do as they require **large amounts of energy**.*
Model Answer	**Describe how sewerage is treated.** *First the sewerage passes through a metal grid which removes the large debris and substances such as grit. This processes is known as **screening**. The screened sewerage is then left for s**edimentation** to occur. The heavier substances will sink to the bottom and form a layer of **sludge** while the liquid layer above is the **effluent**. The sludge is piped away any broken down by **microbes anaerobically** while the effluent is broken down **aerobically** in another tank by microbes. The water is then **sterilised** to kill off any pathogens.*
Practice	1. Learn and practice the model answers above.

Topic	C14 The Earth's Resources
Qu	Describe how copper is made using phytomining. Explain why biological methods are being used to extract copper. Explain how copper can be extracted from a copper solution using scrap iron.
Info	At least one of these questions is likely to come up. The examiner is going to be looking for a clear answer written in a logical sequence.
Top Tip	Be careful that you use key words/phrases accurately (these are in bold in your model answers below).
Model Answer	**Describe how copper is made using phytomining.** *Plants are grown on land containing **low grade copper ores**. Once the plants are grown the plants are then harvested and **burned** to make an ash. The ash is collected and added to an **acid** for it to dissolve and form a **copper solution**. This solution then undergoes **electrolysis** to extract the copper.*
Model Answer	**Explain why biological methods are being used to extract copper.** *Copper is becoming **scare** and using biological methods helps us to extract copper from **low grade ores**. Using biological methods also means that we do not have to use **mining** which then avoids having to move and dispose of lots of rock.*
Model Answer	**Explain how copper can be extracted from a copper solution using scrap iron.** *Iron is **more reactive** than copper. The iron will therefore **displace** the copper in the solution and so **copper ions will be reduced** and copper will form.*
Practice	1. Learn and practice the model answers above.

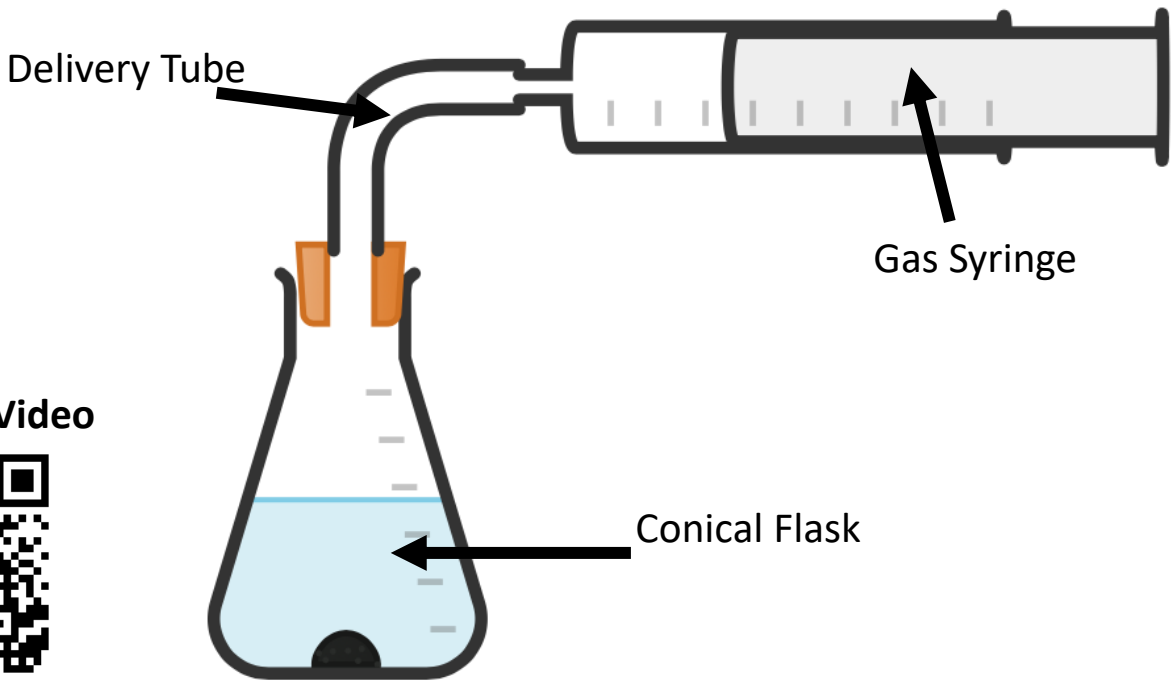
Topic	C15 Using Our Resources
Qu	Identify the catalyst in the Haber Process and explain why its used. Identify and explain the temperature that the Haber Process takes place at. Identify and explain the pressure that the Haber Process takes place at.
Info	At least one of these questions is likely to come up. The examiner is going to be looking for a clear answer written in a logical sequence.
Top Tip	Be careful that you use key words/phrases accurately (these are in bold in your model answers below).
Model Answer	**Identify the catalyst in the Haber Process and explain why its used.** *The catalyst used in the Haber processes is **iron**. It is used because it lowers the **activation energy** of the reaction. It is relatively **cheap** and helps to achieve an acceptable **yield** of ammonia in an acceptable **time**.*
Model Answer	**Identify and explain the temperature that the Haber Process takes place at.** *The Haber Process takes place at **450 °C.** The breakdown of ammonia is an **endothermic reaction** and so when temperatures are higher the breakdown of ammonia would increase. However, at lower temperatures the particles would move slower leading to **fewer collisions** between hydrogen and nitrogen and so less ammonia would form. A temperature of **450 °C** is therefore used as an **optimum**.*
Model Answer	**Identify and explain the pressure that the Haber Process takes place at.** *The Haber Process takes place at **200 atmospheres**. The greater the pressure the **higher the yield** of ammonia as **equilibrium** is moved to the right. However, the higher the pressure the **higher the cost** and the greater the **safety risk**. A pressure of 200 atmospheres is therefore used as an **optimum**.*
Practice	1. Learn and practice the model answers above.

Topic	C15 Using Our Resources
Qu	Explain the conditions used during the Haber Process
Info	This question is a frequent long response question found on a Chemistry Paper 2. The examiner often provides charts and graphs to interpret as part of the question. You may need to use the data they give; however, this question will mostly be looking for you to apply your knowledge about the conditions of the Haber Process **Examples of questions in the past include:** 1. Use your knowledge of reversible reactions to explain the conditions used in the Haber process. 2. Explain, as fully as you can, why a temperature of about 450°C and a pressure of about 200 atmospheres are normally used. 3. State which conditions of temperature and pressure would give the highest percentage of ammonia at equilibrium. Explain why. 4. Use the graph, together with your knowledge of the process, to explain why many industrial ammonia plants operate at 200 atmospheres and 450°C.
Top Tip	The answer you would give for each of these questions is going to be very similar. Construct a small paragraph explaining why it takes place at 200 atmospheres, another small paragraph explaining why it takes place at 450 °C and then if you have been asked about the use of a catalyst include a final small paragraph about this also.
Model Answer	**Use your knowledge of reversible reactions to explain the conditions used in the Haber process.** *The Haber Process takes place at **200 atmospheres**. The greater the pressure the **higher the yield** of ammonia as **equilibrium** is moved to the right. However, the higher the pressure the **higher the cost** and the greater the **safety risk**. A pressure of 200 atmospheres is therefore used as an **optimum**.* *The Haber Process takes place at **450 °C.** The breakdown of ammonia is an **endothermic reaction** and so when temperatures are higher the breakdown of ammonia would increase. However, at lower temperatures the particles would move slower leading to **fewer collisions** between hydrogen and nitrogen and so less ammonia would form. A temperature of **450 °C** is therefore used as an **optimum**.* *The catalyst used in the Haber processes is **iron**. It is used because it lowers the **activation energy** of the reaction. It is relatively **cheap** and helps to achieve an acceptable **yield** of ammonia in an acceptable **time**.*
Practice	1. Learn and practice the model answer above. 2. Construct and learn model answers for questions 2, 3 and 4.

RP5 Rate of Reaction

Method when at least one of the products is a gas...

When Method Used	When a gas is made.
Outline Method	1. Set up experiment as shown in diagram. 2. Add 10 g of _____ into the flask. 3. Add 50 cm^3 of _____, connect the gas syringe and start a timer.
What is Measured (Dependent Variable)	Total volume of gas made in 1 minute. **<u>OR</u>** Volume of gas every 10 seconds for 1 minute.
Possible Variables	Surface Area of Reactant Mass of Reactant Concentration of Acid Temperature of Reactants

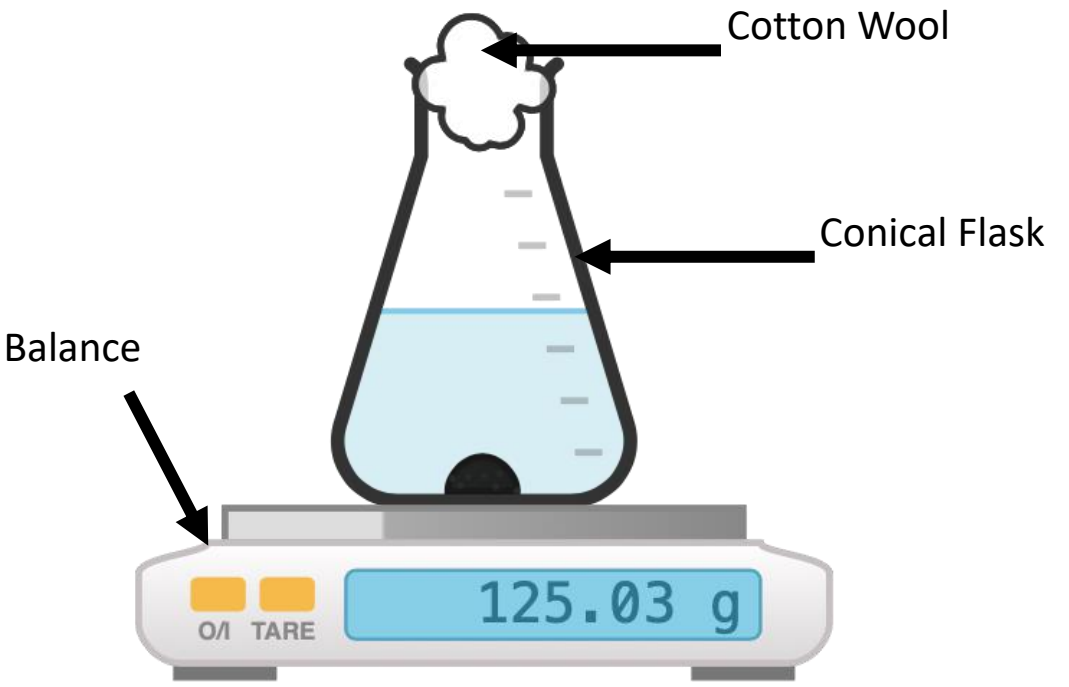


Practical Video

RP5 Rate of Reaction

Alternative method when at least one of the products is a gas...

When Method Used	When a gas is made.
Outline Method	1. Set up experiment as shown in diagram. 2. Add 10 g of _____ into the flask. 3. Add 50 cm^3 of _____ and start a timer.
What is Measured (Dependent Variable)	Total mass of gas lost in 1 minute. **<u>OR</u>** Mass every 10 seconds for 1 minute.
Possible Variables	Surface Area of Reactant Mass of Reactant Concentration of Acid Temperature of Reactants

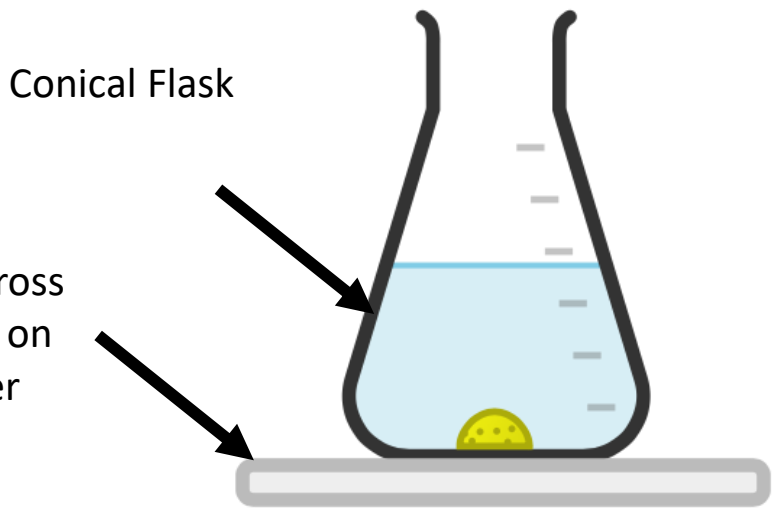


Practical Video

RP5 Rate of Reaction

Method when one of the products is a solid...

When Method Used	When a solid (precipitate) is made.
Outline Method	1. Put 50 cm^3 of sodium thiosulfate solution into a container. 2. Put the container on a cross drawn on a piece of paper. 3. Add 5 cm^3 of dilute hydrochloric acid and start timing.
What is Measured (Dependent Variable)	Time it takes for the cross to disappear.
Possible Variables	Concentration/Volume of Sodium Thiosulfate Concentration/Volume of Acid Temperature of Reactants



Practical Video

RP5: Rate of Reaction

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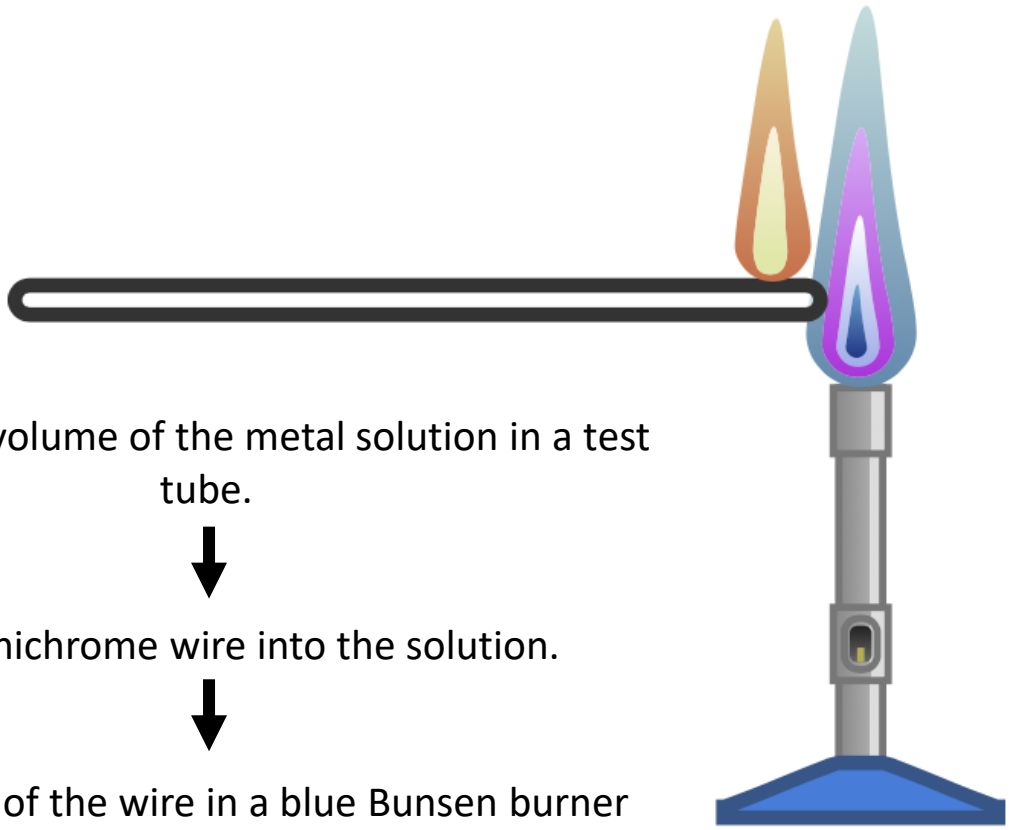
1. What is rate of reaction?
2. What is turbidity?
3. What apparatus would you need to measure mass?
4. What apparatus would you need to measure time?
5. What apparatus would you need to measure temperature?
6. What apparatus would need to measure volume?
7. What would be the most accurate way of measuring 25cm^3 of liquid?
8. What are the possible dependent variables if you were investigating the rate of reaction?
9. When would you measure rate of reaction by their measuring the volume of gas produced or decrease in mass?
10. When would you measure the rate of reaction by measuring the time taken for a cross to disappear?
11. How can you tell from a symbol equation if the solution is going to turn cloudy?
12. How can you calculate rate of reaction at a specific time?
13. When investigating the rate at which a precipitate forms why should the same person should look at the black cross?
14. What does the word reproducible mean?
15. What does the word repeatable mean?
16. If you are investigating the effect of a particular factor on the rate of reaction what are the possible variables, one you could change, and the others you would need to keep the same?
17. How could results when investigating rates of reaction be made more accurate?

1. It is how fast a reaction occurs.
2. The cloudiness of a solution due to the presence of particles invisible to the eye that are suspended in the fluid.
3. Balance
4. Stop clock
5. Thermometer
6. Measuring cylinder
7. Use a pipette or burette.
8. Volume of gas made, decrease in mass or time it takes for a cross to disappear.
9. When at least one of the products is a gas and has the state symbol (g) after it.
10. One of the products will be a solid and will have the state symbol (s) after it.
11. When one of the products is a solid and has the state symbol (s) after it.
12. Draw a tangent to the curve and calculate the gradient using: difference in y-axis/ difference in x-axis.
13. Different people may decide that they cannot see the cross at different amounts of cloudiness which can lead to errors deciding when to take the reaction time.
14. If the experiment is repeated by another person, the same results are obtained.
15. If the experiment is repeated by the same person and the same results are obtained.
16. Concentration of reactants, volume/mass of reactants, surface area of reactants, temperature of reactants, pressure of reactants, presence of a catalyst.
17. Repeat the experiment twice more, discard any outliers and calculate a mean.

Practical	RP5 Rates of Reaction Practical
Qu	Plan an investigation to show how _____ affects the rate of the reaction with _____.
Info	You could be asked this question for different practical's. Some that have come up in the past include: • The concentration of the sodium thiosulfate solution reacting with hydrochloric acid. • The temperature of the sodium thiosulfate solution reacting with hydrochloric acid. • The mass of marble chips reacting with hydrochloric acid. To answer this question you will need to do the following: 1. Construct a diagram of the equipment. 2. Describe how you will collect results. 3. Identify what you will measure. 4. Identify repeats you will do. If you are investigating the effect of a variable you will need 5. 5. Identify what you will control.
Top Tip	Your method needs to produce valid results. This means you need to clearly identify what you are changing and measuring and what you are going to control.
Model Answer	**Plan an investigation to show how the concentration of the sodium thiosulfate solution affects the rate of the reaction with dilute hydrochloric acid.** *Measure 25cm^3 of sodium hydroxide using a measuring cylinder and add to a conical flask. Measure out 100cm^3 hydrochloric acid and add it to the conical flask. Place the flask on a piece of paper with a black cross and time how long it takes for the cross to disappear. Repeat this two more times to identify outliers and calculate an average. Repeat with 5 different concentrations of sodium thiosulfate. I will control the concentration and volume of sodium thiosulfate and hydrochloric acid.*
Practice	1. Learn and practice the model answer above. 2. Prepare and learn model answers to investigate the effect of temperature, surface area and mass on the rate of reaction.

RP7 Identifying Ions

Flame Tests



1. Pour a small volume of the metal solution in a test tube.

2. Dip the nichrome wire into the solution.

3. Hold the tip of the wire in a blue Bunsen burner flame.

4. Observe the colour.

5. Use the colour to identify the metal ion.

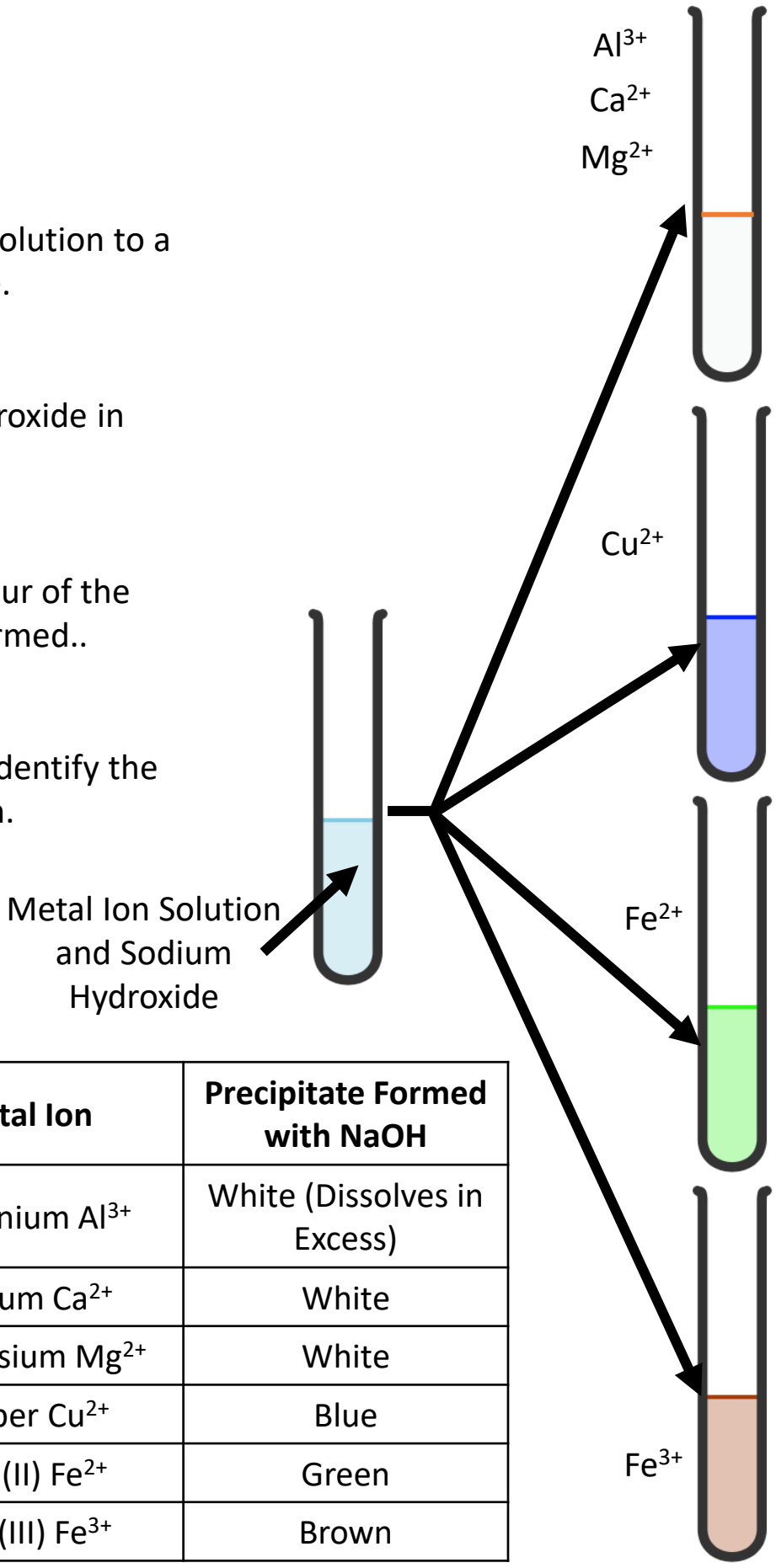
Practical Video

Metal Ion	Flame Colour
Lithium Li^+	Crimson
Sodium Na^+	Yellow
Potassium K^+	Lilac
Calcium Ca^{2+}	Orange - Red
Copper Cu^{2+}	Green

RP7 Identifying Ions

Metal Hydroxides

1. Add the metal ion solution to a test tube.
2. Add sodium hydroxide in excess.
3. Observe the colour of the precipitate formed..
4. Use the colour to identify the metal ion.



Metal Ion	Precipitate Formed with NaOH
Aluminium Al^{3+}	White (Dissolves in Excess)
Calcium Ca^{2+}	White
Magnesium Mg^{2+}	White
Copper Cu^{2+}	Blue
Iron (II) Fe^{2+}	Green
Iron (III) Fe^{3+}	Brown

Practical Video

RP7 Identifying Ions

Carbonate Ions

1. Add a dilute acid to the solution.

↓

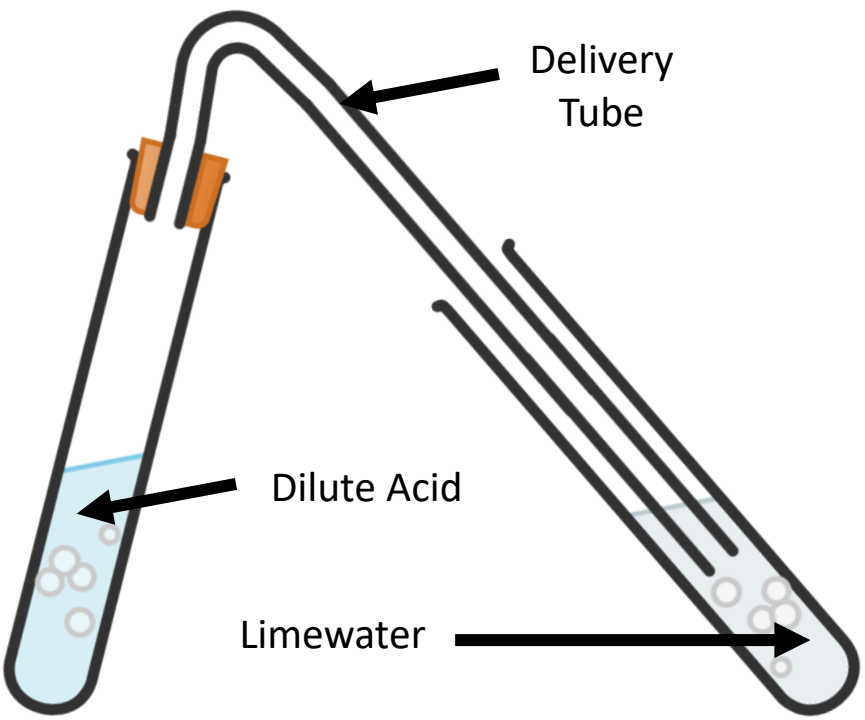
2. Bubble the gas produced through limewater.

↓

3. If carbon dioxide is present the limewater will turn cloudy.

↓

4. The presence of carbon dioxide indicates the solution is a carbonate.

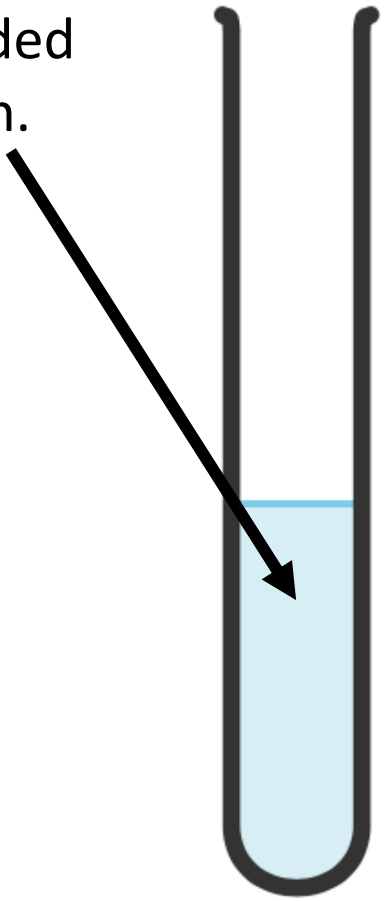


Practical Video

RP7 Identifying Ions

Halide Ions

Dilute nitric acid and silver nitrate added to test solution.



1. Add dilute nitric acid to the test solution.
2. Add silver nitrate solution.
3. Observe the colour of the precipitate formed.
4. Use the colour to identify the ion.

Practical Video

Halide Ion	Precipitate Formed When Nitric Acid and Silver Nitrate is Added
Chloride Cl^-	White
Bromide F^-	Cream
Iodide I^-	Yellow

RP7 Identifying Ions

Sulfate Ions

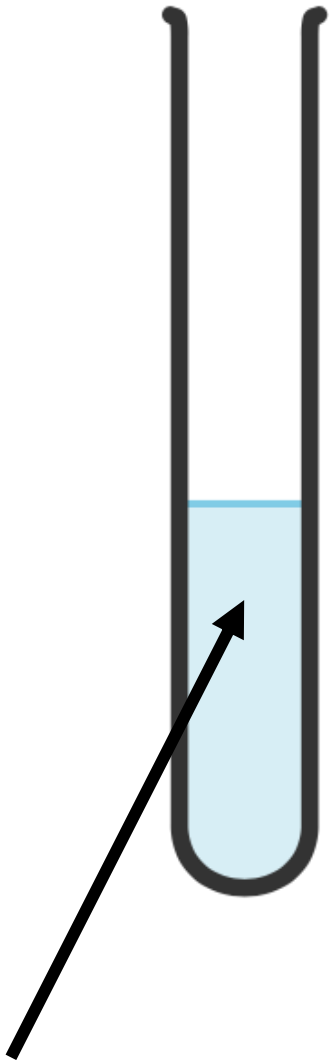
1. Add dilute hydrochloric acid to the solution.

↓

2. Add barium chloride solution.

↓

3. If a white precipitate forms sulfate ions are present.



Dilute hydrochloric acid and barium chloride added to test solution.

Practical Video

RP7: Identifying Ions

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1. What are flame tests?
2. What is the positive result for lithium compounds in a flame test?
3. What is the positive result for sodium compounds in a flame test?
4. What is the positive result for potassium compounds in a flame test?
5. What is the positive result for calcium compounds in a flame test?
6. What is the positive result for copper compounds in a flame test?
7. What is the problem if there is a mixture of ions in a flame test?
8. What can be used to identify some metal ions?
9. What is the result when solutions containing aluminium ions are added to sodium hydroxide?
10. What is the result when solutions containing calcium ions are added to sodium hydroxide?
11. What is the result when solutions containing magnesium ions are added to sodium hydroxide?
12. What is the positive result for copper (II) ions?
13. What is the positive result for iron (II) ions?
14. What is the positive result for iron (III) ions?
15. Why is it difficult to tell if a metal ion is calcium or magnesium when using sodium hydroxide?
16. How can carbonates be identified?
17. How can we test for halides?
18. What is a positive result for chloride ions?
19. What is a positive result for bromide ions?
20. What is a positive result for iodide ions?
21. How can we test for sulfates?

1. A test used to identify metal ions.
2. Crimson flame
3. Yellow flame
4. Lilac flame
5. Orange-red flame
6. Green flame
7. Some flame colours can be masked.
8. Sodium hydroxide.
9. White precipitate forms which dissolves when sodium hydroxide is added in excess.
10. A white precipitate forms.
11. A white precipitate forms.
12. Blue precipitate.
13. Green precipitate.
14. Brown precipitate.
15. They both form white precipitates.
16. React with a dilute acid and see if carbon dioxide is made using limewater.
17. Add nitric acid and silver nitrate and observe the colour of the precipitate formed. .
18. White precipitate
19. Cream precipitate
20. Yellow precipitate
21. Add nitric acid and barium chloride. Sulfates make a white precipitate.

Practical	RP7 Identifying Ions Practical
Qu	Describe a test to prove that a solution contains _____ions.
Info	You could be asked this question for lots of different substances. Some that have come up in the past include: • Identifying an unknown metal ion • Identifying if a solution contains halide, sulfate or carbonate ions. • Identifying the positive and negative ion is a test solution. To answer this question you will need to do the following: 1. Describe what you would do to the test solution. 2. Identify what the positive result would be.
Top Tip	You could also be asked to write a method to test for metal ions as well as carbonate, halide and sulfate ions. Be careful that you add the correct chemicals and identify the positive result.
Model Answer	**Describe a test to prove that a solution contains calcium chloride ions.** *Split the solution into two. Take one of the sample solutions and dip in the nichrome wire and place this into a blue flame. If the colour is orange – red this confirms that the solution is likely to contain calcium ions. To confirm that the solution contains calcium add some sodium hydroxide and observe the colour of the precipitate formed. If the precipitate is white the solution contains calcium ions. To the second sample of the solution add nitric acid and silver nitrate. If the colour of the precipitate is white this confirms that the negative ion is a chloride ion.*
Practice	1. Learn and practice the model answer above. 2. Prepare and learn model answers to determine the positive and negative ions in a mystery solution.