MEGA LECTURE

AQA (GCSE Notes)

Chapter 4: Chemical Changes

Q1. What is formed when a metal reacts with oxygen?
Answer: When a metal reacts with oxygen, a metal oxide is formed. This is a type of chemical reaction called oxidation. For example, when magnesium reacts with oxygen, it forms magnesium oxide. These oxides are usually solid and often form a white or coloured powder. The reaction is often accompanied by heat and light, especially with highly reactive metals.

Q2. Why is the reaction between a metal and oxygen called an oxidation reaction?
Answer: It is called an oxidation reaction because the metal gains oxygen during the process. In chemical terms, oxidation is the addition of oxygen to a substance. When a metal reacts with oxygen, it forms a metal oxide, meaning the oxygen atoms have chemically combined with the metal atoms, which fits the definition of oxidation.

Q3. Define oxidation in terms of oxygen.
Answer: Oxidation is defined as the process in which a substance gains oxygen. In other words, during an oxidation reaction, oxygen atoms are added to a substance. This can be seen clearly in reactions where metals react with oxygen to form metal oxides. For example, magnesium + oxygen → magnesium oxide.

Q4. Define reduction in terms of oxygen.
Answer: Reduction is defined as the removal of oxygen from a substance. In chemical reactions, when a compound loses oxygen atoms, it is said to be reduced. For example, when copper oxide is heated with carbon, copper is formed and the oxygen is removed as carbon dioxide. So, copper oxide is reduced to copper.

Q5. What happens to a metal atom when it becomes a positive ion?
Answer: When a metal atom becomes a positive ion, it loses one or more electrons. This is because metals tend to have few electrons in their outer shell, which they lose easily during chemical reactions to achieve a stable electronic configuration. Losing electrons gives them a positive charge, forming cations (positive ions).

Q6. How is the reactivity of a metal related to its ability to form positive ions?
Answer: The more reactive a metal is, the more easily it loses electrons to form positive ions. Reactivity is linked to how easily atoms give away electrons. Highly reactive metals like potassium or sodium lose electrons quickly and easily, forming positive ions rapidly. Less reactive metals lose electrons less readily and react more slowly.

Q7. Why are potassium and sodium placed at the top of the reactivity series?
Answer: Potassium and sodium are placed at the top of the reactivity series because they are very

reactive. They lose electrons easily to form positive ions and react quickly and strongly with water and acids. Their reactions are often exothermic and can be explosive, which shows their high reactivity compared to other metals.

Q8. What is observed when potassium is added to water?

Answer: When potassium is added to water, it reacts violently. It moves rapidly on the surface, melts into a silvery ball, and produces a lilac flame due to the heat of the reaction. Hydrogen gas is released, and the solution becomes alkaline because potassium hydroxide is formed. The reaction is highly exothermic and must be handled with care.

Q9. Describe the reaction of sodium with water.

Answer: Sodium reacts quickly with water. It melts into a ball, skims around the water surface, and produces fizzing due to the release of hydrogen gas. The solution becomes alkaline as sodium hydroxide is formed. The reaction is exothermic but less violent than potassium. A safety screen is usually used during the demonstration.

Q10. How does lithium react with water at room temperature?

Answer: Lithium reacts more slowly with water than sodium or potassium. It floats on the surface, moves slowly, and fizzes gently, releasing hydrogen gas. The reaction forms lithium hydroxide, making the solution alkaline. Although the reaction is less intense, it still shows lithium's reactivity as an alkali metal.

Q11. What type of gas is released when a reactive metal reacts with water?

Answer: When a reactive metal reacts with water, hydrogen gas is released. This gas causes fizzing or bubbling on the surface of the water. The metal also forms a metal hydroxide that dissolves in water, making the solution alkaline. The general reaction is: metal + water → metal hydroxide + hydrogen gas.

Q12. What happens to magnesium when it reacts with dilute hydrochloric acid?

Answer: When magnesium reacts with dilute hydrochloric acid, it fizzes and releases hydrogen gas. A salt called magnesium chloride is also formed. The reaction is exothermic and fairly quick. The gas produced can be tested using a lit splint, which gives a ‘pop’ sound confirming the presence of hydrogen.

Q13. Why does zinc react slowly with dilute acids compared to magnesium?

Answer: Zinc reacts more slowly with dilute acids than magnesium because it is lower in the reactivity series. It loses electrons less readily than magnesium, so the reaction proceeds at a slower rate. The slower production of hydrogen gas and less vigorous fizzing are clear indicators of its lower reactivity.

Q14. Why does copper not react with dilute acids?

Answer: Copper does not react with dilute acids because it is less reactive than hydrogen. For a metal to displace hydrogen from an acid, it must be more reactive than hydrogen. Since copper is

below hydrogen in the reactivity series, it cannot displace it and therefore no reaction occurs with dilute acids.

Q15. Arrange calcium, zinc, and iron in order of reactivity based on their reactions with acid.
Answer: Based on their reactions with acid, the order of reactivity is: calcium > zinc > iron. Calcium reacts very quickly and vigorously, producing a lot of hydrogen gas. Zinc reacts more slowly than calcium but faster than iron. Iron reacts the slowest among the three and produces fewer bubbles over time.

Q16. How can we use reactions with water to compare the reactivity of different metals?
Answer: We can compare the reactivity of different metals by observing how quickly and strongly they react with water. Metals that react quickly, with fizzing and heat, are more reactive. Metals that show no reaction or react very slowly are less reactive. This observation helps us rank metals in the reactivity series.

Q17. What safety precautions should be taken when reacting potassium with water?
Answer: Potassium reacts very violently with water, so safety precautions are essential. These include wearing goggles and lab coats, using small pieces of potassium, performing the reaction behind a safety screen, using tongs to handle the metal, and standing at a safe distance. This prevents injuries from splashes or flames.

Q18. What does a fast reaction between a metal and dilute acid indicate about the metal's reactivity?
Answer: A fast reaction between a metal and dilute acid shows that the metal is highly reactive. The metal loses electrons quickly and forms positive ions, releasing hydrogen gas rapidly. This is seen as fizzing or bubbling. The faster and more vigorous the reaction, the more reactive the metal is considered to be.

Q19. What is meant by the term “reactivity series”?
Answer: The reactivity series is a list of metals arranged in order of their reactivity, from most reactive to least reactive. It helps predict how metals will react with water, acids, or other metal salts. It also shows which metals can displace others in chemical reactions, especially displacement reactions.

Q20. Which two non-metals are often included in the reactivity series and why?
Answer: Hydrogen and carbon are often included in the reactivity series. Hydrogen is used as a reference point because many metal reactions involve displacing hydrogen from acids. Carbon is included because it is used in the extraction of some metals from their oxides. Their positions help in predicting certain chemical behaviours.

Q21. Why is hydrogen used as a reference point in the reactivity series?
Answer: Hydrogen is used as a reference point because it helps to determine whether a metal will

react with acids. Metals above hydrogen in the series will displace hydrogen from acids and react, while metals below will not. This makes hydrogen a useful marker to compare the reactivity of metals.

Q22. What does it mean if a metal is below hydrogen in the reactivity series?
Answer: If a metal is below hydrogen in the reactivity series, it means that the metal is less reactive than hydrogen. As a result, it cannot displace hydrogen from dilute acids, so no reaction occurs. These metals do not produce hydrogen gas when added to acid. Examples include copper, silver, and gold.

Q23. What is a displacement reaction?
Answer: A displacement reaction occurs when a more reactive metal displaces a less reactive metal from its compound. For example, if magnesium is added to copper sulfate solution, magnesium will replace copper to form magnesium sulfate, and copper will be left as a solid. This shows magnesium is more reactive than copper.

Q24. Describe a displacement reaction between magnesium and copper sulfate.
Answer: When magnesium is placed in copper sulfate solution, it reacts by displacing copper from the solution. Magnesium forms magnesium sulfate and copper is deposited as a reddish-brown solid. The blue colour of the copper sulfate fades as the reaction continues. This is because magnesium is more reactive than copper.

Q25. Explain how displacement reactions can help us rank metals in the reactivity series.
Answer: Displacement reactions help rank metals by showing which metals can replace others in compounds. If a metal displaces another from its salt solution, it is more reactive. By testing different combinations, we can build a clear picture of the order of reactivity. This method provides practical evidence for the reactivity series.

Q26. Write an example of a displacement reaction involving zinc and another metal compound.
Answer: Zinc can displace copper from copper sulfate solution because it is more reactive.
Solution: $Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$. Zinc loses electrons to form Zn^{2+} ions, while copper ions gain electrons and form solid copper.

Q27. How can experiments involving reactions with water be used to deduce metal reactivity?
Answer: By observing if a metal reacts with cold water or steam, and how quickly it reacts, you can determine its position in the reactivity series. More reactive metals like sodium react violently with cold water, while less reactive ones like iron might not react at all.

Q28. What would you observe when calcium is placed in water?
Answer: Calcium reacts with water quickly. You would see bubbles of hydrogen gas, slight heat, and the formation of a milky white solution due to calcium hydroxide. The calcium may also move around in the water as it reacts.

Q29. Why does iron not react with cold water?
Answer: Iron is not reactive enough to displace hydrogen from cold water. The reaction needs more

energy, such as heat from steam, to occur. Therefore, at room temperature, no visible reaction is seen between iron and water.

Q30. How does the reaction of magnesium with water compare to its reaction with acids?
Answer: Magnesium reacts very slowly with cold water but reacts much faster with dilute acids. Acids provide more hydrogen ions, leading to a quicker release of hydrogen gas compared to the reaction with water.

Q31. Suggest a method to compare the reactivity of metals using dilute hydrochloric acid.
Answer: Add equal-sized pieces of different metals (like magnesium, zinc, and iron) to separate test tubes containing the same volume and concentration of dilute hydrochloric acid. Observe and compare the rate at which bubbles (hydrogen gas) form to determine which metal is more reactive.

Q32. How can gas collection be used to measure the rate of a metal's reaction with acid?
Answer: You can collect the hydrogen gas produced using a gas syringe or an inverted measuring cylinder over water. The faster the gas is produced, the more reactive the metal. Measuring the volume of gas at set intervals shows the reaction rate.

Q33. Why does copper not displace iron from iron sulfate?
Answer: Copper is less reactive than iron, so it cannot displace iron from its compound. Displacement only happens when a more reactive metal replaces a less reactive one from a compound.

Q34. What is observed when iron is added to copper sulfate solution?
Answer: A reddish-brown layer of copper forms on the surface of the iron, and the blue colour of the copper sulfate solution fades as iron sulfate forms. This shows iron is more reactive than copper.

Q35. Explain why magnesium can displace zinc from zinc chloride.
Answer: Magnesium is more reactive than zinc and can displace it from its compound. When magnesium is added to zinc chloride, magnesium forms magnesium chloride and zinc is released as a solid.

Q36. Describe what happens when a metal is oxidised.
Answer: When a metal is oxidised, it loses electrons and forms positive ions. This often happens during reactions with oxygen, acids, or other substances. The metal increases in oxidation state.

Q37. What is the role of oxygen in a metal oxidation reaction?
Answer: Oxygen acts as an oxidising agent. It accepts electrons from the metal, allowing the metal to be oxidised. The metal combines with oxygen to form a metal oxide.

Q38. What evidence would show that a metal has undergone oxidation?
Answer: The formation of a metal oxide, colour change on the metal surface (such as rusting in iron), and loss of shine or brightness can indicate oxidation. Also, changes in mass or production of heat may be observed.

Q39. How would you demonstrate that magnesium is more reactive than iron using dilute acid?
Answer: Add equal pieces of magnesium and iron into separate test tubes with the same amount and concentration of dilute hydrochloric acid. Magnesium will react faster and produce more hydrogen gas bubbles than iron, showing it is more reactive.

Q40. How does the tendency to lose electrons relate to metal reactivity?
Answer: Metals that lose electrons easily are more reactive. Reactivity increases when it takes less energy to remove electrons, allowing the metal to form positive ions quickly in chemical reactions.

Q41. Which metal would you expect to react most vigorously with acid: zinc, calcium, or iron?
Answer: Calcium would react most vigorously with acid because it is the most reactive among the three. It reacts quickly with acids, producing hydrogen gas rapidly and releasing heat.

Q42. What does it mean for a metal to have a strong tendency to form positive ions?
Answer: It means the metal loses electrons easily during chemical reactions, forming positively charged ions. This characteristic is linked to higher reactivity in metals.

Q43. Why is it important to conduct metal-acid reactions at room temperature for comparison?
Answer: Room temperature ensures that all metals are tested under the same conditions. If temperature varies, it could affect the reaction rate and give misleading results about reactivity.

Q44. What is meant by "more reactive" in terms of metal behaviour?
Answer: A more reactive metal reacts faster or more easily with substances like acids, water, or oxygen. It loses electrons more readily and displaces less reactive metals from compounds.

Q45. Why is steam not used in these metal reaction comparisons?
Answer: Steam introduces extra heat, which could speed up reactions and make it hard to compare metal reactivity fairly. Cold water or acids at room temperature give more accurate results.

Q46. What kind of evidence from a chemical reaction can help identify a more reactive metal?
Answer: Faster gas production, more heat, or noticeable changes like bubbling or colour shifts can indicate higher reactivity. Also, a metal that displaces another from its compound is more reactive.

Q47. Why does magnesium react with acids but copper does not?
Answer: Magnesium is more reactive than hydrogen, so it displaces hydrogen from acids. Copper is less reactive than hydrogen, so it cannot displace it and therefore does not react with dilute acids.

Q48. What is the importance of using the same conditions when comparing metal reactivity?
Answer: Consistent conditions such as temperature, concentration, and metal size ensure a fair test. This way, differences in reaction are due to metal reactivity, not other variables.

Q49. How can you tell if a displacement reaction has occurred?
Answer: A visible change, such as a colour change, metal deposits forming, or a temperature

change, indicates displacement. Also, the less reactive metal is often seen as a solid forming from solution.

Q50. Describe a simple lab experiment to test the reactivity of iron, copper, and magnesium using acids.

Answer: Add equal-sized pieces of iron, copper, and magnesium to three separate test tubes containing the same volume and concentration of dilute hydrochloric acid. Observe the rate and amount of gas bubbles formed. Magnesium will react vigorously, iron moderately, and copper will show little to no reaction. This helps rank their reactivity.

Q51. What is the product formed when a metal oxide is reduced by carbon?

Answer: The product formed when a metal oxide is reduced by carbon is a metal and carbon dioxide. In this reaction, carbon takes the oxygen from the metal oxide, reducing the metal oxide to its pure metal form and forming carbon dioxide as a by-product. For example, when copper(II) oxide is reduced by carbon, copper and carbon dioxide are formed.

Q52. Explain why carbon cannot be used to extract aluminium from its oxide.

Answer: Carbon cannot be used to extract aluminium from its oxide because aluminium is more reactive than carbon. In the reactivity series, aluminium is placed above carbon, which means carbon does not have enough ability to displace aluminium from its compound. Therefore, aluminium is extracted using electrolysis, a method that uses electricity to break down its oxide into aluminium metal and oxygen.

Q53. In the extraction of iron, which substance is reduced?

Answer: In the extraction of iron, iron(III) oxide (Fe_2O_3) is reduced. This means that iron(III) oxide loses its oxygen atoms and is turned into iron metal. The reducing agent is carbon monoxide or carbon, which removes the oxygen from the iron oxide. As a result, iron is produced along with carbon dioxide.

Q54. In the reaction between copper oxide and carbon, which substance is oxidised?

Answer: In the reaction between copper oxide and carbon, carbon is oxidised. This means that carbon gains oxygen to form carbon dioxide. While carbon is oxidised, copper oxide is reduced to copper metal by losing its oxygen. This is a redox reaction, where both oxidation and reduction happen at the same time.

Q55. What evidence suggests that a reduction reaction has taken place?

Answer: One piece of evidence that suggests a reduction reaction has taken place is the removal of oxygen from a substance. For example, if a metal oxide is heated with carbon and the metal appears as a shiny solid, it indicates that the metal oxide has been reduced. Also, a change in colour, formation of a new metal, or the release of gases like carbon dioxide can be signs of a reduction reaction.

Q56. How does the position of a metal in the reactivity series affect its method of extraction?
Answer: The position of a metal in the reactivity series determines whether it can be extracted using a chemical reducing agent like carbon or needs electrolysis. Metals below carbon in the series can be extracted using carbon because carbon is more reactive and can displace them from their oxides. However, metals above carbon, such as aluminium or potassium, are more reactive and need electrolysis for extraction because carbon cannot displace them.

Q57. Why are metals above carbon in the reactivity series not extracted using carbon?
Answer: Metals above carbon in the reactivity series are not extracted using carbon because they are more reactive than carbon. Carbon cannot remove the oxygen from these metal oxides, as it does not have enough reactivity to do so. Instead, these metals are extracted by electrolysis, which involves passing an electric current through their molten compounds to break them down into pure metals and non-metals.

Q58. Describe what happens to oxygen atoms during a reduction reaction.
Answer: During a reduction reaction, oxygen atoms are removed from a substance. For example, in the reduction of metal oxides, the metal oxide loses oxygen, resulting in the formation of the pure metal. This loss of oxygen is what defines the process of reduction in terms of oxygen transfer. If carbon is used as a reducing agent, the oxygen is transferred from the metal oxide to the carbon, forming carbon dioxide.

Q59. Why is carbon often used in metal extraction processes?
Answer: Carbon is often used in metal extraction processes because it is cheap, readily available, and effective in removing oxygen from metal oxides. It acts as a reducing agent, meaning it helps convert metal oxides into pure metals by taking away their oxygen. Carbon can be used for metals that are less reactive than it, such as iron and copper, making it suitable for large-scale extractions.

Q60. What happens to carbon during the reduction of a metal oxide?
Answer: During the reduction of a metal oxide, carbon is oxidised. This means carbon gains oxygen from the metal oxide and forms carbon dioxide. At the same time, the metal oxide is reduced to a pure metal. This is a redox reaction in which carbon acts as the reducing agent and is itself oxidised by gaining oxygen.

Q61. Give an example of a metal oxide that can be reduced using carbon.
Answer: One example of a metal oxide that can be reduced using carbon is iron(III) oxide (Fe_2O_3). When iron(III) oxide is heated with carbon, carbon removes the oxygen from the oxide, producing iron metal and carbon dioxide. This method is widely used in the blast furnace to extract iron from its ore.

Q62. What does it mean when a substance is said to be oxidised?
Answer: When a substance is said to be oxidised, it means that it has gained oxygen or lost electrons. In chemical reactions, oxidation can involve a substance combining with oxygen, such as carbon turning into carbon dioxide. It can also mean the substance has lost electrons, especially in redox reactions where electron transfer is involved.

Q63. How can you tell from a reaction if a substance has been reduced?
Answer: You can tell that a substance has been reduced if it has lost oxygen or gained electrons in the reaction. In a reaction involving a metal oxide and carbon, if the metal oxide changes to the pure metal, it indicates that the substance has been reduced. A change in colour or state of the metal, and the removal of oxygen, are clear signs of reduction.

Q64. Write a word equation for the reduction of copper(II) oxide using carbon.
Answer: Copper(II) oxide + Carbon → Copper + Carbon dioxide.
This equation shows that copper(II) oxide loses oxygen (is reduced) and carbon gains oxygen (is oxidised), resulting in the formation of copper metal and carbon dioxide gas.

Q65. Why is gold typically not found as a compound in nature?
Answer: Gold is typically not found as a compound in nature because it is a very unreactive metal. It does not easily react with oxygen, water, or most other substances in the environment. As a result, gold usually exists in its native metallic form in the earth, rather than as part of a compound like an oxide or sulphide.

Q66. Why is it easier to extract metals that are less reactive than carbon?
Answer: It is easier to extract metals that are less reactive than carbon because carbon can act as a reducing agent to remove oxygen from their oxides. This process is simple, cost-effective, and does not require expensive equipment. For example, iron and copper can be extracted by heating their oxides with carbon, which is easier than using electrolysis needed for more reactive metals.

Q67. What is formed when carbon reacts with oxygen during the reduction of metal oxides?
Answer: When carbon reacts with oxygen during the reduction of metal oxides, carbon dioxide is formed. This is because carbon takes oxygen from the metal oxide and combines with it to form CO_2. In some reactions, carbon monoxide (CO) may also be formed first and then further oxidised to carbon dioxide.

Q68. In a metal extraction reaction, how can you identify the oxidising agent?
Answer: In a metal extraction reaction, the oxidising agent is the substance that causes oxidation by accepting electrons or providing oxygen. You can identify the oxidising agent by looking at which substance is being reduced (losing oxygen or gaining electrons). The oxidising agent is the one being reduced in a redox reaction.

Q69. How does the extraction of iron from iron oxide show a redox reaction?
Answer: The extraction of iron from iron oxide shows a redox reaction because it involves both reduction and oxidation. Iron oxide is reduced to iron by losing oxygen, while the carbon or carbon monoxide used in the process is oxidised by gaining oxygen to form carbon dioxide. This simultaneous process of reduction and oxidation defines a redox reaction.

Q70. What is the importance of redox reactions in metal extraction?
Answer: Redox reactions are important in metal extraction because they allow metals to be

separated from their oxides or other compounds. In these reactions, the metal oxide is reduced to the metal, and the reducing agent is oxidised. This principle is widely used in extracting metals like iron, copper, and zinc from their ores using carbon or other reducing agents.

Q71. Define oxidation in terms of electron transfer.
Answer: Oxidation in terms of electron transfer means the loss of electrons by a substance. When a substance is oxidised, it gives away electrons to another substance. This is a key part of redox reactions, where oxidation and reduction happen together, and electrons are transferred from one substance to another.

Q72. Define reduction in terms of electron transfer.
Answer: Reduction in terms of electron transfer means the gain of electrons by a substance. When a substance is reduced, it accepts electrons from another substance. This is the opposite of oxidation, and both processes always occur together in redox reactions.

Q73. In terms of electrons, what happens to a metal when it is oxidised?
Answer: In terms of electrons, when a metal is oxidised, it loses electrons. This causes the metal to form positive ions. For example, when magnesium reacts with acid, it loses two electrons and forms Mg^{2+} ions. This loss of electrons is what defines oxidation in electron terms.

Q74. In terms of electrons, what happens to a metal ion when it is reduced?
Answer: When a metal ion is reduced, it gains electrons. This gain of electrons changes the metal ion into a neutral metal atom. For example, Cu^{2+} ions gain two electrons to become copper metal. This electron gain is what defines reduction in terms of electrons.

Q75. Explain what is meant by a half equation in redox chemistry.
Answer: A half equation in redox chemistry shows the movement of electrons during either oxidation or reduction. It focuses on one part of the redox reaction—either the loss of electrons (oxidation) or the gain of electrons (reduction). For example, the half equation $Cu^{2+} + 2e^- \rightarrow Cu$ shows the reduction of copper ions to copper metal by gaining two electrons.

Q76. Write a half equation for the reduction of Cu^{2+} to Cu.
Answer: $Cu^{2+} + 2e^- \rightarrow Cu$
Solution: In this half equation, copper ions (Cu^{2+}) gain two electrons ($2e^-$) to become copper atoms (Cu). This is a reduction process because electrons are gained.

Q77. How can you tell from a half equation which species is gaining electrons?
Answer: In a half equation, the species gaining electrons will have electrons written on the left side of the equation. This shows that the species is taking in electrons, which is the definition of reduction.

Q78. How can you tell from a half equation which species is losing electrons?
Answer: In a half equation, if electrons appear on the right side, it means the species is losing electrons. This is because the electrons are being released, which is the definition of oxidation.

Q79. In the reaction between zinc and copper sulfate, which metal is oxidised?
Answer: Zinc is oxidised in this reaction. It loses electrons and forms Zn^{2+} ions, which shows that it is undergoing oxidation.

Q80. In the same reaction, which metal ion is reduced?
Answer: The copper ion (Cu^{2+}) is reduced. It gains electrons from zinc and becomes copper metal (Cu), showing a reduction process.

Q81. Why is the reaction between magnesium and copper sulfate a redox reaction?
Answer: This is a redox reaction because magnesium is oxidised (loses electrons) and copper ions are reduced (gain electrons). Both oxidation and reduction happen at the same time, which is the definition of a redox reaction.

Q82. Write the ionic equation for the reaction between iron and copper(II) sulfate.
Answer: $Fe + Cu^{2+} \rightarrow Fe^{2+} + Cu$
Solution: In this equation, iron loses electrons and forms Fe^{2+}, while copper ions gain electrons to become copper metal.

Q83. What are spectator ions in a displacement reaction?
Answer: Spectator ions are ions that do not change during the reaction. They are present in the solution but do not take part in the chemical change. For example, in the reaction between zinc and copper sulfate, the sulfate ions are spectator ions.

Q84. How do displacement reactions provide evidence for reactivity trends?
Answer: In displacement reactions, a more reactive metal will displace a less reactive metal from its compound. By observing which metals can displace others, we can arrange metals in order of reactivity and understand their trends.

Q85. Identify the oxidising agent in the reaction between magnesium and copper(II) sulfate.
Answer: The oxidising agent is the copper(II) ion (Cu^{2+}) because it gains electrons from magnesium and is reduced in the process. Oxidising agents always cause other substances to be oxidised.

Q86. Identify the reducing agent in the reaction between zinc and iron(II) sulfate.
Answer: The reducing agent is zinc because it loses electrons and is oxidised. It provides electrons to the iron(II) ions, reducing them to iron metal.

Q87. What is shown by the loss of electrons in a half equation?
Answer: Loss of electrons in a half equation shows oxidation. It indicates that the substance is being oxidised by releasing electrons, and its oxidation state increases.

Q88. What is shown by the gain of electrons in a half equation?
Answer: Gain of electrons in a half equation shows reduction. It means that the substance is taking in electrons, and its oxidation state is being reduced.

Q89. Why are displacement reactions examples of redox reactions?
Answer: Displacement reactions involve one element losing electrons (oxidation) and another gaining electrons (reduction), which is the basic requirement for a redox reaction. Both processes happen together.

Q90. Explain the change in oxidation state when a metal is oxidised.
Answer: When a metal is oxidised, it loses electrons and its oxidation state increases. For example, zinc goes from Zn (oxidation state 0) to Zn^{2+} (oxidation state +2), showing an increase due to electron loss.

Q91. Explain the change in oxidation state when a metal ion is reduced.
Answer: When a metal ion is reduced, it gains electrons and its oxidation state decreases. For example, Cu^{2+} becomes Cu, going from +2 to 0, which shows a reduction because of the electron gain.

Q92. Write an ionic equation for the displacement of silver by copper.
Answer: $Cu + 2Ag^{+} \rightarrow Cu^{2+} + 2Ag$
Solution: In this reaction, copper loses electrons and becomes Cu^{2+}, while silver ions gain electrons and become silver metal. This shows a redox reaction.

Q93. Why do more reactive metals displace less reactive metals from solutions?
Answer: More reactive metals have a greater tendency to lose electrons and form positive ions. They can push out less reactive metals from their compounds by giving electrons to their ions and reducing them.

Q94. What is the role of electrons in redox reactions?
Answer: Electrons are transferred between substances in redox reactions. One substance loses electrons (oxidation) while the other gains electrons (reduction). This transfer defines redox processes.

Q95. Why are ionic equations useful for showing redox processes?
Answer: Ionic equations show only the ions involved in the reaction and leave out the spectator ions. This makes it easier to focus on the substances that gain and lose electrons, clearly showing the redox changes.

Q96. How can you balance a half equation for a redox reaction?
Answer: To balance a half equation, first balance the atoms except hydrogen and oxygen. Then balance oxygen using H_2O, hydrogen using H^{+}, and finally balance the charges by adding electrons to one side. Make sure both mass and charge are equal.

Q97. Write the half equation for the oxidation of Zn to Zn^{2+}.
Answer: $Zn \rightarrow Zn^{2+} + 2e^{-}$
Solution: Zinc loses two electrons and becomes a zinc ion. This is an example of oxidation.

Q98. Write the half equation for the reduction of Fe^{3+} to Fe^{2+}.
Answer: $Fe^{3+} + e^- \rightarrow Fe^{2+}$
Solution: Iron(III) ion gains one electron to become iron(II) ion, which is a reduction process.

Q99. How would you identify the species being reduced in a full redox reaction?
Answer: In a full redox reaction, the species being reduced is the one that gains electrons. Its oxidation state decreases. You can also identify it as the one that appears on the left with a positive charge and on the right as a neutral or lower-charged ion.

Q100. Describe how you would use experimental data to decide which species has been oxidised.
Answer: You can look for changes in oxidation state, observe which metal forms ions, or use colour changes and gas production. If a metal disappears and forms a solution, it's oxidised. If its ions become solid metal, it's reduced. Comparing before and after helps you decide.

Q101. What gas is produced when magnesium reacts with hydrochloric acid?
Answer: The gas produced is hydrogen. When magnesium reacts with hydrochloric acid, it displaces the hydrogen ions from the acid, forming magnesium chloride and releasing hydrogen gas. This is a typical metal-acid reaction where the metal replaces hydrogen.

Q102. What salt is formed when zinc reacts with sulfuric acid?
Answer: The salt formed is zinc sulfate. Zinc reacts with sulfuric acid in a metal-acid reaction where zinc displaces the hydrogen ions from the acid, producing zinc sulfate and releasing hydrogen gas.

Q103. Write a word equation for the reaction between iron and hydrochloric acid.
Answer: Iron + Hydrochloric acid → Iron chloride + Hydrogen

Q104. Explain why the reaction between a metal and an acid is a redox reaction.
Answer: A metal-acid reaction is a redox reaction because it involves the transfer of electrons. The metal loses electrons and is oxidised, while the hydrogen ions in the acid gain electrons and are reduced. This simultaneous oxidation and reduction define a redox process.

Q105. In terms of electrons, what happens to magnesium when it reacts with hydrochloric acid?
Answer: Magnesium loses two electrons when it reacts with hydrochloric acid. This electron loss causes magnesium to be oxidised and form magnesium ions (Mg^{2+}), which then combine with chloride ions from the acid to form magnesium chloride.

Q106. In terms of electrons, what happens to hydrogen ions during a reaction with zinc?
Answer: During the reaction with zinc, hydrogen ions gain electrons. These ions are reduced as they accept electrons from zinc and form hydrogen gas. This electron gain is what causes the bubbles of hydrogen gas to be released in the reaction.

Q107. Identify the species being oxidised in the reaction between zinc and hydrochloric acid.
Answer: The species being oxidised is zinc. Zinc atoms lose electrons to form zinc ions (Zn^{2+}), meaning it undergoes oxidation in the reaction with hydrochloric acid.

Q108. Identify the species being reduced in the reaction between iron and sulfuric acid.
Answer: The species being reduced is hydrogen ions from the sulfuric acid. These hydrogen ions gain electrons from the iron and are converted into hydrogen gas, which is released during the reaction.

Q109. Write the balanced symbol equation for the reaction between magnesium and sulfuric acid.
Answer: $Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$

Q110. What is the ionic equation for the reaction between zinc and hydrochloric acid?
Answer: $Zn(s) + 2H^+(aq) \rightarrow Zn^{2+}(aq) + H_2(g)$

Q111. What are the products when an acid reacts with a metal carbonate?
Answer: The products are a salt, carbon dioxide gas, and water. This is a typical reaction between an acid and a metal carbonate, where the carbonate part reacts with the acid to produce carbon dioxide and water, and the metal forms a salt with the acid.

Q112. Describe the products formed when calcium carbonate reacts with nitric acid.
Answer: The reaction produces calcium nitrate, carbon dioxide gas, and water. Calcium carbonate reacts with the nitric acid where the carbonate part breaks down to form CO_2 and H_2O, and calcium forms a salt with the nitrate ions.

Q113. Write a word equation for the reaction between copper(II) oxide and sulfuric acid.
Answer: Copper(II) oxide + Sulfuric acid → Copper(II) sulfate + Water

Q114. Which acid and base combination would produce sodium sulfate?
Answer: Sulfuric acid and sodium hydroxide. When these react in a neutralisation reaction, they form sodium sulfate and water.

Q115. What are the products of the reaction between sodium hydroxide and hydrochloric acid?
Answer: The products are sodium chloride and water. This is a neutralisation reaction where the acid and base cancel each other out, producing a salt and water.

Q116. What salt is formed when potassium carbonate reacts with nitric acid?
Answer: Potassium nitrate is formed. The potassium from the carbonate combines with nitrate ions from the acid to form the salt, while carbon dioxide and water are also produced.

Q117. Why does magnesium react faster with hydrochloric acid than iron?
Answer: Magnesium reacts faster because it is more reactive than iron in the reactivity series. It

loses electrons more easily, which speeds up the reaction rate. This higher reactivity means that more hydrogen gas is produced more quickly when magnesium is added to acid.

Q118. How can you test for the presence of hydrogen gas in a metal-acid reaction?
Answer: You can test for hydrogen gas by using a lit splint. If hydrogen gas is present, it will burn with a squeaky pop sound. This simple test confirms the presence of hydrogen, which is commonly produced during metal-acid reactions.

Q119. What is the role of hydrogen ions in acid-metal reactions?
Answer: The hydrogen ions act as oxidising agents. They accept electrons from the metal, allowing the metal to be oxidised and the hydrogen ions to be reduced to hydrogen gas. Without hydrogen ions, the reaction between the acid and metal wouldn't occur.

Q120. Predict the salt formed when zinc carbonate reacts with sulfuric acid.
Answer: The salt formed is zinc sulfate. When zinc carbonate reacts with sulfuric acid, it produces zinc sulfate, carbon dioxide, and water. This is a typical acid-carbonate reaction.

Q121. What is observed when magnesium is added to dilute sulfuric acid?
Answer: You will see bubbles or fizzing, which is due to the production of hydrogen gas. The magnesium will slowly disappear as it reacts with the acid to form magnesium sulfate and hydrogen. The solution may also become slightly warm due to the exothermic nature of the reaction.

Q122. Explain why acid-metal reactions are examples of redox reactions.
Answer: Acid-metal reactions involve electron transfer. The metal loses electrons (oxidation) and the hydrogen ions in the acid gain those electrons (reduction). Since both oxidation and reduction occur together, these reactions are redox reactions.

Q123. In the reaction between iron and hydrochloric acid, what is the oxidising agent?
Answer: The oxidising agent is the hydrogen ions from hydrochloric acid. They cause iron to lose electrons and become iron ions while themselves gaining electrons and forming hydrogen gas.

Q124. In the same reaction, what is the reducing agent?
Answer: The reducing agent is the iron. It donates electrons to the hydrogen ions, causing them to be reduced to hydrogen gas, while the iron itself is oxidised.

Q125. How is a salt formed during a neutralisation reaction?
Answer: A salt is formed when an acid reacts with a base. The hydrogen ions from the acid combine with the hydroxide ions from the base to form water, and the remaining parts of the acid and base form the salt. For example, hydrochloric acid and sodium hydroxide produce sodium chloride and water.

Q126. What type of reaction occurs between an acid and a metal hydroxide?
Answer: A neutralisation reaction occurs between an acid and a metal hydroxide. In this reaction, the acid donates hydrogen ions, and the metal hydroxide provides hydroxide ions. These ions

combine to form water. The other product of the reaction is a salt, depending on the acid and the metal involved. This type of reaction reduces the acidity of the solution.

Q127. Why is water formed when an acid reacts with a base?

Answer: Water is formed because hydrogen ions (H^+) from the acid react with hydroxide ions (OH^-) from the base. These two ions combine to produce H_2O, which is water. This process is known as neutralisation. It reduces the concentration of hydrogen ions, thus lowering the acidity of the solution.

Q128. What is the ionic equation for the neutralisation of hydrochloric acid with sodium hydroxide?

Answer:

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

This shows that the hydrogen ion from hydrochloric acid reacts with the hydroxide ion from sodium hydroxide to form water. The sodium and chloride ions remain in the solution as spectator ions.

Q129. Which salt is produced when copper(II) carbonate reacts with nitric acid?

Answer: Copper(II) nitrate is produced when copper(II) carbonate reacts with nitric acid. The reaction also forms water and carbon dioxide. The name of the salt is based on the metal (copper) and the acid used (nitric acid), which gives the nitrate part of the salt.

Q130. What two products are always formed when an acid reacts with a carbonate?

Answer: The two products always formed when an acid reacts with a carbonate are carbon dioxide gas and water. In addition to these, a salt is also formed. The reaction is a typical acid-carbonate reaction and is often used to test for the presence of carbonates.

Q131. How can you test for carbon dioxide gas in a neutralisation reaction?

Answer: You can test for carbon dioxide by bubbling the gas through limewater. If carbon dioxide is present, the limewater will turn milky or cloudy. This reaction occurs because carbon dioxide reacts with calcium hydroxide in the limewater to form insoluble calcium carbonate, which causes the cloudy appearance.

Q132. What is the difference between a base and an alkali?

Answer: A base is any substance that can neutralise an acid, usually by accepting hydrogen ions. An alkali is a type of base that dissolves in water to produce hydroxide ions (OH^-). All alkalis are bases, but not all bases are alkalis. For example, copper(II) oxide is a base but not an alkali because it does not dissolve in water.

Q133. Explain why the choice of acid determines the name of the salt formed.

Answer: The name of the salt depends on the acid used because the acid provides the anion part of the salt. For example, hydrochloric acid forms chlorides, sulfuric acid forms sulfates, and nitric acid forms nitrates. The metal or base provides the cation part, and the acid determines the other half of the salt's name.

Q134. What determines the metal ion in the salt formed during neutralisation?
Answer: The metal ion in the salt comes from the base, alkali, or metal that reacts with the acid. For instance, if sodium hydroxide reacts with an acid, sodium will be the metal ion in the salt. The combination of this metal ion with the acid's anion determines the full name of the salt.

Q135. Predict the salt formed from the reaction between calcium oxide and nitric acid.
Answer: The salt formed is calcium nitrate. Calcium oxide acts as a base and reacts with nitric acid to form calcium nitrate and water. The name of the salt comes from the metal in the oxide (calcium) and the acid used (nitric acid, which gives nitrate).

Q136. What are the products when iron reacts with sulfuric acid?
Answer: When iron reacts with sulfuric acid, the products are iron(II) sulfate and hydrogen gas. The acid reacts with the metal to form a salt and release hydrogen gas as a result of the displacement of hydrogen ions by the metal.

Q137. Write a balanced equation for the reaction between magnesium and hydrochloric acid.
Answer:
Balanced Equation: $Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$
This shows that magnesium reacts with hydrochloric acid to form magnesium chloride and hydrogen gas.

Q138. What observations would indicate a reaction is occurring between a metal and acid?
Answer: You might observe fizzing or bubbling due to the production of hydrogen gas. The metal may slowly disappear as it reacts, and the temperature may increase slightly. If the solution is in a test tube, you may also hear a popping sound if hydrogen gas is tested with a lit splint.

Q139. What type of salt is formed from hydrochloric acid?
Answer: Hydrochloric acid forms chloride salts. The metal or base involved in the reaction will determine the first part of the salt's name, while the acid (hydrochloric acid) determines that the second part will be "chloride." For example, sodium hydroxide with hydrochloric acid forms sodium chloride.

Q140. What salt would be formed from the reaction between sodium carbonate and sulfuric acid?
Answer: Sodium sulfate is the salt formed. Sulfuric acid provides the sulfate ion, and sodium comes from sodium carbonate. The reaction also produces water and carbon dioxide gas, as is typical for acid-carbonate reactions.

Q141. What is the name of the salt produced from potassium hydroxide and nitric acid?
Answer: The salt produced is potassium nitrate. Potassium comes from the base (potassium hydroxide), and the nitrate part comes from the nitric acid. Water is also formed in this neutralisation reaction.

Q142. Write a balanced symbol equation for the reaction between zinc and nitric acid.
Answer:
Balanced Equation: $Zn(s) + 2HNO_3(aq) \rightarrow Zn(NO_3)_2(aq) + H_2(g)$
This equation shows that zinc reacts with nitric acid to form zinc nitrate and hydrogen gas.

Q143. Explain why no reaction occurs between copper and dilute acids under normal conditions.
Answer: Copper is less reactive than hydrogen and is below hydrogen in the reactivity series. This means copper cannot displace hydrogen ions from acids to produce hydrogen gas. As a result, no reaction occurs under normal conditions with dilute acids like hydrochloric or sulfuric acid.

Q144. What type of reaction occurs when an acid reacts with a metal oxide?
Answer: A neutralisation reaction occurs. The acid reacts with the metal oxide (a base) to produce a salt and water. No gas is produced in this type of reaction. The reaction helps reduce the acidity of the acid by neutralising it with the oxide.

Q145. Write a word equation for the reaction between iron(III) oxide and hydrochloric acid.
Answer:
Word Equation: Iron(III) oxide + Hydrochloric acid → Iron(III) chloride + Water
This shows that the metal oxide reacts with the acid to form a salt (iron(III) chloride) and water.

Q146. Predict the salt formed when magnesium reacts with nitric acid.
Answer: The salt formed is magnesium nitrate. Magnesium reacts with nitric acid to displace hydrogen and form magnesium nitrate. Hydrogen gas is also released during the reaction.

Q147. Why is carbon dioxide formed when an acid reacts with a metal carbonate?
Answer: Carbonates contain the carbonate ion (CO_3^{2-}), which reacts with hydrogen ions from the acid. This reaction produces carbon dioxide gas, water, and a salt. The CO_2 forms as a result of the breakdown of the carbonate ion when it reacts with the acid.

Q148. How can you determine the formula of a salt formed in a given acid-base reaction?
Answer: Identify the metal or base to find the positive ion and the acid to determine the negative ion. Then combine them using their charges to create a neutral compound. For example, if potassium hydroxide (K^+) reacts with sulfuric acid (SO_4^{2-}), the salt is K_2SO_4, as two potassium ions are needed to balance the sulfate ion.

Q149. What is the general formula for a salt formed from a metal and hydrochloric acid?
Answer: The general formula is MCl or MCl_2, depending on the charge of the metal ion. For example, sodium (Na^+) reacts to form NaCl, while magnesium (Mg^{2+}) forms $MgCl_2$. The salt's formula reflects the metal ion's charge balanced with chloride ions.

Q150. Write the full chemical equation for the reaction between calcium carbonate and sulfuric acid.
Answer:

Chemical Equation: $CaCO_3(s) + H_2SO_4(aq) \rightarrow CaSO_4(aq) + H_2O(l) + CO_2(g)$
This equation shows that calcium carbonate reacts with sulfuric acid to produce calcium sulfate, water, and carbon dioxide gas.

Q151. How do you make a pure, dry sample of a soluble salt from an insoluble oxide?
Answer: To make a pure, dry sample of a soluble salt from an insoluble oxide, you start by warming a dilute acid, such as sulfuric acid, in a beaker. Then, you gradually add the insoluble metal oxide, like copper(II) oxide, while stirring. The oxide reacts with the acid to form a soluble salt and water. You keep adding the oxide until no more reacts. This ensures all the acid has been used. Next, you filter the mixture to remove the excess solid. The filtrate contains the salt solution. You then heat the solution gently to evaporate some water, and finally, leave it to cool so crystals form. These are pure, dry salt crystals once dried.

Q152. What is the role of a Bunsen burner in preparing a pure sample of a soluble salt?
Answer: A Bunsen burner is used to gently heat the dilute acid before adding the insoluble oxide. Warming the acid increases the rate of reaction between the acid and the oxide, making the process faster and more effective. It is also used later to gently heat the filtered salt solution to evaporate some water and start the crystallisation process.

Q153. How is dilute acid used in the preparation of a soluble salt from a carbonate?
Answer: Dilute acid reacts with the insoluble carbonate to produce a soluble salt, water, and carbon dioxide gas. The carbonate is added to the warm acid until it stops fizzing, which shows the reaction is complete. The solution is then filtered to remove any unreacted carbonate, and the salt solution is evaporated to obtain the dry salt.

Q154. Why is excess solid filtered off during the preparation of a salt solution?
Answer: The excess solid is filtered off to remove any unreacted oxide or carbonate that was added to ensure all the acid had been used up. This ensures that the resulting salt solution contains only the dissolved salt and not any impurities or unreacted materials. It helps in making the final salt sample pure.

Q155. What is the purpose of heating the acid in the preparation of a salt solution?
Answer: Heating the acid speeds up the reaction with the insoluble oxide or carbonate, helping the reaction go to completion faster. It also ensures that the salt dissolves properly in the solution. Heating helps produce a salt solution ready for filtration and later evaporation.

Q156. How does evaporating the salt solution help in obtaining pure, dry salt crystals?
Answer: Evaporating the salt solution reduces the amount of water, making the solution more concentrated. As the solution cools, the salt comes out of the solution and forms crystals. This crystallisation process helps in obtaining pure, dry salt crystals, which can then be filtered out and dried.

Q157. What type of apparatus can be used as an alternative to a water bath for evaporating a solution?

Answer: An evaporating basin placed on a tripod stand and gauze mat over a Bunsen burner can be used instead of a water bath. You need to heat it gently to avoid splashing or overheating, which can damage the salt or cause loss of product. It is important to control the heat carefully.

Q158. Why must the solid reactant be added until no more reacts with the acid?

Answer: The solid reactant is added until no more reacts to make sure all the acid has been used up. This prevents any acid from being left in the final salt solution, which would make the salt impure. It also ensures the correct amount of salt is formed from the full reaction.

Q159. What role does filtration play in the process of making a soluble salt?

Answer: Filtration is used to remove any excess unreacted solid material from the salt solution. This step helps ensure that the solution only contains the dissolved salt. It is important for getting a clean and pure solution that will later be evaporated to form pure salt crystals.

Q160. Describe how you would ensure that the salt obtained is pure.

Answer: To ensure the salt is pure, you must use an excess of the insoluble reactant to use up all the acid. After the reaction, filter the solution to remove any excess solid. Then evaporate the solution carefully and allow it to cool so crystals form. Finally, dry the crystals completely. Avoid overheating or contamination at any stage.

Q161. How can the use of a water bath improve the evaporation process of a salt solution?

Answer: A water bath provides gentle and even heating, which reduces the risk of overheating the salt solution. This prevents the salt from decomposing or splattering, which can happen if heated directly with a Bunsen burner. It helps in controlled evaporation and better crystal formation.

Q162. What is the importance of using an insoluble oxide or carbonate in this preparation?

Answer: Using an insoluble oxide or carbonate allows you to add it in excess to make sure all the acid reacts. Any unreacted solid can easily be filtered out after the reaction. This helps produce a pure salt solution, free from acid and unwanted materials, which is important for getting pure crystals.

Q163. Explain the steps involved in crystallising a salt from its solution.

Answer: First, heat the salt solution gently to evaporate some water and make it concentrated. Then remove the heat and let the solution cool slowly. As it cools, crystals of the salt begin to form. These are collected by filtration, then rinsed and left to dry completely. This process ensures you get pure, dry salt crystals.

Q164. How does the presence of excess insoluble material affect the quality of the salt produced?

Answer: The excess insoluble material itself doesn't react and can be easily filtered off, so it doesn't affect the salt quality if removed properly. However, if not filtered thoroughly, bits of unreacted material may remain and contaminate the salt, making it impure. So proper filtration is important.

Q165. Why is it important to control the heating during the evaporation of the salt solution?
Answer: Controlling the heating prevents the salt from decomposing or forming very small crystals. Gentle heating also avoids splashing and helps better quality crystals to grow as the solution cools. Too much heat can spoil the salt or cause loss of product, so it must be done carefully.

Q166. What precautions should be taken when using a Bunsen burner in the lab?
Answer: Always keep flammable materials away, tie back long hair, and never leave the Bunsen burner unattended while it's on. Use a safety flame when not actively heating, and handle hot equipment with care. Also, make sure your work area is clear and follow all teacher or lab safety instructions.

Q167. How does the reaction between an insoluble carbonate and dilute acid lead to the formation of a salt?
Answer: When an insoluble carbonate reacts with dilute acid, the acid breaks down the carbonate to form a salt, carbon dioxide gas, and water. The gas is seen as fizzing or bubbling. Once the reaction stops, the remaining mixture contains the dissolved salt, which can be separated and crystallised.

Q168. What happens to the carbon dioxide produced during the reaction of a carbonate with an acid?
Answer: The carbon dioxide is released as a gas during the reaction and escapes into the air. It causes bubbling or fizzing in the solution, which stops when the reaction is complete. This gas does not stay in the solution or affect the salt being produced.

Q169. Describe the method used to remove impurities from the salt solution before evaporation.
Answer: After the reaction is complete, the mixture is filtered to remove any unreacted solid materials. Only the clear salt solution passes through the filter paper into the beaker below. This removes impurities, leaving a clean solution ready for evaporation and crystallisation.

Q170. How can you check that a salt solution is ready to be evaporated?
Answer: Once the solid stops reacting with the acid and you've filtered the solution to remove any excess solid, the clear solution left behind is ready for evaporation. It should not be cloudy or have any solids remaining. If needed, a small sample can be tested for salt content before proceeding.

Q171. Explain why pure dry samples of salts are important for chemical analysis.
Answer: Pure dry salts are needed to get accurate results in chemical tests and experiments. Impurities can affect the reactions, give false readings, or damage equipment. Dry samples also allow you to measure the correct amount of the salt without including water weight or contamination.

Q172. How does a wide range indicator help in measuring the pH of a solution?
Answer: A wide range indicator shows a different colour for each pH level, usually from pH 1 to 14. This makes it easier to estimate the pH of a solution just by looking at the colour it turns. It gives a quick way to see if a solution is acidic, neutral, or alkaline.

Q173. What does a pH value below 7 indicate about a solution?

Answer: A pH value below 7 means the solution is acidic. The lower the pH number, the stronger the acid. For example, a solution with pH 2 is more acidic than one with pH 6. Acids have more hydrogen ions (H^+), which is what causes the low pH.

Q174. How can a pH probe be used to determine the acidity of a solution?

Answer: A pH probe is placed in the solution and connected to a digital meter. It gives an exact numerical reading of the solution's pH. It is more accurate than using indicator paper or colour charts and is useful for measuring small changes in pH during reactions.

Q175. What is the meaning of pH 7 in terms of solution neutrality?

Answer: A pH of 7 means the solution is neutral, which means it is neither acidic nor alkaline. Pure water has a pH of 7. In a neutral solution, the number of hydrogen ions and hydroxide ions is equal, so they balance each other out.

Q176. How does universal indicator show the approximate pH of a solution?

Answer: Universal indicator is a mixture of dyes that changes colour depending on the pH of a solution. It helps to identify whether a solution is acidic, neutral, or alkaline. For example, it turns red in strong acids, green in neutral solutions, and purple in strong alkalis. By comparing the colour to a pH scale chart, we can estimate the solution's pH value approximately.

Q177. Why might it be necessary to use an indicator to measure pH in a practical experiment?

Answer: An indicator is used in experiments to show changes in pH levels. It helps to visually track whether a solution is acidic, neutral, or alkaline. This is important in reactions such as neutralisation where knowing the exact point of pH change matters. Without an indicator, it would be difficult to tell when the reaction is complete or how acidic or alkaline a solution is.

Q178. Explain what is meant by an acidic solution in terms of hydrogen ion concentration.

Answer: An acidic solution is one that has a high concentration of hydrogen ions (H^+). The more H^+ ions present in the solution, the stronger the acid. Acids release hydrogen ions when dissolved in water. The presence of these ions causes the pH value to be below 7, with stronger acids having a lower pH due to a greater concentration of H^+ ions.

Q179. How is the pH scale used to identify an alkaline solution?

Answer: The pH scale ranges from 0 to 14. A solution with a pH above 7 is considered alkaline. The higher the pH, the stronger the alkali. For example, a pH of 8 or 9 indicates a weak alkali, while a pH close to 14 indicates a strong alkali. Alkaline solutions contain a high concentration of hydroxide ions (OH^-), which makes them basic.

Q180. What type of color change might you observe when using universal indicator in an acid?

Answer: When universal indicator is added to an acid, it changes colour to shades of red, orange, or yellow depending on how strong the acid is. A strong acid usually turns the indicator red, a

medium-strength acid gives an orange colour, and a weak acid turns it yellow. This colour change helps estimate the pH level of the acid.

Q181. Describe the visual indication provided by a pH probe when measuring an alkaline solution.

Answer: A pH probe gives a digital reading that shows the pH value of the solution. For an alkaline solution, the reading would be above 7. The stronger the alkali, the higher the number shown on the display, which can go up to 14. Unlike colour indicators, a pH probe provides an accurate numerical value for the pH of the solution.

Q182. How can you tell if a solution is neutral using the pH scale?

Answer: A neutral solution has a pH of exactly 7. On the pH scale, 7 is the midpoint between acidic and alkaline values. A pH probe would show a reading of 7, and a universal indicator would turn green. This tells us that the solution has equal amounts of hydrogen ions (H^+) and hydroxide ions (OH^-), making it neutral.

Q183. Why is it important to know the pH of a solution when performing neutralisation reactions?

Answer: Knowing the pH of a solution helps determine when the reaction between the acid and alkali is complete. During neutralisation, the acid and alkali cancel each other out, forming a neutral solution. Monitoring pH ensures the correct amount of acid and alkali are used and helps avoid making the solution too acidic or too alkaline after the reaction.

Q184. What happens during the neutralisation reaction between an acid and an alkali?

Answer: During neutralisation, the hydrogen ions (H^+) from the acid react with the hydroxide ions (OH^-) from the alkali to form water. This reaction reduces the acidity or alkalinity of the solution. A salt is also formed as a product of the reaction. The pH of the solution moves closer to 7 as the reaction proceeds.

Q185. How do hydrogen ions and hydroxide ions interact in a neutralisation reaction?

Answer: In a neutralisation reaction, the hydrogen ions (H^+) from the acid combine with the hydroxide ions (OH^-) from the alkali to produce water (H_2O). This process removes the ions responsible for acidity and alkalinity, resulting in a solution that is more neutral. The reaction is represented as: $H^+ + OH^- \rightarrow H_2O$.

Q186. Write a simple word equation to show the reaction between an acid and an alkali.

Answer:

Word Equation: Acid + Alkali → Salt + Water

For example: Hydrochloric acid + Sodium hydroxide → Sodium chloride + Water.

Q187. How does the pH scale assist in predicting the products of a neutralisation reaction?

Answer: The pH scale helps to monitor the progress of the neutralisation reaction. As the acid reacts with the alkali, the pH changes from low (acidic) to neutral (pH 7) and then to high (alkaline) if too

much alkali is added. By checking the pH during the reaction, we can predict that once a neutral pH is reached, water and a salt have been formed as products.

Q188. What information does a wide range indicator provide about a salt solution?
Answer: A wide range indicator can show the approximate pH of a salt solution. After a neutralisation reaction, it helps to check whether the resulting salt solution is acidic, neutral, or alkaline. For example, if a salt solution turns the indicator green, it suggests that the solution is neutral. Other colours can indicate that the salt formed is from a weak acid or alkali.

Q189. How can you use the pH scale to control the progress of a neutralisation experiment?
Answer: During a neutralisation experiment, measuring the pH helps track how close the solution is to being neutral. By regularly checking the pH with a probe or indicator, small amounts of acid or alkali can be added to slowly approach a pH of 7. This prevents overshooting the neutral point and ensures that the reaction is completed accurately.

Q190. What does a pH reading above 7 imply about the characteristics of a solution?
Answer: A pH reading above 7 means the solution is alkaline. The higher the pH, the stronger the alkali. Alkaline solutions have more hydroxide ions (OH^-) than hydrogen ions (H^+). Common alkaline substances include sodium hydroxide and ammonia. A pH close to 14 indicates a very strong alkali, while a pH of 8 or 9 shows a weak alkali.

Q191. How can you demonstrate that a solution has been neutralised using a pH probe?
Answer: A pH probe gives a digital reading of the solution's pH. During a neutralisation reaction, the probe reading will gradually move toward 7. When the pH reaches exactly 7, the probe confirms that the solution is neutral. This indicates that the acid and alkali have reacted completely and no excess of either remains.

Q192. What role does water play in the neutralisation reaction?
Answer: Water is formed as a product when hydrogen ions from the acid react with hydroxide ions from the alkali. The creation of water is what makes the solution neutral. It shows that the acidic and alkaline components have been cancelled out. The formation of water is the key result of neutralisation and helps reduce the pH change.

Q193. How can the use of universal indicator improve the accuracy of pH measurements in the lab?
Answer: Universal indicator offers a clear visual sign of the pH of a solution by changing colour across a wide range. By matching the colour to a chart, you can estimate the pH more accurately than with a single-colour indicator. This helps in experiments where tracking pH changes is important, such as in neutralisation reactions or acid-base titrations.

Q194. Explain how you would prepare a salt solution from an insoluble carbonate.
Answer: First, warm the acid gently in a beaker. Then slowly add the insoluble carbonate to the acid a little at a time until no more reacts. This means all the acid has been used up. Filter the mixture to

remove the excess carbonate. The liquid left is a salt solution. Heat it gently to evaporate some of the water, then leave it to cool so crystals form.

Q195. Why is it important to heat the acid slowly when preparing a salt solution?

Answer: Heating the acid slowly ensures it doesn't boil or splash, which can be dangerous. It also prevents the acid from breaking down or reacting too quickly. Controlled heating helps the reaction proceed steadily, improving the safety and accuracy of the salt preparation. Slow heating also avoids damaging the salt that forms later in the experiment.

Q196. Describe the changes you expect to see in the solution as it is heated to evaporate the water.

Answer: As the solution is heated, steam starts to rise, and the volume of liquid slowly reduces. The solution becomes more concentrated. After some time, salt crystals begin to appear as the water continues to evaporate. Eventually, most of the water will be gone, leaving behind a solid layer of salt crystals at the bottom of the container.

Q197. How can you ensure that the salt crystals formed are dry and free of impurities?

Answer: To dry the crystals, gently blot them with filter paper to remove surface moisture. Leave them in a warm, dry place to air dry completely. To ensure purity, make sure excess carbonate was filtered out before crystallisation. Avoid overheating, which can damage the crystals. Washing the crystals briefly with a small amount of cold distilled water can also remove surface impurities.

Q198. What steps are taken to confirm that no additional reaction occurs once the salt is fully dissolved?

Answer: You stop adding the insoluble carbonate once no more reacts, meaning the acid is used up. Filtering the mixture removes the unreacted solid. Heating the filtered solution to form crystals confirms the reaction is complete. The fact that no gas is released and no more solid dissolves shows the reaction has ended and the salt is fully formed.

Q199. How does the concentration of the acid affect the formation of the salt solution?

Answer: A more concentrated acid has more hydrogen ions, so it reacts faster and forms more salt in a shorter time. However, using too strong an acid might cause the reaction to be too vigorous. A dilute acid makes the reaction slower but safer. The concentration also affects how much carbonate is needed to fully react with the acid.

Q200. What safety measures should be followed when evaporating a salt solution using an electric heater?

Answer: Always wear safety goggles and gloves to protect from hot liquids or splashes. Use heat-resistant glassware and keep it on a heatproof mat. Do not leave the solution unattended while heating. Keep flammable materials away from the heater. Ensure the area is well-ventilated and switch off the heater once enough water has evaporated. Let the solution cool before handling it.

Q201. What piece of equipment is used to accurately measure the volume of alkali in a titration?

Answer: A burette is used to accurately measure the volume of alkali in a titration. It is a long, graduated glass tube with a tap at the bottom, which allows precise control over the amount of liquid released. The burette helps to measure the volume of the alkali added to the acid in small, exact amounts until the reaction reaches its end point.

Q202. What is the purpose of using an indicator in a titration?

Answer: An indicator is used in a titration to show when the acid and alkali have completely reacted. It changes colour at a specific pH level, signalling the end point of the reaction. Without an indicator, it would be difficult to know when to stop adding the alkali or acid, and the results would not be accurate.

Q203. Why should you swirl the conical flask during a titration?

Answer: Swirling the conical flask during a titration ensures that the acid and alkali mix thoroughly with each drop added. This helps the reaction happen evenly and prevents one side of the solution from reacting faster than the other. It also avoids adding too much of the titrant before the colour change is noticed.

Q204. How can you tell when a titration has reached the end point?

Answer: The end point of a titration is seen when the indicator changes colour, showing that the acid and alkali have reacted completely. This colour change happens suddenly and stays constant with further swirling. You must stop adding more solution as soon as this happens to avoid overshooting the result.

Q205. Which type of indicator is most suitable for a titration between a strong acid and a strong alkali?

Answer: For a titration between a strong acid and a strong alkali, either phenolphthalein or methyl orange can be used. However, phenolphthalein is commonly preferred because it gives a clear colour change from colourless in acid to pink in alkali near the neutral point of the reaction.

Q206. Describe how to rinse the burette before starting a titration.

Answer: Before starting a titration, rinse the burette first with distilled water to clean out any residue. Then rinse it with the alkali solution that will be used in the titration. This prevents dilution of the solution and ensures accuracy. Let some solution flow through the tap to fill the nozzle and remove air bubbles.

Q207. What is the correct method for reading the volume in a burette?

Answer: The correct method is to read the volume from the bottom of the meniscus, which is the curved surface of the liquid. Your eyes should be level with the meniscus to avoid parallax error. The reading is taken to the nearest 0.05 cm^3 for accuracy.

Q208. Why is it important to repeat the titration and take an average of concordant results?
Answer: Repeating the titration helps identify and eliminate errors, and taking an average of concordant results—those within 0.10 cm^3 of each other—gives a more reliable and accurate value. It also increases confidence in the consistency and accuracy of the experiment.

Q209. Describe how to fill a pipette safely and accurately.
Answer: Use a pipette filler to draw the liquid into the pipette safely, avoiding the use of your mouth. Fill it just above the calibration mark, then gently release some liquid until the bottom of the meniscus is exactly on the mark. Wipe the pipette tip before transferring the liquid into the conical flask.

Q210. What is meant by a concordant result in titration?
Answer: A concordant result in titration refers to titration readings that are very close to each other, typically within 0.10 cm^3. Concordant results show consistency and reliability, indicating that the titration was done carefully and accurately.

Q211. What is the function of the white tile used during titration?
Answer: The white tile is placed under the conical flask during titration to make it easier to see the colour change of the indicator. This helps in identifying the exact end point of the reaction clearly, especially when using indicators that produce faint or light colours.

Q212. Describe the steps involved in setting up a titration.
Answer: First, rinse and fill the burette with the solution to be added (usually alkali), and set it vertically in a clamp stand. Use a pipette and filler to transfer a fixed volume of the other solution (usually acid) into a conical flask. Add a few drops of a suitable indicator to the flask. Place the flask on a white tile and slowly add the alkali from the burette while swirling until the indicator shows the end point.

Q213. Why must the acid or alkali be added slowly near the end point of a titration?
Answer: Near the end point, the solution is almost neutral, so only a small amount of acid or alkali is needed to complete the reaction. Adding it slowly helps avoid overshooting the end point, which would give an inaccurate result. A sudden addition could cause the indicator to change too quickly and miss the exact volume needed.

Q214. How can the concentration of an unknown acid be determined using titration?
Answer: The concentration of an unknown acid can be determined by titrating it with a solution of known concentration (usually an alkali). Measure the volume of alkali required to neutralise a known volume of the acid. Use the balanced chemical equation to find the mole ratio and then apply the concentration formula to calculate the acid's concentration.

Q215. In a titration, what volume measurements must be taken to calculate concentration?
Answer: You must measure the volume of the acid or alkali delivered from the burette (final reading minus initial reading) and the fixed volume of the solution in the conical flask, usually measured with a

pipette. These volumes are used along with the known concentration of one reactant to find the concentration of the unknown.

Q216. What are the units of concentration when calculated in mol/dm³?

Answer: The units of concentration when calculated in mol/dm³ are simply mol/dm³. This means moles of solute per cubic decimetre of solution. It shows how many moles of the substance are present in every 1 dm³ of solution.

Q217. What formula is used to calculate concentration in mol/dm³ from moles and volume?

Answer:

Answer:

Formula: Concentration (mol/dm³) = Moles ÷ Volume (dm³)

Solution: First convert the volume from cm³ to dm³ by dividing by 1000. Then divide the number of moles of solute by this volume in dm³ to get the concentration in mol/dm³.

Q218. How is concentration in g/dm³ calculated from mol/dm³?

Answer:

Formula: Concentration (g/dm³) = Concentration (mol/dm³) × Relative formula mass (Mr)

Solution: Multiply the concentration in mol/dm³ by the Mr of the solute. This gives the mass of solute in grams present in each dm³ of solution.

Q219. What information must be known to calculate the number of moles in a titration?

Answer: To calculate the number of moles in a titration, you need the concentration of the solution (in mol/dm³) and the volume used (in dm³). Use the formula: moles = concentration × volume. Volume must be converted into dm³ before using the formula.

Q220. What is the molar ratio in the reaction between hydrochloric acid and sodium hydroxide?

Answer: The reaction between hydrochloric acid (HCl) and sodium hydroxide (NaOH) is a neutralisation reaction and follows a 1:1 molar ratio. One mole of HCl reacts with one mole of NaOH to produce one mole of sodium chloride and one mole of water.

Q221. How do you calculate the number of moles of acid from its volume and concentration?

Answer:

Formula: Moles = Concentration (mol/dm³) × Volume (dm³)

Solution: First, convert the volume from cm³ to dm³ by dividing by 1000. Then multiply the concentration by the volume in dm³ to calculate the number of moles of acid present in the solution.

Q222. How can you calculate the mass of solute in a solution using concentration and volume?

Answer:

Formula: Mass (g) = Concentration (g/dm³) × Volume (dm³)

Solution: Convert the volume into dm^3 if needed, then multiply by the concentration in g/dm^3. This will give the total mass of solute in grams in that volume of solution.

Q223. What is the key difference between a strong acid and a weak acid?
Answer: A strong acid fully ionises in water, releasing all of its hydrogen ions. A weak acid only partially ionises, meaning only a few of its molecules release hydrogen ions. As a result, strong acids are more reactive and have lower pH values compared to weak acids at the same concentration.

Q224. Why does a strong acid have a lower pH than a weak acid of the same concentration?
Answer: A strong acid has a lower pH because it releases more hydrogen ions (H^+) into the solution. The higher the concentration of hydrogen ions, the lower the pH. A weak acid, on the other hand, only releases some hydrogen ions, so it has a higher pH than a strong acid of the same concentration.

Q225. Give an example of a weak acid and explain its behaviour in water.
Answer: Ethanoic acid (CH_3COOH) is an example of a weak acid. When dissolved in water, only a small fraction of its molecules ionise to release hydrogen ions. Most of the acid remains as whole molecules. This limited ionisation makes ethanoic acid less reactive and gives it a higher pH than a strong acid at the same concentration.

Q226. What does it mean for an acid to be fully ionised in solution?
Answer: When an acid is fully ionised in solution, it means that all the acid molecules break apart completely into hydrogen ions (H^+) and their corresponding negative ions. This happens in strong acids like hydrochloric acid, where no un-ionised acid molecules are left in the solution. The result is a high concentration of hydrogen ions, which makes the acid highly reactive and gives it a low pH.

Q227. Why does a weak acid conduct electricity less well than a strong acid?
Answer: A weak acid only partially ionises in solution, meaning only a small fraction of its molecules release hydrogen ions. This results in fewer charged particles (ions) that can carry an electric current. In contrast, a strong acid fully ionises, producing more ions, so it conducts electricity better. The fewer ions present in a weak acid make it a poorer conductor.

Q228. What is the effect on hydrogen ion concentration when the pH drops by one unit?
Answer: When the pH of a solution drops by one unit, the hydrogen ion concentration increases by a factor of 10. This is because the pH scale is logarithmic, meaning each decrease of 1 on the scale represents a tenfold increase in H^+ ion concentration. For example, if the pH drops from 5 to 4, the solution becomes ten times more acidic.

Q229. Explain why the pH scale is logarithmic.
Answer: The pH scale is logarithmic because it is based on the concentration of hydrogen ions in a solution, which can vary greatly. A logarithmic scale allows large differences in concentration to be shown in a simpler form. For example, a change in pH from 3 to 2 represents a tenfold increase in H^+ concentration. This type of scale makes it easier to compare acidity levels.

Q230. What happens to the pH of a solution when it becomes ten times more acidic?
Answer: When a solution becomes ten times more acidic, its pH decreases by 1 unit. This is because the pH scale is logarithmic, so a tenfold increase in hydrogen ion concentration corresponds to a 1-unit drop in pH. For example, if the pH changes from 6 to 5, the solution is now ten times more acidic than before.

Q231. How does concentration differ from strength in acids?
Answer: Strength of an acid refers to how completely it ionises in solution. A strong acid fully ionises, while a weak acid only partially ionises. Concentration, on the other hand, refers to how much acid is dissolved in a certain volume of solution. You can have a dilute strong acid or a concentrated weak acid. Strength is about ionisation; concentration is about the amount of acid.

Q232. What does it mean for a solution to be concentrated?
Answer: A concentrated solution contains a large amount of solute (such as acid or base) dissolved in a small amount of solvent, usually water. It means the particles of the solute are densely packed in the solution. This does not necessarily mean the acid or base is strong; it just means there is a high quantity of the substance per unit volume of solution.

Q233. What does it mean for a solution to be dilute?
Answer: A dilute solution has a small amount of solute dissolved in a larger amount of solvent. In the case of acids or bases, it means fewer acid or base particles are present in a given volume of water. A dilute solution can still contain a strong acid if the acid that is present is fully ionised, but there just isn't much of it in the solution.

Q234. How can pH values be used to compare the strengths of two acids?
Answer: pH values can indicate the concentration of hydrogen ions in solution. A lower pH means a higher concentration of H^+ ions, which usually suggests a stronger acid if concentration is the same. If two acids have the same concentration but different pH values, the one with the lower pH is stronger because it releases more hydrogen ions into the solution.

Q235. Why might two acids of equal concentration have different pH values?
Answer: Two acids of equal concentration might have different pH values because they have different strengths. A strong acid ionises completely, releasing more hydrogen ions and resulting in a lower pH. A weak acid only partially ionises, releasing fewer hydrogen ions, leading to a higher pH. So, strength affects how many H^+ ions are in solution, changing the pH.

Q236. Describe how a pH probe can be used to monitor acid strength.
Answer: A pH probe is an electronic device that measures the hydrogen ion concentration in a solution and displays the pH. To monitor acid strength, you place the probe into the acid solution and record the pH value. A lower pH suggests a stronger acid. Comparing pH values of acids with the same concentration helps determine which acid is stronger based on ionisation.

Q237. How does hydrogen ion concentration affect the acidity of a solution?
Answer: The higher the hydrogen ion concentration in a solution, the more acidic it is. Acidity increases as more H^+ ions are present, which lowers the pH. Conversely, if there are fewer hydrogen ions, the solution is less acidic and the pH is higher. So, hydrogen ion concentration directly controls how acidic a solution is.

Q238. Describe how you would compare the strength of hydrochloric acid and ethanoic acid.
Answer: To compare their strengths, use equal concentrations of hydrochloric acid (a strong acid) and ethanoic acid (a weak acid), and measure their pH using a pH probe. Hydrochloric acid will have a lower pH due to full ionisation, while ethanoic acid will have a higher pH because it ionises only slightly. This difference shows that hydrochloric acid is stronger.

Q239. What is meant by the term "ionisation" in the context of acids in solution?
Answer: Ionisation in acids refers to the process where acid molecules break apart in water to form hydrogen ions (H^+) and negative ions. Strong acids ionise completely, releasing all their hydrogen ions, while weak acids only release some. This process is key to how acids behave in chemical reactions and affects their conductivity and pH.

Q240. How is water formed in a neutralisation reaction?
Answer: In a neutralisation reaction, water is formed when hydrogen ions (H^+) from the acid combine with hydroxide ions (OH^-) from the base. This produces H_2O, or water. The reaction removes the acidic and basic properties, resulting in a neutral solution. This is the main reaction in acid-base neutralisation.

Q241. Describe what happens to hydrogen ions during a neutralisation reaction.
Answer: During a neutralisation reaction, hydrogen ions (H^+) from the acid react with hydroxide ions (OH^-) from the base. These ions combine to form water (H_2O). As a result, the number of free hydrogen ions decreases, reducing the acidity of the solution and making it neutral if the right amounts are used.

Q242. How does the hydrogen ion concentration change in a neutral solution?
Answer: In a neutral solution, the hydrogen ion concentration is equal to the hydroxide ion concentration. This balance means the pH is 7, which is neutral. There are still H^+ ions present, but they are in equal numbers to OH^- ions, so the solution is neither acidic nor alkaline.

Q243. Explain how changes in pH relate to changes in ion concentration.
Answer: pH is based on the concentration of hydrogen ions. A small change in pH reflects a large change in ion concentration because the pH scale is logarithmic. For every decrease of 1 in pH, the hydrogen ion concentration increases tenfold. So a pH change from 6 to 4 means the solution is 100 times more acidic.

Q244. What is the pH of a neutral solution and why?
Answer: The pH of a neutral solution is 7. This is because, in a neutral solution, the concentration of

hydrogen ions is equal to the concentration of hydroxide ions. This balance means the solution is neither acidic nor alkaline. Pure water is a common example of a neutral solution with pH 7.

Q245. Why is it important to use precise measurements in titration?
Answer: Precise measurements in titration are important to ensure accurate and reliable results. Even small errors in the volume of acid or base can lead to incorrect conclusions about the concentration of a solution. Accuracy is especially critical when calculating unknown concentrations or finding the exact point of neutralisation.

Q246. How can titration results be used to identify an unknown concentration?
Answer: In a titration, you add a solution of known concentration to a solution of unknown concentration until neutralisation is reached. By measuring the volume of the known solution used, you can calculate the unknown concentration using the titration formula and balanced equation. This allows for the precise determination of the unknown.

Q247. In titration, how do you determine the volume of acid needed to neutralise a base?
Answer: To find the volume of acid needed to neutralise a base, you slowly add the acid from a burette into the base while stirring and using an indicator or pH probe to detect when neutralisation occurs. The volume at the neutral point is recorded, usually after repeating the process for accuracy. This gives the exact amount needed.

Q248. How does a strong alkali behave in aqueous solution?
Answer: A strong alkali fully ionises in water to release hydroxide ions (OH^-). For example, sodium hydroxide dissolves completely and provides a high concentration of OH^- ions. This makes the solution strongly alkaline with a high pH, usually above 12, and gives it the ability to neutralise acids effectively.

Q249. What is the balanced symbol equation for the reaction between nitric acid and sodium hydroxide?
Answer:
Solution: $HNO_3 + NaOH \rightarrow NaNO_3 + H_2O$
This shows nitric acid reacting with sodium hydroxide to form sodium nitrate and water, which is a typical acid-base neutralisation reaction.

Q250. Describe the effect of adding a strong acid to a weak alkali on the pH of the solution.
Answer: When you add a strong acid to a weak alkali, the acid begins to neutralise the alkali. Because the alkali is weak and only partially ionised, it cannot neutralise the acid effectively. As a result, the solution becomes more acidic and the pH drops significantly. The final pH depends on the amounts and strengths of both.

Q251. What happens to the ions in an ionic compound when it is melted?
Answer: When an ionic compound is melted, the strong forces between the ions are broken,

allowing the ions to move freely. The solid turns into a liquid, and the ions are no longer held in fixed positions. This free movement of ions makes the molten compound able to conduct electricity.

Q252. Why can molten ionic compounds conduct electricity?
Answer: Molten ionic compounds can conduct electricity because their ions are free to move. In the molten state, the lattice of the solid breaks down, allowing the positive and negative ions to carry electric current through the liquid. The movement of these charged particles allows electricity to flow.

Q253. What are electrolytes?
Answer: Electrolytes are substances that can conduct electricity when dissolved in water or melted. They contain ions that are free to move and carry charge. Most ionic compounds act as electrolytes because they break into ions when melted or dissolved in water.

Q254. Why can't solid ionic compounds conduct electricity?
Answer: Solid ionic compounds cannot conduct electricity because their ions are fixed in a rigid lattice. They cannot move freely to carry an electric current. Only when the compound is melted or dissolved in water can the ions move and conduct electricity.

Q255. What type of electrode attracts positive ions during electrolysis?
Answer: The negative electrode, called the cathode, attracts positive ions. This happens because opposite charges attract, so the positively charged ions move toward the negatively charged electrode during electrolysis.

Q256. What type of electrode attracts negative ions during electrolysis?
Answer: The positive electrode, called the anode, attracts negative ions. This is because the negative ions are drawn to the positive charge where they can lose electrons.

Q257. What is produced when positive ions gain electrons at the cathode?
Answer: When positive ions gain electrons at the cathode, neutral atoms are produced. This process is called reduction. For example, metal ions like Zn^{2+} would gain two electrons and become zinc metal at the cathode.

Q258. What happens to negative ions at the anode?
Answer: At the anode, negative ions lose electrons and become neutral atoms or molecules. This process is called oxidation. For example, Cl^- ions lose electrons and form chlorine gas at the anode.

Q259. Why is electrolysis used to extract metals from their ores?
Answer: Electrolysis is used to extract metals from their ores when the metal is too reactive to be extracted by reduction with carbon. It helps to separate pure metal from its compound by using electricity to break the bonds between the metal and other elements.

Q260. What does the term "discharged" mean in electrolysis?
Answer: In electrolysis, the term "discharged" means that an ion has gained or lost electrons to

become a neutral atom or molecule. For example, when a Cl^- ion loses an electron, it becomes a chlorine atom and is said to be discharged at the electrode.

Q261. Explain the movement of ions during electrolysis.
Answer: During electrolysis, positive ions (cations) move toward the negative electrode (cathode) to gain electrons. Negative ions (anions) move toward the positive electrode (anode) to lose electrons. This movement of ions allows the flow of electricity and leads to chemical changes at the electrodes.

Q262. What is formed at the cathode when lead bromide is electrolysed?
Answer: When lead bromide is electrolysed, lead ions (Pb^{2+}) move to the cathode and gain electrons to form lead metal. The reaction at the cathode is: $Pb^{2+} + 2e^- \rightarrow Pb$.

Q263. What is formed at the anode when lead bromide is electrolysed?
Answer: At the anode, bromide ions (Br^-) lose electrons and form bromine gas. The reaction is: $2Br^- \rightarrow Br_2 + 2e^-$. So, bromine gas is produced at the anode.

Q264. Why are inert electrodes used in electrolysis?
Answer: Inert electrodes are used because they do not react with the electrolyte or the products of electrolysis. Materials like graphite or platinum are often used, ensuring that only the ions in the electrolyte take part in the reactions.

Q265. Name a safer compound that can be used in electrolysis instead of lead bromide.
Answer: Sodium chloride (common salt) is a safer compound that can be used in electrolysis. It does not release toxic substances like lead compounds and is safer to handle in a lab setting.

Q266. Write the ionic formula for zinc chloride.
Answer: The ionic formula for zinc chloride is $ZnCl_2$. Zinc forms Zn^{2+} ions, and chloride forms Cl^- ions. Two chloride ions are needed to balance the +2 charge of one zinc ion.

Q267. Predict the products of electrolysis of molten zinc chloride.
Answer: During electrolysis of molten zinc chloride, zinc metal is formed at the cathode as Zn^{2+} ions gain electrons. Chlorine gas is formed at the anode as Cl^- ions lose electrons. The overall products are zinc and chlorine.

Q268. Which electrode would zinc form at during the electrolysis of zinc chloride?
Answer: Zinc would form at the cathode. The Zn^{2+} ions move to the negative electrode, gain electrons, and become zinc metal.

Q269. Which electrode would chlorine form at during the electrolysis of zinc chloride?
Answer: Chlorine would form at the anode. The Cl^- ions move to the positive electrode, lose electrons, and form chlorine gas.

Q270. What does the term "molten" mean?
Answer: The term "molten" means that a solid has been heated to become a liquid. In this state, the

particles are free to move. For ionic compounds, this means the ions are no longer in fixed positions and can move to conduct electricity.

Q271. What is the role of electricity in electrolysis?
Answer: Electricity provides the energy needed to break the chemical bonds in an ionic compound. It causes ions to move to the electrodes, where they either gain or lose electrons, leading to the formation of new substances.

Q272. What is the name of the negative electrode?
Answer: The negative electrode is called the cathode. It attracts positive ions and is where reduction (gain of electrons) takes place.

Q273. What is the name of the positive electrode?
Answer: The positive electrode is called the anode. It attracts negative ions and is where oxidation (loss of electrons) takes place.

Q274. Why are the electrodes called "inert"?
Answer: Electrodes are called inert if they do not take part in the chemical reactions during electrolysis. They only serve to carry the electric current and provide a surface for the reactions to happen.

Q275. What is meant by a binary ionic compound?
Answer: A binary ionic compound is made up of only two elements – one metal and one non-metal. The metal forms positive ions and the non-metal forms negative ions. An example is sodium chloride (NaCl), which contains sodium and chlorine.

Q276. Describe what happens to bromide ions at the anode during electrolysis of lead bromide.
Answer: During the electrolysis of lead bromide, bromide ions (Br^-) move towards the anode because they are negatively charged. At the anode, each bromide ion loses an electron (oxidation) and becomes a bromine atom. Two bromine atoms then pair up to form bromine gas (Br_2), which is released at the anode. This process is called oxidation.

Q277. Describe what happens to lead ions at the cathode during electrolysis of lead bromide.
Answer: Lead ions (Pb^{2+}) are positively charged and move towards the cathode. At the cathode, each lead ion gains two electrons (reduction) and becomes a neutral lead atom. These atoms collect at the cathode as molten lead metal. This process is called reduction and it is the opposite of what happens at the anode.

Q278. What is the charge on a bromide ion?
Answer: The charge on a bromide ion is -1. This means it has gained one extra electron compared to a neutral bromine atom, making it negatively charged.

Q279. What is the charge on a lead ion in lead bromide?
Answer: In lead bromide, the lead ion has a charge of +2. This means the lead atom has lost two electrons to become a positively charged Pb^{2+} ion.

Q280. What is the purpose of writing half equations in electrolysis?
Answer: Half equations are written to show what happens at each electrode during electrolysis. They help to clearly represent the loss or gain of electrons during oxidation and reduction. This makes it easier to understand and balance the overall chemical changes and shows the electron flow during the process.

Q281. Write a word equation for the electrolysis of molten lead bromide.
Answer: Lead bromide → Lead + Bromine

Q282. What state must the ionic compound be in for electrolysis to work?
Answer: The ionic compound must be in a molten state or dissolved in water (aqueous solution). This is because the ions must be free to move to conduct electricity and carry the electric current during electrolysis.

Q283. What safety precautions should be taken when carrying out electrolysis of lead bromide?
Answer: Safety precautions include wearing goggles and gloves to protect from hot and harmful substances, ensuring good ventilation because bromine gas is toxic, using proper heat-resistant equipment to melt the lead bromide, and handling the apparatus carefully to avoid burns or chemical exposure.

Q284. What type of reaction takes place at the cathode?
Answer: A reduction reaction takes place at the cathode. This is where positively charged ions gain electrons to become neutral atoms or molecules.

Q285. What type of reaction takes place at the anode?
Answer: An oxidation reaction takes place at the anode. This is where negatively charged ions lose electrons and form neutral atoms or molecules.

Q286. Why does a bromide ion lose an electron during electrolysis?
Answer: A bromide ion loses an electron during electrolysis because it is attracted to the positively charged anode. At the anode, it undergoes oxidation, which involves losing one electron to become a neutral bromine atom that later forms bromine gas.

Q287. What happens to electrons at the cathode?
Answer: At the cathode, electrons are supplied to the positive ions arriving there. These electrons are gained by the ions in a reduction reaction, turning them into neutral atoms or metal deposits, such as lead in the case of lead bromide electrolysis.

Q288. What happens to electrons at the anode?
Answer: At the anode, electrons are taken away from the negative ions in an oxidation reaction. These electrons then flow through the external circuit to the cathode, completing the electric current path.

Q289. Define the term "electrolysis".
Answer: Electrolysis is the chemical process of using electricity to break down an ionic compound into its elements. It involves passing an electric current through a molten or dissolved ionic substance to cause a chemical change at the electrodes.

Q290. Why must the ionic compound be molten or in solution for electrolysis?
Answer: The compound must be molten or in solution so that the ions are free to move. In solid form, the ions are fixed in place and cannot carry electric current. Only in a liquid state or solution can the ions migrate towards the electrodes to allow electrolysis to happen.

Q291. What element is formed at the anode during the electrolysis of molten zinc chloride?
Answer: Chlorine gas is formed at the anode during the electrolysis of molten zinc chloride. The chloride ions lose electrons (are oxidised) and form chlorine gas.

Q292. What element is formed at the cathode during the electrolysis of molten zinc chloride?
Answer: Zinc metal is formed at the cathode. The zinc ions gain electrons (are reduced) and become neutral zinc atoms, which deposit as molten zinc metal.

Q293. What happens to chloride ions at the anode?
Answer: Chloride ions move to the anode where they lose electrons and undergo oxidation. Two chloride ions each lose one electron to form chlorine gas (Cl_2), which is released at the anode.

Q294. Why is it important to balance half equations?
Answer: It is important to balance half equations to make sure that the number of atoms and the charges on both sides are equal. This reflects the conservation of mass and charge in chemical reactions, which is essential for accurate chemical understanding.

Q295. Explain why electrons are involved in reactions at both electrodes.
Answer: Electrons are involved at both electrodes because electrolysis is based on redox reactions. At the cathode, electrons are gained by positive ions (reduction), and at the anode, electrons are lost by negative ions (oxidation). The movement of electrons in and out of the electrodes completes the electrical circuit.

Q296. What equipment is needed to carry out electrolysis of molten lead bromide?
Answer: The equipment needed includes a heat source to melt the lead bromide, a crucible to hold the molten compound, two inert electrodes (like graphite), wires to connect the electrodes to a power supply, and safety equipment like goggles and gloves.

Q297. What is observed at the cathode during electrolysis of molten lead bromide?
Answer: At the cathode, molten lead metal is observed. It appears as a shiny grey deposit or collects at the bottom of the container because it is denser than the molten electrolyte.

Q298. What is observed at the anode during electrolysis of molten lead bromide?
Answer: At the anode, a brown vapour is observed. This is bromine gas, which forms when bromide ions lose electrons. Bromine has a strong smell and is toxic, so good ventilation is necessary.

Q299. What gas is released during the electrolysis of molten bromide compounds?
Answer: Bromine gas is released at the anode. This occurs when bromide ions are oxidised, losing electrons and forming bromine molecules.

Q300. Why does electrolysis not work on solid ionic compounds?
Answer: Electrolysis does not work on solid ionic compounds because the ions are fixed in place and cannot move. For electrolysis to occur, ions must be able to move freely to the electrodes. Only in molten or aqueous form can they do this and conduct electricity.

Q301. Why is electrolysis used to extract metals that are too reactive to be reduced by carbon?
Answer:
Electrolysis is used to extract metals that are too reactive to be reduced by carbon because these metals form very stable compounds with oxygen or other elements. Their reactivity means that carbon is not strong enough to remove the oxygen and reduce the metal. Therefore, electrical energy is used to break the bonds in the compound and separate the metal. Metals like aluminium, potassium, and sodium require this method because carbon cannot displace them from their oxides.

Q302. What is electrolysis?
Answer:
Electrolysis is a chemical process in which electrical energy is used to drive a non-spontaneous chemical reaction. It involves passing an electric current through an electrolyte, which is a liquid containing ions, to cause the movement of ions towards electrodes. Positive ions move to the cathode to gain electrons (reduction), and negative ions move to the anode to lose electrons (oxidation), resulting in the formation of new substances.

Q303. Why is a large amount of energy needed during the electrolysis of molten compounds?
Answer:
A large amount of energy is needed during the electrolysis of molten compounds because high temperatures are required to keep the compound in a molten (liquid) state, especially for ionic compounds like aluminium oxide that have very high melting points. Additionally, the process of breaking strong ionic bonds in the molten compound and driving the movement of ions using electricity also consumes a lot of energy.

Q304. Why is aluminium extracted using electrolysis instead of carbon?

Answer:

Aluminium is extracted using electrolysis because it is more reactive than carbon. This means carbon cannot reduce aluminium oxide to aluminium metal, as it cannot displace aluminium from its compound. Electrolysis is used instead to separate aluminium from its oxide by supplying electrical energy, which is strong enough to break the bonds in aluminium oxide and extract pure aluminium.

Q305. What role does cryolite play in the extraction of aluminium?

Answer:

Cryolite is used in the extraction of aluminium to lower the melting point of aluminium oxide. Aluminium oxide has a very high melting point of about 2000°C, which would make the process extremely expensive if used alone. Mixing it with cryolite brings down the melting point to around 950°C, which reduces the energy needed for the process and makes electrolysis more efficient and cost-effective.

Q306. Why is aluminium oxide mixed with cryolite before electrolysis?

Answer:

Aluminium oxide is mixed with cryolite before electrolysis to reduce its melting point. Pure aluminium oxide melts at a very high temperature, making it difficult and expensive to use in electrolysis. Cryolite acts as a solvent and brings the melting point down to a more manageable level. This helps save energy, reduces operational costs, and allows the electrolysis process to occur more smoothly.

Q307. What is the function of the carbon anode during the extraction of aluminium?

Answer:

The carbon anode in the extraction of aluminium serves as the positive electrode where oxidation occurs. During electrolysis, oxygen ions from aluminium oxide move to the anode, where they lose electrons and form oxygen gas. The carbon anode reacts with this oxygen to form carbon dioxide gas. So, the anode not only allows the flow of current but also participates in the reaction with the released oxygen.

Q308. Why must the carbon anode be replaced regularly during the electrolysis of aluminium oxide?

Answer:

The carbon anode must be replaced regularly during the electrolysis of aluminium oxide because it reacts with the oxygen gas produced at the anode to form carbon dioxide. This reaction gradually wears down the carbon anode, causing it to burn away over time. As the anode gets used up and reduces in size, it needs to be replaced to maintain the efficiency of the electrolysis process.

Q309. Write the general rule for what happens at the cathode during the electrolysis of aqueous solutions.

Answer:

During the electrolysis of aqueous solutions, the general rule is that the least reactive positive ion will be discharged at the cathode. If the metal ion in the solution is more reactive than hydrogen,

hydrogen gas is produced at the cathode. If the metal ion is less reactive than hydrogen, then the metal is deposited at the cathode by gaining electrons (reduction).

Q310. What happens at the anode during the electrolysis of an aqueous solution that contains no halide ions?

Answer:

If an aqueous solution contains no halide ions, then at the anode, oxygen gas is produced from the hydroxide ions (OH^-) in the water. These hydroxide ions lose electrons (are oxidised) to form water and oxygen gas. This happens because sulfate, nitrate, and other non-halide anions do not get discharged easily, so water molecules provide the hydroxide ions instead.

Q311. Why is hydrogen produced at the cathode if the metal in the solution is more reactive than hydrogen?

Answer:

If the metal in the solution is more reactive than hydrogen, hydrogen gas is produced at the cathode because the metal ions are less likely to gain electrons. In such cases, the hydrogen ions (H^+) from the water are reduced instead, forming hydrogen gas. This is because it is easier for hydrogen ions to gain electrons and be discharged than it is for a more reactive metal.

Q312. What product is formed at the anode when a halide ion is present in the aqueous solution?

Answer:

When a halide ion such as chloride, bromide, or iodide is present in the aqueous solution, the halogen gas corresponding to that halide is formed at the anode. For example, chloride ions lose electrons and form chlorine gas. Halide ions are preferentially discharged over hydroxide ions when present in high enough concentration in the solution.

Q313. What ions are produced when water molecules break down in an aqueous solution?

Answer:

When water molecules break down in an aqueous solution, they produce hydrogen ions (H^+) and hydroxide ions (OH^-). This process is called the ionisation of water. These ions take part in electrolysis and can be discharged at the electrodes depending on which ions are more easily reduced or oxidised compared to the other ions in the solution.

Q314. Why is water involved in the electrolysis of aqueous solutions?

Answer:

Water is involved in the electrolysis of aqueous solutions because it contains ions (H^+ and OH^-) that can participate in the reaction. During electrolysis, water can supply hydrogen ions for reduction at the cathode and hydroxide ions for oxidation at the anode. These ions compete with the ions from the dissolved salt, affecting what products are formed at each electrode.

Q315. What is the significance of using inert electrodes in the electrolysis of aqueous solutions?

Answer:

Inert electrodes like platinum or graphite are used in the electrolysis of aqueous solutions because they do not react with the electrolyte or the products formed during electrolysis. This ensures that the only reactions taking place are those involving the ions in the solution, allowing for more accurate and controlled results. Inert electrodes remain unchanged and do not interfere with the chemical process.

Q316. What kind of hypothesis might you develop when investigating the electrolysis of an aqueous solution?

Answer:

A possible hypothesis when investigating the electrolysis of an aqueous solution could be: “If the electrolyte contains a more reactive metal ion than hydrogen, then hydrogen gas will be produced at the cathode.” This hypothesis helps guide the experiment and focuses on predicting which substances will be discharged at the electrodes based on the reactivity of the ions in solution.

Q317. In an experiment, how could you test what gas is released at the cathode?

Answer:

To test the gas released at the cathode, you can collect the gas in an inverted test tube and then bring a lit splint near the mouth of the tube. If the gas is hydrogen, it will produce a squeaky 'pop' sound when the splint is introduced. This sound is due to the rapid combustion of hydrogen with oxygen in the air, confirming the presence of hydrogen gas.

Q318. In an experiment, how could you test what gas is released at the anode?

Answer:

To test the gas released at the anode, collect the gas in an inverted test tube and then place a glowing splint inside. If the gas is oxygen, the glowing splint will relight because oxygen supports combustion. This simple test confirms that the gas released at the anode is oxygen. If halide ions are present, you might observe a different gas like chlorine, which can be identified by its bleach-like smell.

Q319. Predict the products of electrolysis when sodium chloride solution is electrolysed.

Answer:

When sodium chloride solution (brine) is electrolysed, the products formed are hydrogen gas at the cathode and chlorine gas at the anode. Sodium ions are more reactive than hydrogen, so hydrogen is discharged instead. Chloride ions are present in high concentration and get discharged at the anode to form chlorine gas. The solution becomes alkaline due to the remaining hydroxide ions, so sodium hydroxide is also left in solution.

Q320. Predict the products of electrolysis when copper sulfate solution is electrolysed.

Answer:

When copper sulfate solution is electrolysed using inert electrodes, copper metal is produced at the cathode and oxygen gas is released at the anode. Copper ions are less reactive than hydrogen, so copper is deposited. At the anode, sulfate ions do not discharge easily, so hydroxide ions from water are oxidised, forming oxygen gas.

Q321. Why is copper produced at the cathode when copper sulfate solution is electrolysed?

Answer:

Copper is produced at the cathode because copper ions (Cu^{2+}) in the solution are less reactive than hydrogen ions. As a result, they are preferentially reduced at the cathode, gaining electrons to form solid copper metal. This deposition of copper makes electrolysis useful for processes like electroplating and purifying copper.

Q322. Explain why oxygen is produced at the anode when copper sulfate solution is electrolysed.

Answer:

Oxygen is produced at the anode during the electrolysis of copper sulfate solution because sulfate ions are very stable and do not discharge easily. Instead, hydroxide ions from water are oxidised, losing electrons to form water and oxygen gas. This makes oxygen the main product at the anode in aqueous copper sulfate electrolysis with inert electrodes.

Q323. What are half equations?

Answer:

Half equations are simplified equations that show the movement of electrons during the oxidation or reduction processes at the electrodes during electrolysis. They show what happens to each ion as it either gains or loses electrons. These equations help us understand which species are being reduced at the cathode and which are being oxidised at the anode.

Q324. Write the half equation for the formation of hydrogen gas at the cathode.

Answer:

$2H^+ + 2e^- \rightarrow H_2$

Q325. Write the half equation for the production of oxygen gas from hydroxide ions.

Answer:

$4OH^- \rightarrow O_2 + 2H_2O + 4e^-$

Q326. How can you tell if a reaction at an electrode is a reduction?

Answer:

A reaction at an electrode is a reduction if it involves a gain of electrons. In electrolysis, reduction always happens at the cathode, which is the negative electrode. You can tell it's a reduction because positive ions move to the cathode and gain electrons to become neutral atoms or molecules. For example, $Cu^{2+} + 2e^- \rightarrow Cu$ shows that copper ions gain electrons and are reduced.

Q327. How can you tell if a reaction at an electrode is an oxidation?

Answer:

A reaction at an electrode is an oxidation if it involves a loss of electrons. In electrolysis, oxidation always happens at the anode, which is the positive electrode. You can tell it's an oxidation because negative ions move to the anode and lose electrons to become neutral atoms or molecules. For example, $2Cl^- \rightarrow Cl_2 + 2e^-$ shows chloride ions losing electrons, which is oxidation.

Q328. Why do positive ions move to the negative electrode during electrolysis?

Answer:

Positive ions move to the negative electrode (cathode) during electrolysis because opposite charges attract. The cathode has a negative charge, and since positive ions (called cations) are attracted to this charge, they move toward the cathode. Once there, they gain electrons and are reduced, forming neutral atoms or molecules.

Q329. Why do negative ions move to the positive electrode during electrolysis?

Answer:

Negative ions move to the positive electrode (anode) during electrolysis because opposite charges attract. The anode has a positive charge, so the negatively charged ions (called anions) are attracted to it. When they reach the anode, they lose electrons (oxidation) and form neutral atoms or molecules.

Q330. In electrolysis, what does it mean if electrons are gained at an electrode?

Answer:

If electrons are gained at an electrode in electrolysis, it means that a reduction reaction is taking place. This always happens at the cathode, where positive ions gain electrons to become neutral. For example, $H^+ + e^- \rightarrow H$ shows hydrogen ions gaining electrons to form hydrogen gas, which is a reduction.

Q331. In electrolysis, what does it mean if electrons are lost at an electrode?

Answer:

If electrons are lost at an electrode during electrolysis, it means an oxidation reaction is occurring. This always happens at the anode, where negative ions lose electrons to form neutral atoms or molecules. For example, $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$ shows hydroxide ions losing electrons and being oxidised to form oxygen gas.

Q332. Describe what happens to aluminium ions at the cathode during electrolysis.

Answer:

At the cathode, aluminium ions (Al^{3+}) move towards the negative electrode and gain three electrons each to form aluminium metal. This is a reduction reaction. The equation is $Al^{3+} + 3e^- \rightarrow Al$. The aluminium formed collects at the bottom of the cell as molten metal, which can then be tapped off.

Q333. Describe what happens to oxide ions at the anode during aluminium extraction.

Answer:

At the anode, oxide ions (O^{2-}) from aluminium oxide lose electrons and are oxidised to form oxygen gas. This oxygen reacts with the carbon anode to form carbon dioxide. The half equation is $2O^{2-} \rightarrow O_2 + 4e^-$. The continuous reaction with oxygen wears away the carbon anode, so it needs to be replaced regularly.

Q334. Why is it important to control the temperature during electrolysis of molten compounds?

Answer:

Controlling the temperature during the electrolysis of molten compounds is important to keep the substance in its liquid state for ion mobility and efficient conduction of electricity. If the temperature is too low, the compound may solidify and stop the process. If it is too high, it could damage equipment and increase energy costs unnecessarily.

Q335. Why is cryolite used instead of just melting aluminium oxide on its own?

Answer:

Cryolite is used instead of melting aluminium oxide alone because aluminium oxide has a very high melting point of around 2000°C. Cryolite lowers this melting point to about 950°C, making the process more energy-efficient and reducing costs. It also improves the conductivity of the mixture, allowing electrolysis to occur more easily.

Q336. What are the environmental concerns of using large amounts of energy in electrolysis?

Answer:

Using large amounts of energy in electrolysis, especially if the energy comes from burning fossil fuels, contributes to greenhouse gas emissions like carbon dioxide. This leads to global warming and climate change. Additionally, high energy consumption puts pressure on electricity resources and increases operational costs.

Q337. How does electrolysis contribute to carbon dioxide emissions in aluminium production?

Answer:

Electrolysis contributes to carbon dioxide emissions in aluminium production in two ways. First, the electrical energy used often comes from burning fossil fuels, which releases CO_2. Second, the carbon anodes used in the process react with oxygen to form CO_2 directly at the anode. Both sources contribute significantly to environmental pollution.

Q338. What is observed at the anode during the electrolysis of a salt solution without halide ions?

Answer:

During the electrolysis of a salt solution that does not contain halide ions, bubbles of oxygen gas are observed at the anode. This is because hydroxide ions from water are oxidised to form oxygen gas and water. The equation is $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$. No halogen gas is formed since no halide ions are present.

Q339. Why do bubbles form at electrodes during electrolysis?

Answer:

Bubbles form at electrodes during electrolysis when gases are produced as products of the reaction. For example, hydrogen gas forms at the cathode and oxygen or chlorine gas forms at the anode. These gases appear as bubbles when they are released from the electrode surfaces into the solution.

Q340. What is the state of aluminium during its extraction by electrolysis?

Answer:

During its extraction by electrolysis, aluminium is in the molten (liquid) state. Aluminium ions are reduced to aluminium metal at the cathode, and because the electrolysis takes place at high temperatures, the aluminium remains molten and collects at the bottom of the cell, where it can be removed.

Q341. What happens to the mass of the anode during the extraction of aluminium over time?

Answer:

Over time, the mass of the carbon anode decreases during the extraction of aluminium. This is because the anode reacts with the oxygen produced during electrolysis to form carbon dioxide. As the carbon burns away, the anode wears down and needs to be replaced regularly to maintain the process.

Q342. Why is it necessary to purify solutions before electrolysis in industry?

Answer:

It is necessary to purify solutions before electrolysis in industry to remove impurities that can interfere with the efficiency of the process or produce unwanted side reactions. Impurities might also damage the electrodes or affect the quality of the products. Purification ensures consistent and high-quality results.

Q343. What would happen if reactive electrodes were used instead of inert ones in aqueous electrolysis?

Answer:

If reactive electrodes were used instead of inert ones in aqueous electrolysis, they could take part in the reaction and get consumed or corroded. This would change the expected products of electrolysis, reduce efficiency, and possibly introduce unwanted substances into the electrolyte. For accurate results, inert electrodes like graphite or platinum are preferred.

Q344. Why do the products of electrolysis depend on the reactivity of the metal?

Answer:

The products of electrolysis depend on the reactivity of the metal because at the cathode, if the metal is more reactive than hydrogen, hydrogen gas is discharged instead of the metal. Only less reactive metals like copper or silver are deposited during electrolysis of their aqueous salts. This is due to the order of discharge and ease of electron gain.

Q345. How is the overall process of electrolysis different for molten and aqueous solutions?

Answer:

In molten electrolysis, only the ions from the molten compound are involved, and the products are the pure metal and non-metal elements. In aqueous solutions, water also ionises to form H^+ and OH^-, which can be discharged at the electrodes depending on the reactivity of the other ions. This makes the outcome less predictable and dependent on ion reactivity and concentration.

Q346. What product forms at the cathode during the electrolysis of potassium nitrate solution?

Answer:

During the electrolysis of potassium nitrate solution, hydrogen gas forms at the cathode. This happens because potassium is more reactive than hydrogen, so hydrogen ions from water are discharged instead. The half equation is $2H^+ + 2e^- \rightarrow H_2$.

Q347. What product forms at the anode during the electrolysis of potassium nitrate solution?

Answer:

At the anode, oxygen gas is produced during the electrolysis of potassium nitrate solution. Nitrate ions do not get discharged easily, so hydroxide ions from water are oxidised instead. The half equation is $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$.

Q348. Why is a d.c. power source used in electrolysis instead of a.c.?

Answer:

A d.c. (direct current) power source is used in electrolysis because it ensures a constant flow of electrons in one direction. This allows the electrodes to maintain their polarity, which is necessary for oxidation and reduction to happen consistently. If a.c. (alternating current) were used, the electrodes would keep switching roles and the reactions would not proceed properly.

Q349. Why is it important to balance half equations?

Answer:

It is important to balance half equations to ensure that the number of atoms and the total charge are the same on both sides of the equation. This reflects the conservation of mass and charge in chemical reactions. A balanced equation gives a correct and complete picture of what is happening during electrolysis.

Q350. How can you identify unknown gases produced during an electrolysis experiment?

Answer:

You can identify unknown gases in electrolysis using simple gas tests. For hydrogen, use a lit splint — if it makes a pop sound, it confirms hydrogen. For oxygen, use a glowing splint — if it relights, oxygen is present. For chlorine, hold damp blue litmus paper near the gas — if it turns red and then bleaches, chlorine is present. These tests help confirm the identity of gases released.