AQA (GCSE Notes)

Chapter 8: Chemical Analysis

Q1. What is meant by a pure substance in chemistry?
Answer: A pure substance in chemistry is a material that is made up of only one type of element or compound. It has a consistent and fixed composition throughout and cannot be separated into other substances by physical means. Pure substances have specific melting and boiling points which make them different from mixtures that melt and boil over a range of temperatures.

Q2. How can melting point data help identify whether a substance is pure?
Answer: Melting point data can help identify purity because a pure substance has a sharp and specific melting point. If a substance melts over a range of temperatures or at a lower temperature than expected, it suggests that the substance is impure. Impurities disrupt the structure of the substance, lowering and widening the melting range.

Q3. Why do pure substances have specific boiling points?
Answer: Pure substances have specific boiling points because all the particles in the substance are identical, meaning they require the same amount of energy to overcome the intermolecular forces. This results in a distinct and consistent temperature at which the substance changes from liquid to gas.

Q4. What is the main difference between a pure substance and a mixture?
Answer: The main difference is that a pure substance contains only one type of element or compound, while a mixture contains two or more substances that are not chemically bonded. Pure substances have fixed melting and boiling points, while mixtures melt and boil over a range of temperatures due to the presence of different components.

Q5. How does the melting point of a mixture compare with that of a pure substance?
Answer: The melting point of a mixture is usually lower than that of a pure substance and occurs over a range of temperatures. This happens because the presence of different substances disrupts the regular arrangement of particles, making it easier for the mixture to start melting at a lower temperature.

Q6. Why does an impure substance melt over a range of temperatures?
Answer: An impure substance melts over a range of temperatures because impurities interfere with the orderly structure of the pure substance. This causes different parts of the substance to require different amounts of energy to break apart, leading to a gradual melting process instead of a sharp melting point.

Q7. What is the definition of a formulation?
Answer: A formulation is a mixture that has been designed as a useful product. It is made by

combining specific amounts of different substances to produce a material with desired properties and functions. Each component in a formulation contributes to the overall performance of the product.

Q8. Why are formulations used in everyday products?
Answer: Formulations are used because they allow manufacturers to create products with specific properties that meet user needs. By carefully choosing and mixing ingredients, the effectiveness, stability, and safety of products such as medicines, paints, and cosmetics can be controlled and improved.

Q9. How can the properties of a formulation be controlled?
Answer: The properties of a formulation can be controlled by adjusting the types and amounts of the ingredients. Each ingredient is chosen for a specific purpose, and changing its proportion can alter how the final product behaves. This helps in achieving the right texture, strength, colour, or function of the product.

Q10. Give an example of a formulation and explain its components' purposes.
Answer: Paint is an example of a formulation. It typically contains a pigment for colour, a binder to make the paint stick to surfaces, a solvent to thin the paint for application, and additives to improve properties such as drying time. Each component plays a specific role in the effectiveness of the paint.

Q11. How do formulations differ from simple mixtures?
Answer: Formulations are carefully designed mixtures where each ingredient has a specific role and is present in a fixed proportion. In contrast, simple mixtures can have variable compositions and are not usually designed for a specific function. Formulations are made to achieve a particular result, unlike simple mixtures.

Q12. Why is it important to mix the components of a formulation in the correct amounts?
Answer: Mixing components in the correct amounts is important to ensure the product performs as intended. Too much or too little of one ingredient can affect the quality, safety, or function of the formulation. For example, incorrect amounts in medicine can make it ineffective or even harmful.

Q13. What types of products are often made as formulations?
Answer: Many everyday products are formulations, including medicines, cleaning agents, paints, cosmetics, fertilisers, and fuels. These products rely on specific combinations of chemicals to achieve their desired effect, which is why they are made as carefully measured formulations.

Q14. Why are medicines often formulated with more than one chemical?
Answer: Medicines are formulated with multiple chemicals to improve their effectiveness, stability, and delivery. The active ingredient treats the condition, while other chemicals might help preserve the medicine, improve taste, make it easier to swallow, or ensure the active ingredient is released properly in the body.

Q15. How would you identify if a product is a formulation from its label?
Answer: You can identify a formulation by looking at the label, which often lists several ingredients

with specific functions. If the product has multiple components that each contribute to its performance, such as preservatives, colourants, or active agents, it is likely a formulation.

Q16. Why might a paint formulation contain both pigments and solvents?
Answer: Pigments provide the colour in paint, while solvents help thin the paint so it can be applied easily. The solvent evaporates after application, leaving the pigment and binder behind to form a smooth, coloured coating. Both are essential for the paint to function properly.

Q17. What role do fertilisers play as formulations in agriculture?
Answer: Fertilisers are formulations that supply plants with essential nutrients like nitrogen, phosphorus, and potassium in specific amounts. By combining these nutrients in the right ratios, fertilisers improve plant growth and crop yield, making them an important tool in farming.

Q18. How can you test the purity of a chemical substance?
Answer: You can test purity by measuring the melting or boiling point of the substance and comparing it with the known value for the pure substance. If it melts or boils at the expected temperature, it is pure. If the temperature is lower or spread over a range, it likely contains impurities.

Q19. What would happen to the boiling point of a substance if it is contaminated?
Answer: If a substance is contaminated, its boiling point usually increases and becomes less sharp. The presence of other substances interferes with the regular boiling behaviour, causing the boiling point to rise and occur over a wider range of temperatures.

Q20. In what way does the everyday definition of "pure" differ from the scientific definition?
Answer: In everyday language, "pure" often means natural or clean, like pure water or pure honey, even if it contains other substances. In science, "pure" means a substance that contains only one type of element or compound, with no other substances mixed in.

Q21. Why might a pure substance from nature still be considered impure in chemistry?
Answer: A natural substance like honey may appear pure but contains many different compounds like sugars, water, and enzymes. In chemistry, this makes it a mixture and not a pure substance because it is made of more than one type of molecule.

Q22. How do alloys demonstrate the concept of formulations?
Answer: Alloys are mixtures of metals, often with other elements, designed to have specific properties like strength or resistance to corrosion. Each component is added in a controlled amount to achieve the desired result, making alloys a good example of formulations.

Q23. What is the role of chromatography in identifying pure substances?
Answer: Chromatography separates substances based on how they move through a medium. A pure substance will produce a single spot on a chromatogram, while a mixture will produce multiple spots. This helps scientists identify if a substance is pure or contains more than one component.

Q24. Why are boiling point and melting point data useful in forensic science?
Answer: Forensic scientists use melting and boiling point data to identify substances found at crime scenes. By comparing the data with known substances, they can determine the identity and purity of chemicals, which may provide evidence or help link suspects to the scene.

Q25. Why is it important for food products to be pure?
Answer: Purity in food products ensures they are safe to eat and of good quality. Impurities can cause allergic reactions, reduce the effectiveness of preservatives, or be harmful if toxic. Pure ingredients also help ensure consistent taste, texture, and appearance in food items.

Q26. What makes a good cleaning agent formulation?
Answer: A good cleaning agent formulation contains the right combination of ingredients such as solvents, surfactants, fragrances, and preservatives. These work together to remove dirt and grease effectively, while also being safe for use and storage. The formulation must be stable, non-corrosive, easy to rinse off, and suitable for the material being cleaned. It should also leave no harmful residue and not damage surfaces or skin.

Q27. What property of a mixture changes if an extra component is added?
Answer: Adding an extra component to a mixture can change several of its properties, such as boiling point, melting point, viscosity, colour, or even its effectiveness in a formulation. The new component may interact with existing ones, altering the mixture's behaviour and performance. For example, adding more solvent can make a paint thinner, while adding a preservative might extend its shelf life.

Q28. Why do scientists measure both melting and boiling points during purity testing?
Answer: Scientists measure both melting and boiling points during purity testing because pure substances have specific, sharp melting and boiling points. If a substance contains impurities, these temperatures are often lower and occur over a range. Measuring both helps confirm the identity and purity of the substance. It ensures the sample is suitable for its intended use, especially in formulations like medicines and chemicals.

Q29. How do temperature changes affect the properties of mixtures?
Answer: Temperature changes can significantly affect the properties of mixtures. For example, increasing temperature may cause a solid mixture to melt or a liquid to evaporate. It can also affect solubility, reaction rates, viscosity, and stability. Some formulations become less effective or separate into layers if stored at incorrect temperatures. That's why temperature control is crucial during storage and use.

Q30. How does a drug formulation ensure that the medicine works effectively?
Answer: A drug formulation ensures the medicine works effectively by combining the active ingredient with other components like binders, fillers, and coatings. These help control how the drug is released in the body, ensure it is absorbed properly, and improve taste or shelf life. Formulations

are carefully designed so that the correct dose reaches the right part of the body at the right time without causing harm.

Q31. Why can formulations not be separated by simple physical means?
Answer: Formulations are carefully mixed combinations of substances in specific proportions, often involving chemical changes or fine dispersions. The components are chosen and combined to work together in a specific way. Because of this close mixing and interaction, they cannot be separated easily by simple physical means like filtration or decanting, unlike mixtures such as sand and water.

Q32. What is the importance of accurate measuring when making formulations?
Answer: Accurate measuring is important in formulations because even small errors can affect the performance, safety, and stability of the final product. Too much or too little of an ingredient can make a medicine ineffective, change the consistency of paint, or make a cleaning product unsafe. Precision ensures the product works as intended and meets legal and quality standards.

Q33. How does the presence of impurities affect the safety of chemicals?
Answer: Impurities can make chemicals unsafe by introducing unexpected reactions, toxic effects, or reducing effectiveness. In medicines, impurities can cause harmful side effects. In fuels or cleaning products, they can damage engines or surfaces. Impurities can also affect how long a product lasts or how it reacts with other substances, which is why purity testing is essential.

Q34. Why is it important that fuels are carefully formulated?
Answer: Fuels need to be carefully formulated to ensure they burn efficiently, produce the right amount of energy, and minimise pollution. Additives are often included to improve engine performance, reduce harmful emissions, or prevent engine damage. Without proper formulation, fuels might cause engine knocking, reduced performance, or increased air pollution.

Q35. What is the function of binders in paint formulations?
Answer: Binders in paint formulations hold the pigment particles together and help the paint stick to surfaces once applied. They form a protective, durable film when the paint dries. Binders also affect how glossy, flexible, or tough the paint is. Without binders, the paint would not adhere well, fade faster, and be easily washed away.

Q36. Why do scientists analyse formulations in forensic investigations?
Answer: Scientists analyse formulations in forensic investigations to identify substances found at crime scenes. This helps link suspects to the scene or identify unknown materials. For example, the type of paint, ink, or drug found can provide important clues. Analysing formulations helps ensure the evidence is reliable and can support conclusions in court.

Q37. How do changes in component ratios affect the performance of a formulation?
Answer: Changing the ratio of components in a formulation can alter how it behaves. For example, in paint, too much solvent might make it runny, while too little makes it too thick. In medicine, an

incorrect dose of the active ingredient can be ineffective or dangerous. Balanced ratios are necessary to make the product safe, effective, and suitable for its use.

Q38. Why is it important to test the consistency of formulations during manufacturing?
Answer: Testing consistency during manufacturing ensures every batch of the product meets the required quality and performs the same way. Inconsistencies can lead to ineffective products, safety issues, or customer dissatisfaction. For example, if a cleaning spray is not mixed properly, it may not clean well or damage surfaces. Quality control helps avoid such issues.

Q39. What makes instrumental methods more reliable than qualitative tests?
Answer: Instrumental methods are more reliable because they provide accurate, precise, and sensitive measurements that can detect even tiny amounts of substances. Unlike qualitative tests, which rely on human observation, instruments like spectrometers and chromatographs give clear, measurable data. They are also faster and reduce the chance of human error.

Q40. How can chromatography help identify unknown chemicals in a mixture?
Answer: Chromatography separates components of a mixture based on how they move through a medium. Each component moves at a different speed and shows up as a separate spot or peak. By comparing these with known substances, scientists can identify unknown chemicals. It is a useful tool in forensics, drug testing, and food analysis.

Q41. Why is it difficult to identify the components of a complex mixture without instrumental methods?
Answer: Complex mixtures often contain many similar-looking or reacting substances that can't be easily separated or identified by simple methods. Instrumental techniques like chromatography and mass spectrometry are needed because they can analyse tiny amounts, separate components accurately, and provide detailed information about chemical structure.

Q42. What advantage do instrumental methods offer when only a small sample is available?
Answer: Instrumental methods can analyse very small samples with high accuracy and sensitivity. They can detect substances in tiny quantities that are not visible to the eye or testable by traditional means. This is especially important in forensic science, archaeology, or medical testing, where only limited material may be available for analysis.

Q43. How do impurities affect the appearance of a substance during testing?
Answer: Impurities can change the appearance of a substance by altering its colour, texture, or the way it melts or boils. For example, a pure white powder might look grey if contaminated. During chromatography, impurities may appear as extra spots or smudges. These visual changes help scientists detect whether a substance is pure or mixed with other substances.

Q44. What is meant by the term "sensitive" in relation to instrumental testing?
Answer: "Sensitive" in instrumental testing means the method can detect very small amounts of a substance, even at parts per million or billion. This is important when working with rare, dangerous, or

valuable materials where detecting even a tiny amount is crucial. High sensitivity helps scientists get accurate results, especially in safety testing.

Q45. Why must forensic scientists use accurate and sensitive tests?
Answer: Forensic scientists need accurate and sensitive tests because they often work with very small or degraded samples. Reliable results are crucial for legal cases where evidence must stand up in court. Inaccurate or insensitive tests could lead to wrong conclusions, affecting justice. Therefore, they rely on trusted instrumental techniques.

Q46. How can you tell if a liquid is a formulation?
Answer: A liquid is likely a formulation if it has consistent properties and contains multiple ingredients combined for a specific purpose. For example, a shampoo, paint, or medicine usually lists several components. You can often find this information on the label. Unlike pure substances, formulations show consistent colour, smell, and texture due to their precise composition.

Q47. Why are insoluble solids formed during some purity tests?
Answer: Insoluble solids form during some purity tests when a reaction causes impurities to come out of solution or a chemical is added to precipitate them. This helps identify the presence of unwanted substances. For example, if a liquid is meant to be clear but forms a solid when tested, it indicates it's not pure and contains something insoluble.

Q48. Why do cleaning products often contain multiple components?
Answer: Cleaning products contain multiple components to work effectively on different types of dirt and surfaces. Surfactants help remove grease, solvents dissolve stains, and fragrances improve smell. Preservatives stop bacteria growth. Each component has a role, and together they make the product more effective than using just one ingredient.

Q49. What would happen if the components in a formulation were not well mixed?
Answer: If the components in a formulation are not well mixed, the product may not work properly. One part might be too strong, while another might be too weak. For example, in a medicine, an uneven mix could lead to underdosing or overdosing. In paint, poor mixing might cause colour or texture problems. Uniform mixing ensures quality and performance.

Q50. How can you use chromatography to check the purity of a sample?
Answer: Chromatography can check purity by separating the sample into its components. A pure substance will show only one spot or peak on the chromatogram. If there are extra spots or peaks, it means the sample contains impurities. By comparing with a known pure sample, scientists can judge how pure the test substance is.

Q51. What is the purpose of the stationary phase in paper chromatography?
Answer: The stationary phase in paper chromatography is the chromatography paper itself. It acts as a surface for the separation of substances in a mixture. As the solvent (mobile phase) moves up the paper, the components of the mixture interact differently with the stationary phase depending on

their solubility and affinity to the paper. This causes them to separate based on how strongly they are attracted to the paper versus how soluble they are in the solvent.

Q52. What is the role of the mobile phase in paper chromatography?
Answer: The mobile phase is the solvent that moves through the stationary phase (chromatography paper). It carries the substances in the mixture with it as it travels up the paper. The components of the mixture dissolve in the mobile phase and move at different speeds, depending on how well they dissolve in the solvent and how strongly they are attracted to the paper. This difference allows the substances to separate.

Q53. Why do different substances move different distances in paper chromatography?
Answer: Different substances move different distances in paper chromatography because they have different levels of solubility in the solvent and different levels of attraction to the paper. A substance that is more soluble in the solvent and less attracted to the paper will travel further, while a substance that is less soluble or more strongly attracted to the paper will move a shorter distance.

Q54. What is meant by the Rf value in chromatography?
Answer: The Rf value, or retention factor, is a number that represents how far a substance moves in chromatography relative to the solvent front. It is used to identify substances based on how they behave in a particular solvent system. Rf values are always less than 1 and are useful for comparing results from different experiments.

Q55. How is the Rf value of a substance calculated?
Answer: The Rf value is calculated using the formula:
Rf = (Distance moved by the substance) ÷ (Distance moved by the solvent).
You measure how far the centre of the spot has moved from the baseline and divide that by how far the solvent front has moved from the baseline. This gives a number that is always between 0 and 1.

Q56. What does an Rf value tell you about a substance in chromatography?
Answer: An Rf value tells you how far a substance has travelled in relation to the solvent. It is specific to a substance in a given solvent and under the same conditions, so it can be used to identify unknown substances by comparing their Rf values with known substances. A higher Rf means the substance is more soluble in the solvent and less attracted to the paper.

Q57. Why must the baseline in paper chromatography be drawn in pencil?
Answer: The baseline is drawn in pencil because pencil marks do not dissolve in the solvent. If you use ink, it could dissolve and interfere with the results of the experiment. Pencil is made of graphite, which is insoluble and does not move with the solvent, making it ideal for marking the starting point of the substances.

Q58. What would happen if the baseline in chromatography was drawn in ink?
Answer: If the baseline is drawn in ink, the ink could dissolve in the solvent and run up the

chromatography paper. This would interfere with the experiment, as it could create extra spots that mix with the samples being tested, making the chromatogram unclear or misleading.

Q59. What does it mean if a chromatogram shows more than one spot for a substance?
Answer: If a chromatogram shows more than one spot for a substance, it means that the substance is a mixture of two or more different components. Each spot represents a different substance that was present in the original sample and has separated during chromatography.

Q60. How can you tell if a substance is pure using chromatography?
Answer: A substance is considered pure if it produces only one spot on the chromatogram. If the substance produces more than one spot, it indicates that it is a mixture of different compounds. Pure substances always give a single spot regardless of the solvent used.

Q61. What does a single spot on a chromatogram suggest about a substance?
Answer: A single spot on a chromatogram suggests that the substance is pure. This is because a pure substance contains only one type of molecule, which travels a specific distance on the chromatography paper and shows up as one spot. If the substance were a mixture, it would separate into multiple spots.

Q62. Why is it important to keep the solvent level below the baseline in chromatography?
Answer: The solvent level must be below the baseline so that the substances placed on the baseline do not dissolve directly into the solvent. If the solvent touches the spots directly, the substances may wash off into the solvent instead of travelling gradually up the paper with the solvent, which would ruin the separation process.

Q63. Why do different solvents produce different chromatograms for the same mixture?
Answer: Different solvents have different chemical properties and can dissolve substances to different extents. A substance that is very soluble in one solvent might not be in another. This changes how far substances travel and affects the separation pattern. Therefore, using different solvents can produce different chromatograms even with the same mixture.

Q64. What safety precautions should be taken during the chromatography experiment?
Answer: Safety precautions include working in a well-ventilated area, especially if using volatile or flammable solvents. You should wear safety goggles to protect your eyes and gloves to protect your hands from chemicals. Also, keep the chromatography setup away from open flames and ensure containers are covered to avoid inhaling fumes.

Q65. How do you prepare a chromatography paper for separating food colours?
Answer: To prepare chromatography paper for separating food colours, cut a strip of filter paper and draw a pencil baseline near the bottom. Place small drops of different food colourings on the line, let them dry, and then place the paper in a container with a small amount of solvent. Make sure the solvent is below the baseline. Cover the container and allow the solvent to rise.

Q66. What is the significance of placing the lid on the chromatography container?
Answer: Placing a lid on the chromatography container helps to prevent the solvent from evaporating too quickly. This keeps the environment inside the container humid, which helps the solvent rise steadily and ensures better separation of the substances. It also improves the reliability and consistency of the results.

Q67. What can you do if two substances have very similar Rf values?
Answer: If two substances have very similar Rf values, you can try using a different solvent or a different type of chromatography method (like thin-layer chromatography or gas chromatography) to achieve better separation. Changing the solvent can change the solubility and movement of the substances, helping to distinguish them.

Q68. What is the effect of temperature on the movement of substances in chromatography?
Answer: Temperature can affect the rate at which the solvent moves and how substances dissolve. Higher temperatures generally increase the rate of solvent movement and may change how well substances are separated. However, if the temperature is too high, it can cause uneven separation or solvent evaporation, affecting the accuracy of the results.

Q69. Why is it important to allow the solvent to rise to a suitable height on the paper?
Answer: Allowing the solvent to rise to a suitable height on the paper gives enough time and distance for the substances to separate properly. If the solvent doesn't travel far enough, the components may not have enough room to spread out, making it harder to distinguish between them. A good height ensures clear, readable chromatograms.

Q70. How can paper chromatography be used to identify an unknown substance?
Answer: Paper chromatography can be used to identify an unknown substance by comparing its Rf value and position on the chromatogram with those of known substances under the same conditions. If the unknown substance forms a spot that matches the position and Rf value of a known substance, it is likely to be the same.

Q71. In a chromatography experiment, what would you do if the solvent front is not straight?
Answer: If the solvent front is not straight, it may cause uneven separation and unclear results. To fix this, you can repeat the experiment using fresh chromatography paper and ensure the paper is placed straight in the container. Make sure the container is level and the solvent is evenly distributed across the bottom.

Q72. How do impurities in a sample affect the chromatography results?
Answer: Impurities in a sample can create extra spots on the chromatogram, making it harder to interpret the results. They may overlap with spots from the main substance or produce unexpected Rf values. This can lead to confusion about the identity and purity of the sample being tested.

Q73. What are some common solvents used in paper chromatography?
Answer: Common solvents used in paper chromatography include water, ethanol, and propanone

(acetone). Sometimes mixtures of solvents are used to improve separation. The choice of solvent depends on the type of substances being tested and their solubility in the solvent.

Q74. How can you compare Rf values obtained in an experiment with known values?
Answer: You can compare Rf values from your experiment with those in a reference table or with values obtained from known substances under the same conditions. The solvent and temperature should be the same. If the Rf value and the position of the spot match those of a known substance, you can identify the unknown.

Q75. How would you measure the distance moved by the solvent?
Answer: To measure the distance moved by the solvent, use a ruler to measure from the baseline (where the substances were placed) to the highest point the solvent reached, which is called the solvent front. This distance is needed to calculate the Rf values of the substances.

Q76. How would you measure the distance moved by a coloured spot?
Answer: To measure the distance moved by a coloured spot, use a ruler to measure from the original pencil line where the spot was placed to the centre of the spot after chromatography has taken place. This distance should be measured in millimetres (mm) or centimetres (cm) and recorded accurately, making sure not to include the solvent front in the measurement.

Q77. What units are used when calculating Rf values?
Answer: Rf values are calculated as ratios, so they have no units. The Rf value is found by dividing the distance moved by the spot by the distance moved by the solvent front. Since both distances are measured in the same units (e.g., cm), the units cancel out, leaving a pure number without units.

Q78. What is the maximum value an Rf value can have?
Answer: The maximum value an Rf (retention factor) can have is 1. This would occur if the substance being tested travelled exactly the same distance as the solvent front. However, this is rare because most substances do not travel as far as the solvent front.

Q79. Why should Rf values be recorded to two decimal places?
Answer: Rf values should be recorded to two decimal places for accuracy and consistency. Recording to two decimal places helps reduce rounding errors and allows more precise comparisons with known Rf values of substances, especially in identification of compounds during chromatography.

Q80. What is the test for hydrogen gas?
Answer: The test for hydrogen gas is to insert a lit splint into a test tube containing the gas. If hydrogen is present, it reacts with oxygen in the air and ignites with a small explosion, producing a characteristic 'pop' sound. This confirms the presence of hydrogen.

Q81. What observation confirms the presence of hydrogen during the test?
Answer: The observation that confirms the presence of hydrogen during the test is a small 'pop'

sound. This sound is made when the hydrogen gas reacts rapidly with oxygen in the air, causing a mini explosion. It is a safe and quick way to identify hydrogen gas in school experiments.

Q82. Why is a burning splint used when testing for hydrogen?
Answer: A burning splint is used because the flame provides the activation energy needed to ignite the hydrogen gas. Hydrogen is flammable and will react with oxygen in the air when it comes into contact with a flame, producing a 'pop' sound. A glowing splint would not provide enough energy to ignite it.

Q83. What is the test for oxygen gas?
Answer: The test for oxygen gas involves inserting a glowing splint into a test tube containing the gas. If oxygen is present, it will support combustion and relight the glowing splint. This happens because oxygen is a key component needed for combustion to occur.

Q84. What does it mean when a glowing splint relights?
Answer: When a glowing splint relights, it means that oxygen is present in the test tube. Oxygen supports combustion, so it provides the needed condition for the glowing splint to catch fire again. This is a simple way to confirm the presence of oxygen gas in an experiment.

Q85. Why is it important to use a glowing splint instead of a burning one when testing for oxygen?
Answer: A glowing splint is used because it is not already fully burning, so it needs extra oxygen to ignite fully. If a burning splint were used, it would already be on fire, making it impossible to observe the relighting. The glowing splint shows the effect of oxygen more clearly.

Q86. Why must the test tube be open during the test for gases?
Answer: The test tube must be open during the test so that the splint can be inserted safely. A closed test tube could cause pressure to build up or prevent the splint from entering. It also allows any reaction with the gas to happen in a safe and observable way without trapping pressure.

Q87. What might cause a false positive result when testing for hydrogen?
Answer: A false positive for hydrogen might be caused by the presence of other flammable gases or substances that can also make a popping sound when ignited. Also, if air is trapped with a small amount of flammable vapour, it could produce a small 'pop' that might be wrongly identified as hydrogen.

Q88. How can you make sure the gas being tested is not contaminated?
Answer: To avoid contamination, the apparatus should be clean and free of other chemicals. The gas should be collected freshly and tested immediately. Also, using a delivery system that avoids contact with air or other gases helps ensure purity. Clean collection tubes and sealed delivery systems reduce contamination risk.

Q89. Why is it useful to test for gases in chemical reactions?
Answer: Testing for gases helps identify what products are formed in a reaction. This can confirm if

a reaction has occurred and what type it is. For example, testing for oxygen can show if decomposition occurred, and testing for hydrogen can indicate a reaction between acid and metal.

Q90. How do you safely collect hydrogen gas in the lab?
Answer: Hydrogen gas can be safely collected over water in an inverted container such as a gas jar or test tube. The hydrogen produced from a reaction (like magnesium with hydrochloric acid) is passed through a delivery tube into the submerged jar, displacing the water. This method keeps the gas separate from air and reduces risk.

Q91. Why is hydrogen collected over water?
Answer: Hydrogen is collected over water because it is insoluble in water and lighter than air. Collecting it this way helps trap it without mixing with air. Water also acts as a barrier, preventing backflow of air which could create an explosive mixture if hydrogen were ignited.

Q92. What safety concerns are there when testing for hydrogen?
Answer: Hydrogen is flammable and explosive in air, so testing must be done carefully. Use small amounts, work in a well-ventilated space, and never seal containers. Always point test tubes away from people and wear goggles. Testing with a lit splint should be done gently to avoid large pops or fire.

Q93. Why does hydrogen make a 'pop' sound when tested?
Answer: The 'pop' sound is caused by hydrogen gas reacting rapidly with oxygen in the air when ignited. This produces water vapour and releases energy as sound and heat. The sudden combustion makes a small explosion, which creates the popping noise.

Q94. In what type of reaction is oxygen usually produced?
Answer: Oxygen is often produced in decomposition reactions, particularly thermal decomposition of compounds like hydrogen peroxide or metal oxides. In these reactions, a single compound breaks down into simpler substances, one of which is usually oxygen.

Q95. How can you distinguish between hydrogen and oxygen using tests?
Answer: Hydrogen is tested using a lit splint that makes a 'pop' if hydrogen is present. Oxygen is tested with a glowing splint that relights. The sound confirms hydrogen, while relighting confirms oxygen. These distinct results help easily tell the gases apart.

Q96. What would happen if you used a glowing splint to test for hydrogen?
Answer: If a glowing splint is used for hydrogen, it may not react or ignite the gas. A glowing splint does not provide enough heat to ignite hydrogen, so the test may not show a 'pop' or any reaction, leading to a false negative.

Q97. How could you show that a gas produced is not oxygen?
Answer: Insert a glowing splint into the gas. If it does not relight, then the gas is not oxygen. Oxygen supports combustion, so if there's no ignition, oxygen is absent. Testing with both glowing and burning splints can help identify or rule out certain gases.

Q98. Why should you carry out the gas tests quickly after collecting the gas?
Answer: Gases may escape or mix with air if left for too long, leading to false results. Also, some gases like hydrogen may diffuse quickly or react with moisture. To get accurate results, it's important to test the gas as soon as possible after collection.

Q99. What is the advantage of using simple gas tests in school laboratories?
Answer: Simple gas tests are safe, quick, and require minimal equipment. They help students understand chemical reactions and identify products directly. They are cost-effective and provide clear, observable results without needing advanced instruments.

Q100. How can you confirm that a gas collected in an experiment is not air?
Answer: You can test the collected gas using specific gas tests. If it does not behave like oxygen (does not relight a glowing splint), hydrogen (no pop with lit splint), or carbon dioxide (no cloudiness in limewater), then it may just be air or an unknown gas. Comparing results helps confirm it.

Q101. What is the name of the solution used to test for carbon dioxide?
Answer: The solution used to test for carbon dioxide is limewater, which is a dilute solution of calcium hydroxide in water.

Q102. Describe what happens to limewater when carbon dioxide is bubbled through it.
Answer: When carbon dioxide is bubbled through limewater, the limewater turns cloudy or milky. This happens because carbon dioxide reacts with the calcium hydroxide in limewater to form calcium carbonate, which is an insoluble white solid that makes the solution appear cloudy.

Q103. Why does limewater turn cloudy when carbon dioxide is present?
Answer: Limewater turns cloudy in the presence of carbon dioxide because a chemical reaction occurs between calcium hydroxide and carbon dioxide to form calcium carbonate. Calcium carbonate is a white solid that is insoluble in water, and its presence causes the solution to look cloudy. This is a common test for detecting carbon dioxide gas.

Q104. What gas turns damp litmus paper white?
Answer: Chlorine gas turns damp blue or red litmus paper white. This happens because chlorine is a bleaching agent and can remove the dye from the litmus paper, making it appear white. The paper must be damp to allow the chlorine to dissolve and react properly.

Q105. What is the reason for dampening the litmus paper when testing for chlorine?
Answer: The litmus paper is dampened before testing for chlorine to allow the gas to dissolve in the moisture. Chlorine must dissolve in water to form an acidic solution, which then reacts with the dye in the litmus paper. The moist surface also helps chlorine act as a bleach, turning the litmus paper white.

Q106. How does chlorine affect litmus paper?
Answer: Chlorine gas affects litmus paper by turning it white. Initially, chlorine will turn blue litmus paper red because it forms an acidic solution when it dissolves in water. However, with continued

exposure, the chlorine bleaches the litmus paper, removing the dye entirely and making it appear white.

Q107. What colour does lithium produce in a flame test?
Answer: Lithium produces a crimson red flame during a flame test. This red colour is distinct and is used to identify lithium ions in a sample. The colour is produced when the electrons in lithium ions become excited by the heat and then release energy as they return to their original levels.

Q108. What colour does sodium produce in a flame test?
Answer: Sodium ions produce a bright yellow flame during a flame test. The yellow colour is very intense and can mask the colours of other metal ions if present. It is caused by the excitation of electrons in the sodium atoms, which emit light at a specific wavelength when they return to a lower energy state.

Q109. What flame colour is observed for potassium compounds?
Answer: Potassium compounds give a lilac or light purple flame in a flame test. This colour can sometimes be difficult to observe if other metal ions, like sodium, are present, because sodium's yellow flame can overpower the potassium colour.

Q110. What flame colour is produced by calcium ions?
Answer: Calcium ions produce an orange-red flame during a flame test. The colour is slightly less intense than the crimson red of lithium and can be confused with other flame colours unless observed carefully.

Q111. What is the flame colour for copper compounds?
Answer: Copper compounds give a green or blue-green flame in a flame test. This colour is distinctive and is due to the electrons in copper atoms being excited by heat and then releasing energy as coloured light.

Q112. Why might some flame colours be difficult to see in a sample with mixed ions?
Answer: In a sample with mixed metal ions, some flame colours may be difficult to observe because certain colours, such as the bright yellow from sodium, can dominate and mask the colours of other ions. Additionally, overlapping flame colours can make it hard to distinguish one from another clearly.

Q113. What is the purpose of a flame test?
Answer: The purpose of a flame test is to identify the presence of specific metal ions in a sample based on the characteristic colour they produce when heated in a flame. The test is quick and useful for qualitative analysis in laboratories.

Q114. Why is it important to clean the wire loop before performing a flame test?
Answer: It is important to clean the wire loop before a flame test to avoid contamination from previous samples. If the loop is not properly cleaned, it may carry leftover ions that can interfere with the current test and give misleading flame colours.

Q115. Name two metal ions that give a white precipitate when sodium hydroxide is added.
Answer: Aluminium ions and calcium ions both form a white precipitate when sodium hydroxide is added to their solutions. These precipitates are formed due to the formation of insoluble metal hydroxides.

Q116. Which white precipitate dissolves in excess sodium hydroxide?
Answer: The white precipitate formed by aluminium ions dissolves in excess sodium hydroxide. This happens because aluminium hydroxide is amphoteric and can react with excess hydroxide ions to form a soluble complex.

Q117. How would you distinguish between calcium and aluminium ions using sodium hydroxide?
Answer: You can distinguish between calcium and aluminium ions by adding excess sodium hydroxide. Both form white precipitates initially, but aluminium hydroxide dissolves in excess sodium hydroxide, while calcium hydroxide does not.

Q118. What colour precipitate is formed when copper(II) ions react with sodium hydroxide?
Answer: Copper(II) ions form a blue precipitate when reacted with sodium hydroxide. This precipitate is copper(II) hydroxide, which is insoluble in water and gives a distinctive colour, making it easy to identify.

Q119. What colour precipitate does iron(II) form with sodium hydroxide?
Answer: Iron(II) ions form a green precipitate when reacted with sodium hydroxide. The green precipitate is iron(II) hydroxide, which is insoluble in water and can darken to brown on standing due to oxidation.

Q120. What colour precipitate does iron(III) form with sodium hydroxide?
Answer: Iron(III) ions form a brown precipitate when reacted with sodium hydroxide. The precipitate is iron(III) hydroxide, which is insoluble and gives a rusty brown colour.

Q121. How could you distinguish between iron(II) and iron(III) using sodium hydroxide?
Answer: You can distinguish between iron(II) and iron(III) ions by observing the colour of the precipitate formed with sodium hydroxide. Iron(II) forms a green precipitate, while iron(III) forms a brown precipitate.

Q122. What is the name of the solid formed when a metal ion reacts with sodium hydroxide?
Answer: The solid formed when a metal ion reacts with sodium hydroxide is called a metal hydroxide. This solid is often seen as a precipitate, depending on the solubility of the specific hydroxide in water.

Q123. Write a word equation for the reaction of copper(II) sulfate with sodium hydroxide.
Answer: Copper(II) sulfate + Sodium hydroxide → Copper(II) hydroxide + Sodium sulfate

Q124. Write a balanced symbol equation for the reaction of iron(II) sulfate with sodium hydroxide.
Answer: $FeSO_4 + 2NaOH \rightarrow Fe(OH)_2 + Na_2SO_4$

Q125. Write a balanced chemical equation for the reaction of aluminium nitrate with sodium hydroxide.
Answer: $Al(NO_3)_3 + 3NaOH \rightarrow Al(OH)_3 + 3NaNO_3$

Q126. What is a precipitate?
Answer: A precipitate is a solid that forms when two solutions are mixed together and a chemical reaction occurs, resulting in the formation of an insoluble product. This solid appears as a cloudy or milky substance that settles at the bottom of the reaction container. Precipitates often form in reactions involving metal ions and hydroxide, carbonate, or sulfate ions.

Q127. What does it mean if a precipitate dissolves in excess sodium hydroxide?
Answer: If a precipitate dissolves in excess sodium hydroxide, it means that the substance formed a soluble complex ion with the excess hydroxide ions. This is characteristic of amphoteric metal hydroxides such as aluminium hydroxide, which initially forms a white precipitate but then dissolves when more sodium hydroxide is added, forming a colourless solution.

Q128. How can you test whether a white precipitate is aluminium hydroxide?
Answer: To test whether a white precipitate is aluminium hydroxide, add excess sodium hydroxide solution to it. If the white precipitate dissolves, it indicates the presence of aluminium ions because aluminium hydroxide is amphoteric and dissolves in excess sodium hydroxide. This helps distinguish aluminium from other metal ions that also form white precipitates but do not dissolve in excess alkali.

Q129. What is the appearance of magnesium hydroxide when formed in a reaction?
Answer: Magnesium hydroxide appears as a white precipitate when it is formed in a reaction, typically by adding sodium hydroxide to a solution containing magnesium ions. The white solid is insoluble in water and does not dissolve in excess sodium hydroxide, which helps distinguish it from other metal hydroxides like aluminium hydroxide.

Q130. How can you distinguish between magnesium and calcium ions using flame tests?
Answer: You can distinguish between magnesium and calcium ions using flame tests by observing the colour of the flame produced. Calcium ions give a brick-red or orange-red flame, whereas magnesium ions do not produce any visible flame colour. This difference helps identify which metal ion is present in a sample.

Q131. Why is it useful to use both flame tests and sodium hydroxide tests when identifying metal ions?
Answer: It is useful to use both flame tests and sodium hydroxide tests when identifying metal ions because some metal ions produce similar results in one test but different results in another. Using both tests provides a more accurate identification. For example, both aluminium and magnesium form

white precipitates with sodium hydroxide, but only aluminium dissolves in excess. Flame tests add a second layer of confirmation.

Q132. What safety precautions should be taken when using chlorine gas in a test?
Answer: When using chlorine gas in a test, you must take proper safety precautions because chlorine is toxic and can irritate the eyes, skin, and respiratory system. Tests should be carried out in a well-ventilated area or under a fume hood. Safety goggles, gloves, and a lab coat should be worn. You should also avoid inhaling the gas directly and keep exposure time as short as possible.

Q133. What should be done if no flame colour is seen in a flame test?
Answer: If no flame colour is seen in a flame test, check that the wire used is clean, as contamination can interfere with the result. You should also ensure the sample is sufficiently heated and that the sample contains enough of the metal ion to produce a visible colour. If necessary, repeat the test with a new sample and clean equipment.

Q134. Why must the wire used in a flame test be platinum or nichrome?
Answer: The wire used in a flame test must be platinum or nichrome because these metals do not produce any flame colour themselves, so they do not interfere with the test results. They also have high melting points and are chemically stable, which means they won't react with the chemicals being tested or melt in the flame, ensuring reliable and safe testing.

Q135. Describe how to carry out a flame test.
Answer: To carry out a flame test, first clean a platinum or nichrome wire by dipping it in hydrochloric acid and then placing it in a Bunsen flame until no colour is seen. Dip the clean wire into a solution or sample of the metal salt being tested. Place the wire back into the edge of a non-luminous Bunsen flame and observe the colour produced. Record the flame colour to help identify the metal ion.

Q136. What would you observe if you added sodium hydroxide to a solution containing iron(III) ions?
Answer: If you add sodium hydroxide to a solution containing iron(III) ions, you would observe the formation of a brown precipitate. This brown solid is iron(III) hydroxide, which is insoluble in water and does not dissolve in excess sodium hydroxide. The brown colour helps distinguish it from other metal hydroxides, like green from iron(II) and blue from copper(II).

Q137. How does the test for chlorine differ from the test for carbon dioxide?
Answer: The test for chlorine involves using damp blue litmus paper. If chlorine is present, it turns the blue litmus paper red and then bleaches it white. In contrast, the test for carbon dioxide involves bubbling the gas through limewater. If carbon dioxide is present, the limewater turns milky due to the formation of calcium carbonate. Each test uses different indicators and observations.

Q138. Why can some metal hydroxides not be identified by colour alone?
Answer: Some metal hydroxides cannot be identified by colour alone because multiple metal ions can form precipitates of the same or similar colours. For example, both aluminium and magnesium

hydroxides form white precipitates, making it difficult to tell them apart by colour. Additional tests, like adding excess sodium hydroxide to see if the precipitate dissolves, are needed to confirm the identity.

Q139. What ion causes limewater to turn milky?
Answer: The ion that causes limewater to turn milky is the carbonate ion (CO_3^{2-}), which is formed when carbon dioxide gas reacts with calcium hydroxide in limewater. The reaction produces calcium carbonate, which is a white insoluble solid that gives the milky appearance. This is a standard test for the presence of carbon dioxide gas.

Q140. What gas is formed when calcium carbonate reacts with an acid?
Answer: When calcium carbonate reacts with an acid, carbon dioxide gas is formed. This reaction also produces a salt (depending on the acid used) and water. The carbon dioxide gas can be tested by bubbling it through limewater, which turns milky if the gas is present. The reaction is an example of an acid-carbonate reaction.

Q141. Why is calcium hydroxide described as a test reagent?
Answer: Calcium hydroxide is described as a test reagent because it is used in chemical tests to detect the presence of carbon dioxide gas. In the form of limewater (a dilute solution of calcium hydroxide), it reacts with carbon dioxide to form a milky white precipitate of calcium carbonate. This visible reaction makes it useful in gas identification tests.

Q142. What happens to litmus paper in the presence of an acidic gas like chlorine?
Answer: In the presence of an acidic gas like chlorine, blue litmus paper turns red due to the acidic nature of the gas. With continued exposure, the chlorine gas bleaches the paper, causing it to lose its colour entirely. This bleaching effect confirms the presence of chlorine gas and distinguishes it from other acidic gases.

Q143. Why must the litmus paper be damp when testing for chlorine?
Answer: The litmus paper must be damp when testing for chlorine so that the gas can dissolve in the moisture on the paper. Chlorine reacts with water to form acidic solutions, which then affect the litmus dye. Without moisture, the gas would not dissolve properly, and the litmus paper would not show a colour change, making the test unreliable.

Q144. How would you test a solution for the presence of copper(II) ions?
Answer: To test a solution for the presence of copper(II) ions, add a few drops of sodium hydroxide solution. A blue precipitate of copper(II) hydroxide will form, which is insoluble in excess sodium hydroxide. Alternatively, a flame test can be done, where copper(II) ions give a green or blue-green flame, helping confirm their presence.

Q145. What ion gives a green precipitate with sodium hydroxide?
Answer: The ion that gives a green precipitate with sodium hydroxide is the iron(II) ion. When sodium hydroxide is added to a solution containing iron(II) ions, a green precipitate of iron(II)

hydroxide forms. This precipitate is insoluble in excess sodium hydroxide and gradually turns brown as it oxidises to iron(III) hydroxide on exposure to air.

Q146. Explain why flame colours are not reliable for samples with more than one metal ion.
Answer: Flame colours are not reliable for samples with more than one metal ion because the colours may mix or one ion's flame colour may dominate, masking the presence of the other ions. This can lead to incorrect identification. Also, some flame colours are similar, making it hard to distinguish between them. Therefore, flame tests should be used with other confirmatory tests.

Q147. What is the role of sodium hydroxide in ion identification?
Answer: Sodium hydroxide is used in ion identification to test for the presence of metal ions in a solution. When added, it reacts with the metal ions to form hydroxide precipitates. The colour and solubility of these precipitates help identify specific metal ions. For example, it forms a blue precipitate with copper(II), a green one with iron(II), and a brown one with iron(III).

Q148. Why is it important to use clean apparatus when testing for metal ions?
Answer: It is important to use clean apparatus when testing for metal ions to avoid contamination that could interfere with the results. Even small traces of other ions can affect the colour of the flame or the type of precipitate formed, leading to incorrect conclusions. Cleaning ensures the test results reflect only the sample being tested.

Q149. What would you expect to see when sodium hydroxide is added to magnesium chloride?
Answer: When sodium hydroxide is added to magnesium chloride, a white precipitate of magnesium hydroxide forms. This precipitate is insoluble in excess sodium hydroxide, which distinguishes magnesium ions from aluminium ions, whose hydroxide does dissolve. The appearance of the white precipitate confirms the presence of magnesium ions.

Q150. Suggest how a student could confirm that a white precipitate is not calcium hydroxide.
Answer: A student could confirm that a white precipitate is not calcium hydroxide by doing a flame test. Calcium ions produce a brick-red or orange-red flame colour, so if the sample does not produce this flame colour, it is likely not calcium. Additionally, testing the solubility in excess sodium hydroxide may help, as calcium hydroxide remains insoluble, like magnesium hydroxide.

Q151. What gas is produced when a carbonate reacts with a dilute acid?
Answer: The gas produced when a carbonate reacts with a dilute acid is carbon dioxide. This happens because the acid reacts with the carbonate to form a salt, water, and carbon dioxide gas. The reaction is a type of acid-carbonate reaction, and the fizzing or bubbling observed is due to the release of carbon dioxide gas.

Q152. How can you test for the presence of carbon dioxide?
Answer: You can test for carbon dioxide by bubbling the gas through limewater. If carbon dioxide is present, the limewater turns cloudy or milky. This happens because carbon dioxide reacts with

calcium hydroxide in the limewater to form calcium carbonate, which is a white, insoluble solid that causes the cloudiness.

Q153. What happens to limewater when carbon dioxide is bubbled through it?
Answer: When carbon dioxide is bubbled through limewater, the limewater turns cloudy or milky. This is because the carbon dioxide reacts with the calcium hydroxide solution to form calcium carbonate, which is a white precipitate that causes the cloudiness. This reaction is commonly used as a test for carbon dioxide gas.

Q154. Which ion is tested using silver nitrate solution and dilute nitric acid?
Answer: The ion tested using silver nitrate solution and dilute nitric acid is the halide ion. These include chloride (Cl^-), bromide (Br^-), and iodide (I^-) ions. The silver nitrate reacts with these halide ions to form a precipitate whose colour indicates which halide is present.

Q155. What colour precipitate is formed when silver nitrate reacts with chloride ions?
Answer: When silver nitrate reacts with chloride ions, it forms a white precipitate of silver chloride. This test is used to confirm the presence of chloride ions in a solution. The reaction requires the prior addition of dilute nitric acid to remove other interfering ions.

Q156. What is the colour of the precipitate when silver nitrate reacts with bromide ions?
Answer: When silver nitrate reacts with bromide ions, a cream-coloured precipitate of silver bromide is formed. This is part of the halide ion test and helps identify the presence of bromide in a sample. The cream colour helps distinguish bromide from chloride and iodide ions.

Q157. Which halide forms a yellow precipitate when tested with silver nitrate?
Answer: Iodide ions form a yellow precipitate when tested with silver nitrate. The yellow colour indicates the presence of silver iodide. This test, in combination with the white precipitate from chloride and the cream from bromide, helps identify specific halide ions in solution.

Q158. Why is dilute nitric acid added before silver nitrate in the halide test?
Answer: Dilute nitric acid is added before silver nitrate in the halide test to remove any carbonate or hydroxide ions that might be present in the solution. These unwanted ions could react with silver nitrate to form other precipitates, which would interfere with the test results. The nitric acid ensures a more accurate identification of halide ions.

Q159. What is the purpose of adding dilute hydrochloric acid before testing for sulfate ions?
Answer: Dilute hydrochloric acid is added before testing for sulfate ions to remove any carbonate ions that may be present. Carbonate ions can also form white precipitates, which could lead to a false positive result. The acid prevents this by reacting with and removing carbonates before barium chloride is added to test for sulfate.

Q160. What colour precipitate indicates the presence of sulfate ions?
Answer: A white precipitate indicates the presence of sulfate ions. When barium chloride is added to

a solution containing sulfate ions in the presence of dilute hydrochloric acid, a white precipitate of barium sulfate forms. This is a key confirmatory test for the presence of sulfate ions in a solution.

Q161. Which chemical is used with hydrochloric acid to test for sulfate ions?
Answer: Barium chloride is used with hydrochloric acid to test for sulfate ions. When added to a solution containing sulfate ions, it forms a white precipitate of barium sulfate. The hydrochloric acid is added first to remove any carbonate impurities that could otherwise interfere with the test.

Q162. What do all the halide ion tests have in common?
Answer: All the halide ion tests involve adding dilute nitric acid followed by silver nitrate solution. The halide ions react with silver ions to form different coloured precipitates depending on the halide: white for chloride, cream for bromide, and yellow for iodide. The nitric acid removes other interfering ions to make the test more reliable.

Q163. Why is it important to carry out ion tests in a specific order?
Answer: It's important to carry out ion tests in a specific order to avoid interference from previous reagents or reactions. For example, flame tests should be done before precipitation tests because the colours of flame tests can be affected by the presence of other substances. Also, some tests use reagents that could form unwanted precipitates if used in the wrong sequence.

Q164. Why must a flame test be done before precipitation tests?
Answer: A flame test must be done before precipitation tests because the presence of chemicals like silver nitrate or barium chloride can interfere with the flame colour or mask the results. Once a precipitation reaction has taken place, it may be difficult to detect the original metal ion's colour in a flame test accurately.

Q165. What is the general term for tests used to identify ions in a solution?
Answer: The general term for tests used to identify ions in a solution is **qualitative analysis**. These are chemical tests that help determine the presence of specific ions or substances based on observable reactions, such as colour changes or the formation of precipitates.

Q166. What is one limitation of using chemical tests to identify ions?
Answer: One limitation of using chemical tests to identify ions is that they can sometimes give false positives or be affected by impurities in the sample. Also, if multiple ions are present, they might interfere with each other's tests. The results often require interpretation, and human error can lead to incorrect conclusions.

Q167. What is meant by the term 'instrumental method' in chemical analysis?
Answer: An instrumental method in chemical analysis refers to the use of scientific instruments to detect and measure substances. These methods often involve advanced technology, such as flame emission spectroscopy, mass spectrometry, or chromatography, and are typically more sensitive and accurate than simple chemical tests.

Q168. Give one advantage of instrumental methods over chemical tests.
Answer: One advantage of instrumental methods over chemical tests is that they can detect very small amounts of substances, making them more sensitive. This means they can identify trace levels of ions or elements that might be too small to detect with traditional chemical methods, improving reliability and accuracy.

Q169. Why are instrumental methods considered more accurate than chemical tests?
Answer: Instrumental methods are considered more accurate than chemical tests because they rely on precise measurements and reduce the chance of human error. They can also give exact concentrations and detect tiny quantities that are not visible through traditional chemical reactions. This leads to more consistent and trustworthy results.

Q170. Why are instrumental methods faster than traditional chemical tests?
Answer: Instrumental methods are faster because they often automate the detection and analysis process, reducing the time needed for manual testing and observation. They also allow multiple substances to be tested at once and produce immediate digital results, saving time in both testing and interpretation.

Q171. What is meant by sensitivity in the context of instrumental methods?
Answer: Sensitivity in instrumental methods refers to the ability of the method to detect even very small amounts of a substance. A highly sensitive test can identify very low concentrations of ions or molecules, making it useful in detecting trace elements in a sample that might otherwise go unnoticed.

Q172. What is flame emission spectroscopy used for?
Answer: Flame emission spectroscopy is used to identify metal ions in a solution and measure their concentration. The method involves placing a sample in a flame, where the metal ions emit light at characteristic wavelengths. By analysing the emitted light spectrum, scientists can determine which metal is present and in what amount.

Q173. What is the role of the spectroscope in flame emission spectroscopy?
Answer: The spectroscope is used to separate and detect the different wavelengths of light emitted by metal ions in flame emission spectroscopy. Each metal emits light at specific wavelengths, creating a line spectrum. The spectroscope helps identify these lines, which are unique to each element, allowing identification and analysis.

Q174. What does a line spectrum show?
Answer: A line spectrum shows a series of coloured lines at specific wavelengths of light emitted by an element when it is heated. Each element has a unique pattern of lines, like a fingerprint, which allows scientists to identify the element and sometimes its concentration in the sample.

Q175. How can a line spectrum help identify a metal ion?
Answer: A line spectrum can help identify a metal ion because each metal emits light at specific

wavelengths when heated, producing a unique pattern of lines. By comparing the spectrum from a sample to known spectra of metals, the identity of the metal ion can be determined accurately.

Q176. How can the concentration of a metal ion be determined using flame emission spectroscopy?
Answer: Flame emission spectroscopy measures the intensity of light emitted at specific wavelengths by a metal ion in a flame. The brighter the emission line for a particular wavelength, the more concentrated the metal ion in the sample. By comparing the intensity of the sample's emission lines with those from known concentrations (a calibration curve), the concentration of the metal ion can be accurately determined.

Q177. What must be done to compare a sample spectrum to identify the metal ion?
Answer: To identify a metal ion using a sample spectrum, you need to compare the emission lines of the unknown sample to reference spectra of known metal ions. Each metal has a unique set of spectral lines (a fingerprint). If the lines in the sample match those of a known metal, that ion is present in the sample.

Q178. Why is flame emission spectroscopy more useful than a flame test?
Answer: Flame emission spectroscopy is more useful because it is more sensitive, accurate, and can identify multiple metal ions in a mixture. Flame tests only give a general colour, which can be difficult to interpret or masked by other elements. Spectroscopy provides clear data for each metal present and can detect even very small amounts.

Q179. In what form must the sample be for flame emission spectroscopy?
Answer: The sample must be in solution form, usually a liquid containing dissolved metal ions. This allows it to be easily introduced into the flame where the atoms can be excited and emit light. Solid samples need to be dissolved in water or another suitable solvent before testing.

Q180. What happens to the sample in the flame during flame emission spectroscopy?
Answer: When the sample is introduced into the flame, the heat causes the metal ions to become excited. As the excited electrons return to their ground state, they release energy in the form of light. This emitted light is analysed to produce a spectrum unique to the metal ion.

Q181. How does the colour of the flame relate to the metal ion present?
Answer: Each metal ion produces a specific flame colour due to the particular wavelengths of light it emits when its electrons fall back to lower energy levels. For example, sodium gives a yellow flame, while copper gives a green-blue flame. These colours help identify the metal ion.

Q182. What information is needed to interpret a line spectrum?
Answer: You need to know the wavelengths of light associated with specific metal ions. A reference spectrum showing the emission lines for known ions helps you match the lines from the sample to those ions. The pattern and intensity of lines are used to identify and measure the concentration of ions.

Q183. What does each line on the spectrum represent?
Answer: Each line on the spectrum represents light emitted at a specific wavelength by electrons in a metal ion as they return to lower energy levels. These lines are unique to each metal and can be used to identify which ions are present in a sample.

Q184. What is the advantage of using a reference spectrum when analysing results?
Answer: A reference spectrum serves as a comparison to help accurately identify the metal ions in a sample. It provides known emission lines for different ions, so by matching them with the unknown spectrum, the correct ion can be identified and its concentration calculated.

Q185. Which ion tests can be done using only one solution?
Answer: Tests for halide ions (chloride, bromide, iodide) can be done using only silver nitrate solution in the presence of dilute nitric acid. The type of halide present is identified based on the colour of the precipitate that forms (white, cream, or yellow).

Q186. What result confirms the presence of iodide ions in a solution?
Answer: When silver nitrate is added to a solution containing iodide ions, a yellow precipitate of silver iodide forms. This confirms the presence of iodide ions. The test should be done in the presence of dilute nitric acid to avoid interference from other ions.

Q187. What precautions should be taken when using silver nitrate?
Answer: Silver nitrate is corrosive and can stain skin and clothing. It should be handled with gloves, goggles, and in a well-ventilated area. Always avoid contact with eyes and skin, and wash thoroughly after use. Use small amounts and dispose of the waste properly.

Q188. How can you tell if a compound contains sulfate ions?
Answer: To test for sulfate ions, add a few drops of dilute hydrochloric acid followed by barium chloride solution. If sulfate ions are present, a white precipitate of barium sulfate forms. This result confirms the presence of sulfate ions in the solution.

Q189. What is observed if no sulfate ions are present in a test?
Answer: If no sulfate ions are present, adding barium chloride after hydrochloric acid will result in no visible reaction—no precipitate will form. The solution will remain clear, indicating a negative result for sulfate ions.

Q190. Why is hydrochloric acid used instead of nitric acid in the sulfate test?
Answer: Hydrochloric acid is used to remove other anions like carbonate or sulfite that might also form a white precipitate with barium chloride. Nitric acid would not remove these ions effectively. Hydrochloric acid ensures the result is only due to sulfate ions.

Q191. What is a positive result in the carbonate test?
Answer: In the carbonate test, a positive result is the production of carbon dioxide gas when dilute acid is added to a carbonate compound. You will observe fizzing or bubbling, and the gas can be confirmed by passing it through limewater, which turns cloudy.

Q192. What would happen if you used hydrochloric acid with silver nitrate?
Answer: Using hydrochloric acid with silver nitrate can cause a white precipitate to form even if no halide ions are present, due to the chloride ions from the acid. This can give a false positive for chloride ions, so nitric acid is used instead to avoid this.

Q193. Why should flame tests be carried out with a clean wire?
Answer: A clean wire is essential to avoid contamination from previous tests, which can lead to incorrect flame colours. Contaminants may mask or mix with the actual result, making identification of the metal ion difficult or inaccurate.

Q194. How can you clean a wire loop for a flame test?
Answer: To clean a wire loop, dip it in concentrated hydrochloric acid and then place it in a hot flame until it burns without any colour. Repeat the process if any colour remains. This ensures the loop is free from contaminants before testing a new sample.

Q195. Which test could help identify a white precipitate of silver halide?
Answer: The halide ion test using silver nitrate solution in the presence of dilute nitric acid can identify a white precipitate of silver halide. A white precipitate indicates silver chloride, a cream precipitate indicates silver bromide, and a yellow one indicates silver iodide.

Q196. What is the colour difference between silver chloride and silver iodide?
Answer: Silver chloride forms a white precipitate, while silver iodide forms a yellow precipitate. These colours help distinguish between chloride and iodide ions in a solution when silver nitrate is added in the presence of nitric acid.

Q197. Why is a reference chart needed in flame emission spectroscopy?
Answer: A reference chart provides the known wavelengths of emission lines for various metal ions. It is used to match the emission lines from an unknown sample, making it easier to identify which ions are present. It improves accuracy and reliability in the analysis.

Q198. What might cause an incorrect reading in a flame emission spectroscopy test?
Answer: Incorrect readings can be caused by contamination of the sample, interference from other metal ions, improper calibration, or poor maintenance of the equipment. Other errors include not cleaning the burner or using impure chemicals, all of which can affect the accuracy of the results.

Q199. How can two different metal ions be distinguished using spectroscopy?
Answer: Each metal ion emits light at different specific wavelengths when excited in a flame. Flame emission spectroscopy detects these unique emission lines. If two metal ions are present, their emission lines will appear separately on the spectrum, allowing both to be identified.

Q200. Why is it important to test for both anions and cations in an unknown compound?
Answer: Testing for both anions and cations provides a complete picture of the chemical composition of an unknown compound. Identifying only one type of ion can lead to an incomplete or incorrect identification. Both types of ions are needed to determine the full formula of the compound.