MEGA LECTURE

AQA (GCSE Notes)

Chapter 7: Organic Chemistry

Q1. What is crude oil and where is it found?
Answer: Crude oil is a dark, thick liquid mixture of many different hydrocarbons. It is a natural fossil fuel found deep underground in reservoirs beneath the Earth's surface. These reservoirs are often located under the seabed or within sedimentary rocks. Crude oil is extracted by drilling and pumping, and then it is processed to produce fuels and other useful substances.

Q2. How is crude oil formed over millions of years?
Answer: Crude oil forms over millions of years from the remains of ancient marine organisms like plankton. When these organisms die, they settle on the sea floor and get buried under layers of sediment. Over time, heat and pressure from the overlying layers cause chemical changes that turn the organic material into crude oil. This process takes millions of years and happens in the absence of oxygen.

Q3. What type of organisms mainly contribute to the formation of crude oil?
Answer: Tiny marine organisms such as plankton are the main contributors to the formation of crude oil. When these organisms die, they sink to the ocean floor and become part of the sediment. Over time, and with the right conditions of heat and pressure, their remains are transformed into crude oil through chemical changes.

Q4. Why is crude oil considered a finite resource?
Answer: Crude oil is considered a finite resource because it takes millions of years to form, and we are using it much faster than it is naturally replaced. Once current reserves are used up, they cannot be replenished on a human timescale. This means that crude oil will eventually run out if alternative energy sources are not developed and used.

Q5. What is a hydrocarbon?
Answer: A hydrocarbon is a compound made up entirely of hydrogen and carbon atoms. These compounds are the main components of crude oil and natural gas. Hydrocarbons can be classified as either saturated (alkanes) or unsaturated (alkenes and alkynes), depending on the types of bonds between carbon atoms.

Q6. Which two elements make up hydrocarbons?
Answer: Hydrocarbons are made up of only two elements: hydrogen and carbon. These two elements combine in different ways to form a variety of hydrocarbon molecules, which can be found in fuels such as petrol, diesel, and natural gas.

Q7. What is the main type of hydrocarbon found in crude oil?
Answer: The main type of hydrocarbon found in crude oil is the alkane. Alkanes are saturated

hydrocarbons, meaning all carbon-carbon bonds are single bonds. They are the simplest type of hydrocarbon and are part of a homologous series with similar properties.

Q8. What is the general formula for alkanes?
Answer: The general formula for alkanes is C_nH_{2n+2}. This means for every 'n' carbon atoms, there are '2n+2' hydrogen atoms. For example, if there are 2 carbon atoms, the number of hydrogen atoms will be (2×2) + 2 = 6, giving the formula C_2H_6 (ethane).

Q9. Name the first four alkanes in the homologous series.
Answer: The first four alkanes in the homologous series are methane (CH_4), ethane (C_2H_6), propane (C_3H_8), and butane (C_4H_{10}). These alkanes have increasing numbers of carbon atoms and follow the general formula C_nH_{2n+2}. Each one has similar chemical properties but different physical properties like boiling point.

Q10. Write the molecular formula of ethane.
Answer: The molecular formula of ethane is C_2H_6. It contains two carbon atoms and six hydrogen atoms. Ethane is a saturated hydrocarbon (alkane) and follows the general alkane formula C_nH_{2n+2} where n = 2.

Q11. How can alkane molecules be represented?
Answer: Alkane molecules can be represented in several ways, including molecular formulas (e.g., C_2H_6), displayed formulas (which show all atoms and bonds), and structural formulas (which show the arrangement of atoms in a simplified form). These representations help in understanding the bonding and structure of the molecules.

Q12. What is meant by a homologous series?
Answer: A homologous series is a group of organic compounds that have the same functional group, similar chemical properties, and a general formula. Each member of the series differs from the next by a CH_2 unit. For example, alkanes form a homologous series where each member has one more CH_2 group than the one before.

Q13. Why do carbon atoms form so many different compounds?
Answer: Carbon atoms can form so many different compounds because they can make four covalent bonds, allowing them to form long chains, branched chains, and rings. Carbon also bonds well with many elements, especially hydrogen, oxygen, and nitrogen, which adds to the variety of possible compounds.

Q14. What kind of bonds do carbon atoms form with each other?
Answer: Carbon atoms form strong covalent bonds with each other. These bonds can be single, double, or triple bonds. Covalent bonding between carbon atoms is what allows the formation of a wide variety of stable molecules with different shapes and sizes.

Q15. How do carbon atoms form rings and chains?
Answer: Carbon atoms can link to other carbon atoms through covalent bonds, forming long chains

or closed ring structures. This is because each carbon atom can form four bonds, allowing a variety of stable arrangements including straight chains, branched chains, and rings.

Q16. Why is the chemistry of carbon compounds studied as a separate branch?
Answer: The chemistry of carbon compounds is studied as a separate branch called organic chemistry because carbon forms a vast number of compounds with unique properties. The variety, complexity, and importance of these compounds in life and industry require focused study.

Q17. What is the name of the branch of chemistry that studies carbon compounds?
Answer: The branch of chemistry that studies carbon compounds is called organic chemistry. This branch deals with the structure, properties, reactions, and uses of carbon-based compounds, which are found in living organisms and many synthetic materials.

Q18. Why are fossil fuels considered organic compounds?
Answer: Fossil fuels are considered organic compounds because they are made from the remains of living organisms that were rich in carbon and hydrogen. These substances, like crude oil, coal, and natural gas, are mainly composed of hydrocarbons, which are organic molecules.

Q19. What is the role of the petrochemical industry?
Answer: The petrochemical industry processes crude oil and natural gas into useful products. It produces fuels like petrol and diesel, and chemicals that are used to make plastics, detergents, solvents, and many other materials essential to modern life.

Q20. Name four materials made using organic molecules in the chemical industry.
Answer: Four materials made using organic molecules in the chemical industry include plastics, synthetic fibres (like polyester), medicines, and cosmetics. These materials are often derived from hydrocarbons processed in the petrochemical industry.

Q21. What are feedstocks in the petrochemical industry used for?
Answer: Feedstocks in the petrochemical industry are raw materials, usually derived from crude oil, used to make useful products such as fuels, plastics, and other chemicals. These feedstocks are processed through chemical reactions to create new materials with specific properties.

Q22. What is fractional distillation?
Answer: Fractional distillation is a method used to separate a mixture of liquids with different boiling points. In crude oil refining, it separates hydrocarbons into fractions, such as petrol and diesel, by heating the oil so that different components evaporate and condense at different levels of a fractionating column.

Q23. Why is crude oil separated into different fractions?
Answer: Crude oil is separated into different fractions because the hydrocarbons in it have different boiling points and uses. Each fraction contains hydrocarbons of similar chain lengths and is more useful when separated for specific purposes like fuels, lubricants, or raw materials for plastics.

Q24. What do the molecules in each fraction of crude oil have in common?
Answer: The molecules in each fraction of crude oil have similar boiling points and chain lengths. They also tend to have similar physical and chemical properties, which makes each fraction useful for specific applications, such as petrol, diesel, or lubricating oil.

Q25. How does fractional distillation separate mixtures?
Answer: Fractional distillation separates mixtures by heating them until they vaporise and then cooling the vapours so they condense at different temperatures. In a fractionating column, substances with lower boiling points rise higher before condensing, while those with higher boiling points condense lower down, allowing them to be collected separately.

Q26. Explain the role of evaporation in fractional distillation.
Answer: In fractional distillation, evaporation is the first step where crude oil is heated until most of it turns into vapour. This vapour then enters the fractionating column. Different hydrocarbons in the crude oil have different boiling points, so when the crude oil is heated, the substances with lower boiling points evaporate first. Evaporation allows the separation of different fractions based on how easily they vaporise.

Q27. Explain the role of condensation in fractional distillation.
Answer: In fractional distillation, after evaporation, the vapours rise up the fractionating column, which is cooler at the top and hotter at the bottom. As the vapours cool down, they condense back into liquids at different levels in the column. Hydrocarbons with higher boiling points condense lower down, while those with lower boiling points condense near the top. This process separates the mixture into useful fractions.

Q28. Why do different hydrocarbons condense at different levels in the fractionating column?
Answer: Different hydrocarbons condense at different levels because they have different boiling points. The boiling point depends on the size of the molecule and the number of carbon atoms. Larger molecules with more carbon atoms have higher boiling points and condense lower in the column, while smaller molecules with fewer carbon atoms have lower boiling points and condense higher up in the column.

Q29. Name three fuels that are produced from crude oil.
Answer: Three fuels produced from crude oil include petrol (gasoline), diesel, and kerosene. These fuels are separated from crude oil during fractional distillation and are used in transport, heating, and aviation. Each fuel corresponds to a specific fraction based on its boiling point and carbon chain length.

Q30. What is kerosene used for?
Answer: Kerosene is mainly used as a fuel for jet engines in aircraft, known as aviation fuel. It is also used in some domestic heaters, lamps, and stoves, especially in areas without access to electricity. It burns cleanly and has a relatively high energy output, making it useful for both industrial and home applications.

Q31. What is meant by liquefied petroleum gas?
Answer: Liquefied petroleum gas (LPG) is a mixture of hydrocarbon gases, mainly propane and butane, that are stored in liquid form under pressure. It is used as a fuel for heating, cooking, and in some vehicles. LPG is a convenient energy source because it can be easily stored and transported in cylinders.

Q32. Give one example of how a fraction from crude oil can be used as a lubricant.
Answer: One example is the use of heavy oil fractions, such as mineral oil, as lubricants in engines and machinery. These fractions are thick and oily, and they help reduce friction between moving parts, preventing wear and tear. Lubricating oils are essential in car engines and industrial machines.

Q33. What are the main uses of petrol and diesel?
Answer: Petrol is mainly used as a fuel for cars with petrol engines, while diesel is used in diesel engine vehicles like lorries, buses, and some cars. Both are key transport fuels. Diesel engines are generally more fuel-efficient and are preferred for long-distance and heavy-duty transport, whereas petrol engines are more common in smaller personal vehicles.

Q34. How does the number of carbon atoms affect the boiling point of hydrocarbons?
Answer: As the number of carbon atoms in a hydrocarbon increases, the boiling point also increases. This is because larger molecules have more surface area and stronger intermolecular forces, which require more energy to break. Therefore, long-chain hydrocarbons condense at higher temperatures and are collected lower in the fractionating column.

Q35. Why are solvents important in modern life?
Answer: Solvents are important because they are used to dissolve, dilute, or extract other substances. They are used in paints, cleaning products, cosmetics, and pharmaceuticals. In industry, solvents help in the manufacturing and processing of chemicals. Their ability to dissolve different materials makes them essential in everyday life and various sectors.

Q36. What is the difference between natural and synthetic carbon compounds?
Answer: Natural carbon compounds are found in nature and include things like cellulose, proteins, and starch. Synthetic carbon compounds are man-made in laboratories or factories, such as plastics, synthetic fibres, and some medicines. The key difference is that natural compounds occur naturally, while synthetic ones are chemically engineered for specific uses.

Q37. Why can carbon form many different families of compounds?
Answer: Carbon can form many different families of compounds because each carbon atom can make four covalent bonds. This allows carbon atoms to bond with each other in chains, rings, or branches. Carbon also bonds easily with other elements like hydrogen, oxygen, and nitrogen. This flexibility leads to a huge variety of organic compounds.

Q38. Give two examples of materials made from synthetic carbon compounds.
Answer: Two examples of materials made from synthetic carbon compounds are nylon and

polythene. Nylon is a synthetic fibre used in clothing and textiles, while polythene is a plastic used in packaging and containers. These materials are made from carbon-based chemicals derived from crude oil through chemical processes.

Q39. How can chemists use crude oil to make new products?
Answer: Chemists can break down crude oil into useful fractions through fractional distillation. These fractions can then be chemically modified using processes like cracking and polymerisation to create new materials. For example, ethene from cracking can be used to make polythene. Chemists can design molecules with specific properties for use in products like plastics, drugs, and cosmetics.

Q40. Why is the ability to modify organic molecules important?
Answer: The ability to modify organic molecules is important because it allows chemists to design substances with desired properties. This is useful in creating drugs that target specific diseases, materials with high strength or flexibility, or environmentally friendly alternatives to existing products. Modification makes it possible to solve real-world problems using chemistry.

Q41. How are polymers related to crude oil?
Answer: Polymers are made from small molecules called monomers, many of which are derived from crude oil. For example, ethene from crude oil can be polymerised to make polythene. Crude oil provides the raw materials needed to produce synthetic polymers used in packaging, clothing, building materials, and many everyday items.

Q42. What is the importance of detergents in daily life?
Answer: Detergents are important because they help clean clothes, dishes, and surfaces by removing dirt, grease, and oil. They contain molecules with a hydrophilic end that attracts water and a hydrophobic end that attracts oil and grease. This allows them to break up and wash away oily substances. Detergents are essential in homes, hospitals, and industries for hygiene and sanitation.

Q43. What role do perfumes and flavourings play in the chemical industry?
Answer: Perfumes and flavourings are used to enhance the smell and taste of products. In the chemical industry, synthetic versions of natural scents and flavours are created to use in cosmetics, foods, and cleaning products. They help make products more attractive to consumers and are carefully tested to ensure safety and effectiveness.

Q44. How do alkanes differ from alkenes?
Answer: Alkanes are saturated hydrocarbons, meaning they only contain single bonds between carbon atoms. Alkenes are unsaturated hydrocarbons and contain at least one double bond between carbon atoms. This double bond makes alkenes more reactive than alkanes. For example, ethene is an alkene, while ethane is an alkane.

Q45. Why are alkanes described as saturated hydrocarbons?
Answer: Alkanes are described as saturated hydrocarbons because all the bonds between carbon atoms are single bonds, and each carbon atom is bonded to as many hydrogen atoms as possible.

There are no double or triple bonds in alkanes. This structure makes them chemically stable and less reactive compared to unsaturated hydrocarbons.

Q46. How can you identify a substance as an alkane from its molecular formula?
Answer: You can identify an alkane from its molecular formula if it follows the general formula C_nH_{2n+2}, where "n" is the number of carbon atoms. If the number of hydrogen atoms is double the number of carbon atoms plus two, and there are no double or triple bonds, it is an alkane. For example, methane is CH_4 and ethane is C_2H_6.

Q47. What is the significance of using models to represent molecules?
Answer: Using models to represent molecules helps students and scientists understand the structure, shape, and bonding of compounds. Models make it easier to visualise how atoms are arranged and how they interact. They are useful for explaining concepts like molecular geometry, bonding angles, and functional groups in organic chemistry.

Q48. Why are molecular modelling kits useful in chemistry education?
Answer: Molecular modelling kits are useful in chemistry education because they allow students to build physical representations of molecules. This helps them understand how atoms are connected, how molecules are shaped, and how chemical reactions occur. The hands-on experience improves understanding and retention of chemical concepts.

Q49. Why is crude oil important in our modern lifestyle?
Answer: Crude oil is important because it provides the raw materials for fuels, plastics, and many everyday products. Petrol, diesel, and kerosene power vehicles and planes. It also supplies chemicals used in detergents, cosmetics, medicines, and clothing. Without crude oil, modern transport, industry, and daily life would be very different.

Q50. What are the environmental concerns associated with using crude oil?
Answer: The main environmental concerns include air pollution, oil spills, and contribution to climate change. Burning fossil fuels like crude oil releases carbon dioxide, a greenhouse gas that causes global warming. Oil spills can harm marine life and ecosystems. Extracting and processing oil can also damage habitats and use large amounts of energy.

Q51. How does the viscosity of hydrocarbons change when the molecules become larger?
Answer: Viscosity increases as hydrocarbon molecules become larger. This is because longer hydrocarbon chains have stronger intermolecular forces, which make it harder for the molecules to slide past each other. As a result, the liquid becomes thicker and flows more slowly. So, large hydrocarbons are more viscous than smaller ones.

Q52. What is the effect of increasing molecular size on the flammability of hydrocarbons?
Answer: As the molecular size of hydrocarbons increases, their flammability decreases. Larger hydrocarbon molecules require more energy to ignite and burn compared to smaller ones. This is

because they have stronger intermolecular forces and a lower surface area-to-volume ratio, making it harder for oxygen to react with them during combustion.

Q53. Why are shorter-chain hydrocarbons more useful as fuels?
Answer: Shorter-chain hydrocarbons are more useful as fuels because they ignite more easily, burn more cleanly, and release energy quickly. They are also more volatile and produce fewer pollutants when combusted. This makes them suitable for engines where quick and efficient combustion is required, such as in cars and planes.

Q54. Explain why hydrocarbons with small molecules are preferred in car engines.
Answer: Hydrocarbons with small molecules are preferred in car engines because they are more flammable and combust more efficiently. They vaporise easily, allowing them to mix well with air and burn completely, producing a steady and powerful energy release. This results in better engine performance and less harmful emissions.

Q55. What are the products of the complete combustion of a hydrocarbon?
Answer: The complete combustion of a hydrocarbon produces carbon dioxide and water. This happens when there is a sufficient supply of oxygen, allowing all the carbon in the hydrocarbon to be fully oxidised to carbon dioxide, and all the hydrogen to be oxidised to water. This type of combustion releases a large amount of energy.

Q56. Write a balanced symbol equation for the complete combustion of propane (C_3H_8).
Answer: $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

Q57. Write a balanced equation for the complete combustion of butane (C_4H_{10}).
Answer: $2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$

Q58. Why is complete combustion preferred over incomplete combustion?
Answer: Complete combustion is preferred because it releases more energy and produces fewer harmful substances. It results in carbon dioxide and water, whereas incomplete combustion produces carbon monoxide or soot, which are dangerous. Carbon monoxide is toxic, and soot can pollute the air and damage engines.

Q59. What two elements in hydrocarbons are oxidised during combustion?
Answer: The two elements in hydrocarbons that are oxidised during combustion are carbon and hydrogen. Carbon atoms are oxidised to form carbon dioxide, and hydrogen atoms are oxidised to form water. This oxidation releases energy in the form of heat and light.

Q60. Explain the environmental impact of carbon dioxide produced during combustion of hydrocarbons.
Answer: Carbon dioxide is a greenhouse gas. When released in large amounts from the combustion of hydrocarbons, it traps heat in the Earth’s atmosphere, leading to global warming and climate change. This contributes to rising sea levels, extreme weather conditions, and disruption of ecosystems.

Q61. How does the energy released from combustion relate to the size of the hydrocarbon molecule?
Answer: Larger hydrocarbon molecules generally release more energy when combusted because they contain more carbon and hydrogen atoms. More bonds are broken and formed during combustion, releasing more energy. However, they may also burn less cleanly if not enough oxygen is present.

Q62. What is meant by the term 'viscosity' when describing hydrocarbons?
Answer: Viscosity refers to the thickness or resistance to flow of a liquid. In hydrocarbons, high viscosity means the substance flows slowly (like oil), while low viscosity means it flows easily (like petrol). Larger hydrocarbons usually have higher viscosity due to stronger intermolecular forces.

Q63. Why do larger hydrocarbons flow more slowly than smaller ones?
Answer: Larger hydrocarbons flow more slowly because they have stronger intermolecular forces, which increase their viscosity. These stronger forces make it more difficult for the molecules to move past one another, making the liquid thicker and less runny.

Q64. Why do smaller hydrocarbons ignite more easily than larger ones?
Answer: Smaller hydrocarbons ignite more easily because they are more volatile, meaning they evaporate quickly and mix well with air. This makes them easier to burn. They also have weaker intermolecular forces, which require less energy to overcome during ignition.

Q65. What is the colour and state of bromine water before it reacts?
Answer: Before it reacts, bromine water is an orange solution. It is a liquid and used as a test for the presence of unsaturated compounds like alkenes. The orange colour is due to dissolved bromine molecules.

Q66. Describe what happens when an alkene is added to bromine water.
Answer: When an alkene is added to bromine water, the orange colour quickly disappears and the solution becomes colourless. This is because the alkene reacts with bromine in an addition reaction, forming a colourless dibromo compound. This reaction confirms the presence of a double bond.

Q67. How can you use bromine water to distinguish between an alkane and an alkene?
Answer: To distinguish between an alkane and an alkene, add bromine water to both. The alkene will decolourise the orange bromine water due to an addition reaction with the double bond. The alkane will not react, and the bromine water will stay orange.

Q68. What type of hydrocarbon is produced alongside alkenes during cracking?
Answer: During cracking, alkanes are produced alongside alkenes. This process breaks down large hydrocarbon molecules into smaller, more useful ones. Alkanes are saturated hydrocarbons, and they can be used as fuels.

Q69. Why is cracking important in the oil industry?
Answer: Cracking is important because it helps convert large, less useful hydrocarbon molecules

into smaller ones that are more useful, such as petrol and alkenes for making plastics. It meets the high demand for fuels and raw materials in the chemical industry.

Q70. What are the two main methods of cracking?
Answer: The two main methods of cracking are catalytic cracking and steam cracking. Catalytic cracking uses heat and a catalyst, while steam cracking uses heat and steam at very high temperatures to break down large hydrocarbons.

Q71. Describe the conditions required for catalytic cracking.
Answer: Catalytic cracking requires a temperature of about 500°C and the use of a catalyst, usually made of porous ceramics like alumina or silica. The catalyst speeds up the reaction and lowers the energy required, making the process more efficient.

Q72. What conditions are needed for steam cracking?
Answer: Steam cracking requires very high temperatures, often over 850°C, and the presence of steam. The hydrocarbon vapour is mixed with steam and heated rapidly, causing the molecules to break down into smaller hydrocarbons, mainly alkenes.

Q73. What is the purpose of using a catalyst in catalytic cracking?
Answer: A catalyst is used to speed up the cracking reaction without being used up. It allows the reaction to occur at lower temperatures and pressures, saving energy and increasing efficiency. This makes the process more economical and faster.

Q74. Give a reason why steam cracking needs a high temperature.
Answer: Steam cracking needs a high temperature to provide enough energy to break the strong covalent bonds in large hydrocarbon molecules. This ensures that the molecules break down quickly into smaller, more useful hydrocarbons like ethene and propene.

Q75. Why is there a high demand for the products of cracking?
Answer: There is high demand for the products of cracking because they include shorter-chain alkanes used as fuels and alkenes used to make polymers and other chemicals. Fuels are needed for transport and industry, while alkenes are important raw materials in manufacturing plastics and other materials.

Q76. Explain how cracking helps meet the demand for fuels.
Answer: Cracking helps meet the demand for fuels by breaking down large, less useful hydrocarbon molecules into smaller, more useful ones like petrol and diesel. These smaller hydrocarbons are in higher demand because they burn more easily and are better suited for fuels used in cars and other transport. Cracking also produces alkenes, which are valuable for making plastics.

Q77. What is the role of alkenes in the production of polymers?
Answer: Alkenes are used as the starting materials in the production of polymers because they contain a double bond that allows them to join together in a chemical reaction called polymerisation.

During this process, many alkene molecules link together to form a long chain called a polymer. These polymers are used to make materials like plastics, which are widely used in everyday products.

Q78. Why are alkenes more reactive than alkanes?
Answer: Alkenes are more reactive than alkanes because they have a carbon-carbon double bond. This double bond is more chemically reactive than the single bonds found in alkanes. The double bond can easily break and allow new atoms to add to the molecule, making alkenes useful in many chemical reactions, including polymerisation and addition reactions.

Q79. Give one everyday product made from polymers produced using alkenes.
Answer: One everyday product made from polymers produced using alkenes is a plastic shopping bag. These bags are typically made from poly(ethene), which is formed by the polymerisation of ethene, an alkene. This material is lightweight, flexible, and waterproof, making it suitable for carrying items.

Q80. What is a balanced chemical equation for cracking a long-chain hydrocarbon into an alkane and an alkene?
Answer: A balanced chemical equation for cracking decane ($C_{10}H_{22}$) into octane (C_8H_{18}) and ethene (C_2H_4) is:
$C_{10}H_{22} \rightarrow C_8H_{18} + C_2H_4$
This shows that the long-chain alkane decane is broken down into a smaller alkane (octane) and an alkene (ethene) during cracking.

Q81. Why is cracking described as a thermal decomposition reaction?
Answer: Cracking is described as a thermal decomposition reaction because it involves breaking down large hydrocarbon molecules into smaller ones using heat. In thermal decomposition, a substance is chemically changed into two or more simpler substances by heating. Cracking uses high temperatures and sometimes a catalyst to speed up the reaction and split large molecules.

Q82. What is the chemical test used to identify an alkene?
Answer: The chemical test used to identify an alkene is the bromine water test. When an alkene is added to bromine water, the orange colour of the bromine water quickly disappears because the alkene reacts with the bromine in an addition reaction. This reaction does not happen with alkanes, so it's a useful way to distinguish alkenes from alkanes.

Q83. Describe a practical method to show that alkenes are formed during cracking.
Answer: To show that alkenes are formed during cracking, heat a long-chain hydrocarbon with a ceramic catalyst in a test tube. Collect the gases produced in another test tube using a delivery tube. Then, shake the gas with bromine water. If the orange colour of the bromine water disappears, it confirms the presence of an alkene, showing that cracking produced alkenes.

Q84. Why can larger hydrocarbons be less useful than smaller ones?
Answer: Larger hydrocarbons are less useful than smaller ones because they are more difficult to

ignite, have higher boiling points, and do not flow as easily. These properties make them less practical for use as fuels. Smaller hydrocarbons are more flammable and better suited for engines and heating, which makes them more desirable for everyday use.

Q85. What type of reaction occurs when a hydrocarbon is burned in plenty of oxygen?
Answer: When a hydrocarbon is burned in plenty of oxygen, a complete combustion reaction occurs. This type of reaction produces carbon dioxide and water and releases energy. Complete combustion happens when there is enough oxygen for the fuel to react fully, resulting in cleaner burning and more efficient energy release.

Q86. Why do hydrocarbons release energy when burned?
Answer: Hydrocarbons release energy when burned because the chemical bonds in the hydrocarbon molecules break and new bonds form in the products (carbon dioxide and water). The formation of these new bonds releases more energy than is needed to break the original bonds, resulting in an overall release of energy as heat and light.

Q87. What are the dangers of incomplete combustion of hydrocarbons?
Answer: Incomplete combustion of hydrocarbons can produce carbon monoxide, a toxic gas, and soot (carbon particles). Carbon monoxide is dangerous because it binds to haemoglobin in the blood and prevents oxygen from being carried around the body, which can lead to unconsciousness or death. Soot can cause respiratory problems and environmental damage.

Q88. What product is formed during incomplete combustion that is dangerous to humans?
Answer: Carbon monoxide (CO) is formed during incomplete combustion and is dangerous to humans. It is a colourless, odourless gas that can be fatal because it interferes with the body's ability to carry oxygen in the blood. Even small amounts can cause serious health problems or death if inhaled over time.

Q89. What is the difference between alkanes and alkenes in terms of bonds?
Answer: The main difference between alkanes and alkenes is the type of bond between carbon atoms. Alkanes have only single bonds between carbon atoms, making them saturated hydrocarbons. Alkenes, on the other hand, have at least one double bond between carbon atoms, making them unsaturated and more reactive than alkanes.

Q90. Why is it useful to produce alkenes from larger hydrocarbons?
Answer: It is useful to produce alkenes from larger hydrocarbons because alkenes are valuable raw materials for making polymers, which are used in the manufacture of plastics and other useful products. Since crude oil contains fewer small alkenes naturally, cracking helps create more alkenes to meet industrial demand.

Q91. How does cracking support modern transportation?
Answer: Cracking supports modern transportation by producing more of the smaller hydrocarbons like petrol and diesel that are needed for fuels. These smaller molecules are essential for powering

vehicles, such as cars, lorries, and airplanes. Without cracking, there would not be enough of these fuels to meet transportation needs.

Q92. How does the use of hydrocarbons support everyday life?
Answer: The use of hydrocarbons supports everyday life by providing fuels for heating, cooking, electricity generation, and transportation. They are also used as raw materials in the production of plastics, medicines, cosmetics, and other important chemicals. Hydrocarbons play a central role in many aspects of modern living.

Q93. What gases are released into the atmosphere during combustion of hydrocarbons?
Answer: During the combustion of hydrocarbons, carbon dioxide and water vapour are released into the atmosphere if the combustion is complete. If the combustion is incomplete, other gases like carbon monoxide, unburned hydrocarbons, and particulates (soot) may also be released, along with nitrogen oxides depending on the temperature.

Q94. Why does cracking help reduce waste from crude oil?
Answer: Cracking helps reduce waste from crude oil by converting larger, less useful hydrocarbon fractions into smaller, more useful ones. Without cracking, many of the large hydrocarbons from crude oil would go unused or be less valuable. Cracking increases the efficiency of crude oil usage and reduces the amount of waste.

Q95. Name one industrial use of the products formed from cracking.
Answer: One industrial use of the products formed from cracking is the production of plastics. The alkenes produced during cracking, such as ethene and propene, are used as raw materials in the polymer industry to make a wide range of plastic products including bottles, packaging materials, and containers.

Q96. What does it mean if a hydrocarbon is saturated?
Answer: If a hydrocarbon is saturated, it means that all the bonds between carbon atoms are single bonds. This means the hydrocarbon contains the maximum number of hydrogen atoms possible. Alkanes are examples of saturated hydrocarbons. They are generally less reactive than unsaturated hydrocarbons because they do not have double or triple bonds.

Q97. What does it mean if a hydrocarbon is unsaturated?
Answer: An unsaturated hydrocarbon contains at least one double or triple bond between carbon atoms. This means that the molecule has fewer hydrogen atoms than it could have if all the bonds were single. Alkenes and alkynes are examples of unsaturated hydrocarbons. These compounds are usually more reactive than saturated ones.

Q98. How can you tell from a formula if a hydrocarbon is an alkene?
Answer: You can tell that a hydrocarbon is an alkene if its general formula follows CnH2n and it contains at least one double bond between carbon atoms. For example, ethene has the formula C_2H_4, which fits this pattern. The presence of the double bond is the key feature that defines it as an alkene.

Q99. Describe how hydrocarbons are separated before cracking.
Answer: Before cracking, hydrocarbons are separated from crude oil by fractional distillation. In this process, crude oil is heated, and its components are separated based on their boiling points. The smaller, lighter fractions rise to the top of the fractionating column, while the heavier ones stay near the bottom. Larger fractions are collected for cracking.

Q100. Why are hydrocarbons with low boiling points used in camping stoves?
Answer: Hydrocarbons with low boiling points are used in camping stoves because they can easily change into gases and ignite at low temperatures. This makes them convenient and efficient for portable heating and cooking. Examples include propane and butane, which are stored as liquids in pressurised containers and vaporise when released.

Q101. What is the general formula for alkenes?
Answer: The general formula for alkenes is C_nH_{2n}. This shows that for every 'n' number of carbon atoms, there are '2n' hydrogen atoms. This formula reflects the fact that alkenes are unsaturated hydrocarbons with one carbon-carbon double bond, which reduces the number of hydrogen atoms compared to alkanes.

Q102. Why are alkenes described as unsaturated hydrocarbons?
Answer: Alkenes are described as unsaturated hydrocarbons because they contain at least one carbon-carbon double bond in their structure. This double bond means they do not have the maximum number of hydrogen atoms possible, making them "unsaturated." The presence of this double bond allows alkenes to undergo addition reactions, unlike saturated hydrocarbons.

Q103. How many hydrogen atoms are there in a molecule of propene?
Answer: Propene has the molecular formula C_3H_6. This means it contains 3 carbon atoms and 6 hydrogen atoms. The formula follows the general rule for alkenes, C_nH_{2n}. In this case, n = 3, so the number of hydrogen atoms is 2 × 3 = 6.

Q104. What is the molecular formula of butene?
Answer: The molecular formula of butene is C_4H_8. This is because butene contains four carbon atoms and, following the general formula for alkenes (C_nH_{2n}), it will have 2 × 4 = 8 hydrogen atoms.

Q105. How is an alkene different from an alkane in terms of bonding?
Answer: The main difference is that alkenes contain at least one carbon-carbon double bond, whereas alkanes only have single bonds between carbon atoms. This double bond in alkenes makes them unsaturated and more reactive, while the single bonds in alkanes make them saturated and generally less reactive.

Q106. Which functional group is found in all alkenes?
Answer: The functional group found in all alkenes is the carbon-carbon double bond, represented as C=C. This group is responsible for the chemical reactivity of alkenes, especially in addition reactions with substances like hydrogen, halogens, and steam.

Q107. Name the first four alkenes in the homologous series.
Answer: The first four alkenes in the homologous series are: ethene (C_2H_4), propene (C_3H_6), butene (C_4H_8), and pentene (C_5H_{10}). These alkenes follow the general formula C_nH_{2n} and increase by one carbon atom in each successive member.

Q108. Write the displayed formula for ethene.
Answer: The displayed formula for ethene shows two carbon atoms joined by a double bond. Each carbon is also bonded to two hydrogen atoms. The structure is:
$H_2C{=}CH_2$.
This clearly shows the double bond between the carbon atoms and the arrangement of the hydrogen atoms.

Q109. Write the molecular formula for pentene.
Answer: The molecular formula for pentene is C_5H_{10}. It has 5 carbon atoms and 10 hydrogen atoms, following the general formula for alkenes (C_nH_{2n}), where n = 5.

Q110. Why do alkenes burn with a smoky flame?
Answer: Alkenes burn with a smoky flame because they have a higher carbon content compared to alkanes, and they often burn incompletely in air. Incomplete combustion leads to the formation of carbon particles (soot), which produce a smoky flame when burned.

Q111. What type of combustion do alkenes undergo in air?
Answer: Alkenes typically undergo incomplete combustion in air. This happens because the double bond makes them burn less efficiently, and not enough oxygen is usually available to fully oxidise the carbon to carbon dioxide, resulting in carbon monoxide or soot.

Q112. What is the product when ethene reacts with hydrogen?
Answer: When ethene reacts with hydrogen, the double bond breaks and hydrogen atoms are added across the double bond. The product is ethane, an alkane with the molecular formula C_2H_6. This reaction is known as hydrogenation.

Q113. What condition is needed for the hydrogenation of alkenes?
Answer: The hydrogenation of alkenes requires a catalyst and heat. The typical catalyst used is nickel, and the reaction is carried out at a temperature of about 150°C. This condition helps break the double bond and allows hydrogen to add across it.

Q114. What type of reaction occurs when bromine reacts with ethene?
Answer: When bromine reacts with ethene, an addition reaction occurs. The bromine atoms add across the carbon-carbon double bond of ethene, forming dibromoethane. This reaction removes the double bond, converting ethene into a saturated compound.

Q115. What change happens to the carbon-carbon double bond during an addition reaction?
Answer: During an addition reaction, the carbon-carbon double bond breaks and each carbon forms

a new single bond with another atom or group. This changes the molecule from unsaturated (double bond) to saturated (single bonds only), allowing atoms to add across the former double bond.

Q116. What is the product of ethene reacting with bromine?
Answer: The product of ethene reacting with bromine is 1,2-dibromoethane. The bromine atoms add across the double bond in ethene, forming a saturated molecule where each carbon that was part of the double bond is now bonded to a bromine atom.

Q117. Describe the test for an alkene using bromine water.
Answer: To test for an alkene, bromine water is added to the compound. If the compound is an alkene, the bromine water will quickly change from orange-brown to colourless. This happens because the bromine reacts with the double bond in the alkene, forming a colourless addition product.

Q118. Why does bromine water decolourise when added to an alkene?
Answer: Bromine water decolourises because the bromine atoms react with the carbon-carbon double bond in the alkene. This addition reaction breaks the double bond and incorporates the bromine atoms into the molecule, forming a colourless compound like dibromoethane.

Q119. Write the structural formula of the product formed when ethene reacts with chlorine.
Answer: The product is 1,2-dichloroethane. The structural formula is:
$CH_2Cl–CH_2Cl$
In this compound, the chlorine atoms have added across the double bond of ethene, resulting in a saturated molecule.

Q120. What is formed when ethene reacts with steam?
Answer: When ethene reacts with steam, ethanol is formed. The reaction adds a hydrogen atom and a hydroxyl group (–OH) across the double bond, converting ethene into an alcohol. This process is called hydration.

Q121. What are the conditions required for the reaction of ethene with steam?
Answer: The reaction of ethene with steam requires a temperature of around 300°C, a pressure of about 60–70 atmospheres, and a phosphoric acid catalyst. These conditions allow steam to add across the double bond of ethene to form ethanol.

Q122. What is the name of the alcohol formed from the reaction of ethene and water?
Answer: The alcohol formed from the reaction of ethene and water (steam) is ethanol. It is produced by the addition of steam across the double bond of ethene in the presence of a catalyst under high temperature and pressure.

Q123. Why are addition reactions important in the chemical industry?
Answer: Addition reactions are important in the chemical industry because they are used to make a wide range of useful products, such as alcohols, polymers, and halogenoalkanes. These products serve as raw materials for fuels, plastics, pharmaceuticals, and many everyday chemicals.

Q124. What type of reaction is the addition of hydrogen to an alkene?

Answer: The addition of hydrogen to an alkene is called a hydrogenation reaction. It is a type of addition reaction where hydrogen atoms add across the double bond, turning the unsaturated alkene into a saturated alkane.

Q125. What type of bond is broken when an alkene undergoes an addition reaction?

Answer: When an alkene undergoes an addition reaction, the carbon-carbon double bond is broken. Specifically, the π (pi) bond in the double bond is broken, allowing new atoms or groups to form single bonds with the carbon atoms, making the compound saturated.

Q126. Draw the displayed formula of propene.

Answer: The displayed formula of propene shows three carbon atoms. Two carbon atoms are joined by a double bond (C=C), and the third carbon is single-bonded to one of the double-bonded carbons. Each carbon has enough hydrogen atoms to make four bonds in total. The structure is:

```
   H   H
   |   |
H–C=C–C–H
   |   |
   H   H
```

Q127. Show the structural formula of the product when propene reacts with iodine.

Answer: When propene reacts with iodine, it undergoes an addition reaction where the double bond breaks and one iodine atom is added to each carbon from the original double bond. The product is 1,2-diiodopropane. Its structural formula is: CH_3–CHI–CH_2I.

Q128. How can you distinguish between an alkene and an alkane using a chemical test?

Answer: You can distinguish between an alkene and an alkane using bromine water. Alkenes decolourise bromine water from orange to colourless due to the addition reaction with the double bond. Alkanes do not react with bromine water under normal conditions, so the orange colour remains.

Q129. What happens to the number of hydrogen atoms in a molecule when an alkene reacts with hydrogen?

Answer: When an alkene reacts with hydrogen, the double bond in the molecule breaks and two additional hydrogen atoms are added across the double bond. This converts the alkene into an alkane, which has more hydrogen atoms and only single bonds between the carbon atoms.

Q130. What is the product when butene reacts with water?

Answer: When butene reacts with water in the presence of an acid catalyst, it undergoes a hydration reaction. This forms an alcohol. The product is butanol. Depending on the conditions and position of the double bond, either butan-2-ol or butan-1-ol may form.

Q131. Explain why alkenes are more reactive than alkanes.

Answer: Alkenes are more reactive than alkanes because they have a carbon-carbon double bond. This double bond contains a π (pi) bond that is weaker than the σ (sigma) bond and breaks easily during reactions. This makes alkenes more likely to react with substances like halogens, hydrogen, and water.

Q132. Describe the bonding in an ethene molecule.

Answer: In ethene, each carbon atom forms three sigma bonds: two with hydrogen atoms and one with the other carbon. The fourth bond between the carbon atoms is a pi bond, which is formed by the sideways overlap of p-orbitals. The presence of the pi bond makes the molecule more reactive.

Q133. How does the presence of a double bond affect the shape of an alkene molecule?

Answer: The presence of a double bond in alkenes creates a planar (flat) region around the double-bonded carbon atoms. This restricts rotation around the double bond, making the molecule more rigid in that area. The bond angles around the carbon atoms in the double bond are about 120 degrees.

Q134. Which element must be present in all halogenation reactions of alkenes?

Answer: The element that must be present in all halogenation reactions of alkenes is a halogen, such as chlorine (Cl_2), bromine (Br_2), or iodine (I_2). These elements react with the double bond in the alkene, adding across it to form dihaloalkanes.

Q135. What is the purpose of using a catalyst in the hydrogenation of alkenes?

Answer: A catalyst, typically nickel, is used in the hydrogenation of alkenes to speed up the reaction without being used up itself. The catalyst lowers the activation energy needed for hydrogen to add across the double bond, turning the alkene into a saturated alkane more efficiently.

Q136. Draw the displayed formula of butene reacting with chlorine.

Answer: In this reaction, chlorine adds across the double bond of butene, breaking the double bond and forming 1,2-dichlorobutane. The displayed formula shows a four-carbon chain with one chlorine atom attached to each of the previously double-bonded carbon atoms.

```
   H          H
   |          |
H–C–C–C–C–H
   |          |
  Cl       Cl
```

Q137. Write the balanced equation for the reaction between ethene and bromine.

Answer: The balanced chemical equation is:

$C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$

This shows that one molecule of ethene reacts with one molecule of bromine to form one molecule of dibromoethane, where the double bond is broken and bromine atoms add across it.

Q138. What is the main product formed from the hydration of ethene?
Answer: When ethene reacts with water (steam) in the presence of a phosphoric acid catalyst at high temperature and pressure, the main product is ethanol. This reaction is used industrially to produce ethanol from ethene in a continuous process.

Q139. Why are alkenes often used as starting materials in making polymers?
Answer: Alkenes are used as starting materials in polymer production because their double bonds can open up and link with other alkene molecules. This allows them to form long chains called addition polymers, which are used in making plastics and many other synthetic materials.

Q140. Describe the appearance of bromine water before and after it reacts with an alkene.
Answer: Before reacting with an alkene, bromine water is orange-brown in colour. When it reacts with an alkene, the double bond opens and bromine atoms add across it, causing the orange colour to disappear and the solution to turn colourless.

Q141. What happens to the double bond in ethene when it reacts with iodine?
Answer: When ethene reacts with iodine, the double bond breaks, and each of the two carbon atoms forms a new bond with an iodine atom. This forms 1,2-diiodoethane. The reaction is an example of an addition reaction and removes the characteristic reactivity of the double bond.

Q142. What does the term 'addition reaction' mean?
Answer: An addition reaction is a type of chemical reaction where atoms are added to a molecule without taking any atoms away. In the case of alkenes, the double bond opens up and new atoms, like hydrogen or halogens, add across the two carbon atoms, forming a saturated product.

Q143. What type of molecule is produced when ethene reacts with chlorine?
Answer: When ethene reacts with chlorine, it undergoes an addition reaction to form 1,2-dichloroethane. This molecule is a dihaloalkane, meaning it has two halogen atoms (in this case, chlorine) attached to different carbon atoms.

Q144. Give one industrial use of the hydrogenation of alkenes.
Answer: One industrial use of hydrogenation is in the food industry, where vegetable oils (which contain unsaturated alkenes) are hydrogenated to form solid fats like margarine. This changes the consistency and increases the shelf life of the product.

Q145. Describe what is meant by a homologous series.
Answer: A homologous series is a group of organic compounds that have the same functional group and similar chemical properties. Each member differs from the next by a CH_2 group. For example, alkanes and alkenes are both homologous series with predictable trends in properties.

Q146. What colour change is observed when ethene is bubbled through bromine water?
Answer: When ethene is bubbled through bromine water, the orange-brown colour of the bromine water disappears and becomes colourless. This is because ethene reacts with bromine in an addition reaction, forming dibromoethane.

Q147. How many carbon atoms are there in pentene?
Answer: Pentene has five carbon atoms. The name "pentene" comes from "pent-" meaning five and "-ene" indicating the presence of a double bond. It can exist as different isomers depending on the position of the double bond.

Q148. Which product is formed when ethene reacts with HCl?
Answer: When ethene reacts with hydrogen chloride (HCl), the double bond breaks and the hydrogen and chlorine atoms add across it. The product is chloroethane, which is a haloalkane with the molecular formula C_2H_5Cl.

Q149. Why do alkenes burn with more soot than alkanes?
Answer: Alkenes burn with a more sooty, smoky flame than alkanes because they have a higher carbon to hydrogen ratio. This makes their combustion less complete, leading to more unburnt carbon particles, which appear as soot in the flame.

Q150. Draw the fully displayed structure of the product when propene reacts with hydrogen.
Answer: When propene reacts with hydrogen, the double bond breaks and hydrogen atoms add across the double bond, forming propane. The fully displayed structure is:

```
    H   H   H
    |   |   |
H–C–C–C–H
    |   |   |
    H   H   H
```

Q151. What is the functional group present in alcohols?
Answer: The functional group present in alcohols is the **–OH** group, which is called a **hydroxyl group**. This group is attached to a carbon atom and is responsible for the chemical properties of alcohols. It allows alcohols to be soluble in water and to undergo reactions like combustion, oxidation, and reaction with metals such as sodium.

Q152. Write the displayed formula for ethanol.
Answer: The displayed formula for ethanol shows how all atoms are connected:
H–C–C–O–H with three hydrogen atoms bonded to the first carbon and two to the second, plus one hydrogen on the oxygen. The full structure is:

```
H H
| |
H–C–C–O–H
| |
H H
```

Q153. How many carbon atoms does propanol have?
Answer: Propanol has **three carbon atoms** in its structure. It is an alcohol from the homologous

series where each member differs by a $–CH_2$ group. Propanol comes after methanol (1 carbon) and ethanol (2 carbons), and its molecular formula is **C_3H_8O**.

Q154. Describe what happens when ethanol reacts with sodium.
Answer: When ethanol reacts with sodium, a vigorous reaction occurs. Sodium moves around on the surface of the ethanol and may fizz as it reacts. A **salt called sodium ethoxide** is formed, and **hydrogen gas** is released. This reaction is similar to how sodium reacts with water, but it is slower.

Q155. What gas is released when alcohols react with sodium?
Answer: The gas released is **hydrogen gas (H_2)**. This is seen as fizzing or bubbling during the reaction. It happens because the hydroxyl group in the alcohol reacts with sodium, replacing the hydrogen atom from the –OH group.

Q156. What happens when methanol is burned in air?
Answer: When methanol is burned in air, it undergoes **complete combustion** if there is enough oxygen. It produces **carbon dioxide (CO_2)** and **water (H_2O)**. The flame is usually pale blue and almost invisible. Combustion of methanol releases heat energy.

Q157. Write a word equation for the combustion of butanol.
Answer: The word equation is:
Butanol + Oxygen → Carbon dioxide + Water
This shows that during combustion, butanol reacts with oxygen from the air to produce carbon dioxide and water, releasing heat.

Q158. Describe the solubility of ethanol in water.
Answer: Ethanol is **very soluble in water**. This is because of the –OH group in ethanol, which can form **hydrogen bonds** with water molecules. As a result, ethanol and water mix together in all proportions to form a clear solution.

Q159. What is observed when an alcohol is added to water?
Answer: When an alcohol like ethanol is added to water, it **dissolves easily** and forms a clear, colourless solution. There is **no visible reaction** like fizzing or colour change, but the mixture may feel slightly warm due to mixing energy.

Q160. What type of compound is formed when an alcohol reacts with an oxidising agent?
Answer: When an alcohol reacts with an oxidising agent, it is converted into a **carboxylic acid** (if fully oxidised) or an **aldehyde** (if partially oxidised). For example, ethanol oxidises to form ethanoic acid. Oxidising agents used include potassium dichromate or oxygen from the air.

Q161. Describe a use of methanol.
Answer: Methanol is commonly used as a **solvent** in chemical processes and as a **fuel** in some engines or camping stoves. It is also used as a feedstock in the production of formaldehyde and plastics. However, methanol is toxic and must be handled with care.

Q162. Name one common use of ethanol in the home or industry.
Answer: Ethanol is widely used in the home and industry as a **solvent** in perfumes, cosmetics, and medicines. It is also used as a **fuel additive** in petrol and is the **main alcohol in alcoholic drinks**.

Q163. What is the main alcohol found in alcoholic drinks?
Answer: The main alcohol found in alcoholic drinks is **ethanol**. It is produced through the fermentation of sugars using yeast and is responsible for the intoxicating effects of alcoholic beverages.

Q164. Name one use of propanol.
Answer: Propanol is used as a **solvent** in the pharmaceutical and cosmetics industries. It is also used in **cleaning products**, especially where fast evaporation is needed, such as in screen or lens cleaners.

Q165. What conditions are required for the fermentation of sugars using yeast?
Answer: Fermentation using yeast requires **warm temperatures (about 30°C–40°C)**, **absence of air (anaerobic conditions)**, and the presence of **sugar solution**. These conditions help yeast to break down sugars into ethanol and carbon dioxide efficiently.

Q166. What is the role of yeast in fermentation?
Answer: Yeast acts as a **biological catalyst (enzyme)** in fermentation. It contains enzymes that break down sugars such as glucose into **ethanol and carbon dioxide**. This process is done anaerobically, without oxygen.

Q167. What type of sugar is used in fermentation?
Answer: The main type of sugar used in fermentation is **glucose** or other simple sugars like **fructose** or **sucrose**. These sugars are easily broken down by enzymes in yeast to produce ethanol and carbon dioxide.

Q168. What gas is produced during fermentation?
Answer: The gas produced during fermentation is **carbon dioxide (CO_2)**. It is released as a by-product when sugars are converted into ethanol by yeast.

Q169. Why is the fermentation process carried out in the absence of air?
Answer: Fermentation is carried out in the **absence of air** to ensure that yeast undergoes **anaerobic respiration**, which produces ethanol. If air (oxygen) is present, the yeast will perform **aerobic respiration** instead, producing carbon dioxide and water but no ethanol.

Q170. At what temperature is fermentation most efficient?
Answer: Fermentation is most efficient at around **30°C to 40°C**. At this temperature range, the enzymes in yeast work best. If the temperature is too low, the process slows down. If it's too high, the yeast cells may die.

Q171. How can you recognise an alcohol from its name?
Answer: You can recognise an alcohol from its name by the **"–ol" ending**. For example, ethanol, methanol, and propanol are all alcohols. This naming convention indicates the presence of the –OH functional group.

Q172. Which functional group helps to identify alcohols?
Answer: The **hydroxyl group (–OH)** is the functional group that helps to identify alcohols. It is this group that gives alcohols their typical chemical properties, like solubility in water and reactions with metals and oxidising agents.

Q173. How can you tell from a formula that a compound is an alcohol?
Answer: In a molecular formula, an alcohol contains the **–OH group** bonded to a carbon atom. For example, the formula **C_2H_5OH** shows that it is ethanol. The presence of an oxygen and a hydrogen together (OH) attached to a carbon is the key indicator.

Q174. Name the first four members of the alcohol homologous series.
Answer: The first four members of the alcohol homologous series are:

1. Methanol (CH_3OH)
2. Ethanol (C_2H_5OH)
3. Propanol (C_3H_7OH)
4. Butanol (C_4H_9OH)
   Each one differs from the next by a $–CH_2–$ group.

Q175. What is a homologous series?
Answer: A homologous series is a group of compounds with the **same functional group**, **similar chemical properties**, and a **gradual change in physical properties** (like boiling point). Each member differs from the next by a **$–CH_2–$ unit**. Examples include alkanes, alkenes, and alcohols.

Q176. What happens to the reactivity of alcohols as the number of carbon atoms increases?
Answer: As the number of carbon atoms in an alcohol increases, the reactivity generally decreases. This is because the larger carbon chain makes the molecule bulkier and less able to interact easily with other reacting species. Also, longer chains may reduce the polarity of the -OH group, which plays a key role in the chemical reactions of alcohols. As a result, alcohols with longer carbon chains tend to react more slowly in many reactions compared to smaller alcohols.

Q177. Describe one way to test for the presence of alcohol in a liquid.
Answer: One way to test for alcohol is to react it with acidified potassium dichromate solution. When an alcohol is present, the solution changes colour from orange to green as the alcohol is oxidised and

the dichromate is reduced. This test is particularly useful for primary and secondary alcohols, which can be oxidised, whereas tertiary alcohols do not cause this colour change.

Q178. What product forms when an alcohol is oxidised?
Answer: When an alcohol is oxidised, it forms different products depending on the type of alcohol. Primary alcohols are oxidised to form carboxylic acids (through an intermediate aldehyde), secondary alcohols are oxidised to ketones, and tertiary alcohols generally do not oxidise easily. For example, ethanol (a primary alcohol) can be oxidised to ethanoic acid.

Q179. What is the functional group in carboxylic acids?
Answer: The functional group in carboxylic acids is the carboxyl group, which is written as –COOH. This group includes a carbon atom double bonded to an oxygen atom (C=O) and also bonded to a hydroxyl group (–OH). This functional group is responsible for the acidic properties of carboxylic acids.

Q180. Name the carboxylic acid with two carbon atoms.
Answer: The carboxylic acid with two carbon atoms is called ethanoic acid. It is the second member in the homologous series of carboxylic acids and is commonly known as acetic acid. Its chemical formula is CH_3COOH.

Q181. Write the displayed formula for ethanoic acid.
Answer: The displayed formula for ethanoic acid is:
H
|
H–C–C(=O)–OH
|
H
It shows two carbon atoms: one bonded to three hydrogen atoms (a methyl group), and the second carbon is double bonded to an oxygen atom and also bonded to an –OH group, forming the –COOH functional group.

Q182. Describe what happens when a carboxylic acid reacts with a carbonate.
Answer: When a carboxylic acid reacts with a carbonate, a chemical reaction occurs that produces a salt, water, and carbon dioxide gas. The reaction is a typical acid–carbonate reaction. For example, ethanoic acid reacts with sodium carbonate to form sodium ethanoate, water, and carbon dioxide. Effervescence (fizzing) is observed due to the release of carbon dioxide gas.

Q183. What gas is produced when carboxylic acids react with carbonates?
Answer: The gas produced when carboxylic acids react with carbonates is carbon dioxide (CO_2). This gas causes bubbling or fizzing during the reaction. It can be identified by passing it through limewater, which turns milky if carbon dioxide is present.

Q184. What is observed when a carboxylic acid dissolves in water?
Answer: When a carboxylic acid dissolves in water, it partially ionises to form hydrogen ions (H^+) and carboxylate ions ($RCOO^-$). This results in a weakly acidic solution. The pH is lower than 7, indicating acidity, but not as low as with strong acids. The acid does not fully dissociate, so the solution is not strongly acidic.

Q185. Do carboxylic acids fully ionise in water?
Answer: No, carboxylic acids do not fully ionise in water. They are weak acids, meaning only a small fraction of their molecules release hydrogen ions (H^+) in solution. Most of the acid molecules remain undissociated, so the concentration of hydrogen ions is relatively low compared to strong acids.

Q186. Why are carboxylic acids called weak acids?
Answer: Carboxylic acids are called weak acids because they do not fully dissociate into ions when dissolved in water. Only a small proportion of the acid molecules release hydrogen ions (H^+). This partial ionisation results in a less acidic solution compared to strong acids like hydrochloric acid, which dissociate completely in water.

Q187. How does the pH of a carboxylic acid compare to a strong acid of the same concentration?
Answer: The pH of a carboxylic acid is higher than that of a strong acid of the same concentration. This is because carboxylic acids only partially ionise in water, producing fewer hydrogen ions (H^+), which means the solution is less acidic. In contrast, strong acids fully ionise, producing a higher concentration of H^+ ions and resulting in a lower pH.

Q188. Describe what happens when a carboxylic acid reacts with an alcohol.
Answer: When a carboxylic acid reacts with an alcohol in the presence of an acid catalyst (usually sulfuric acid), an ester is formed along with water. This reaction is called esterification. It is a reversible reaction and typically carried out under heat to increase the rate of reaction and improve yield.

Q189. What is formed when a carboxylic acid reacts with an alcohol?
Answer: When a carboxylic acid reacts with an alcohol, an ester and water are formed. This reaction is known as esterification. For example, ethanoic acid reacts with ethanol to form ethyl ethanoate and water. The reaction is usually catalysed by concentrated sulfuric acid.

Q190. What catalyst is used in the reaction between a carboxylic acid and an alcohol?
Answer: The catalyst used in the reaction between a carboxylic acid and an alcohol is concentrated sulfuric acid (H_2SO_4). It speeds up the esterification reaction and also helps to remove water, driving the equilibrium toward ester formation.

Q191. Name the ester formed from ethanol and ethanoic acid.
Answer: The ester formed from ethanol and ethanoic acid is called ethyl ethanoate. This compound

has a sweet, fruity smell and is commonly used in perfumes and flavourings. It is formed through the reaction: ethanol + ethanoic acid → ethyl ethanoate + water.

Q192. How can you recognise a carboxylic acid from its name?
Answer: You can recognise a carboxylic acid from its name by looking for the suffix "-oic acid." This ending indicates that the compound contains a carboxyl group (–COOH). For example, methanoic acid and ethanoic acid are both carboxylic acids.

Q193. What does the –COOH group represent?
Answer: The –COOH group represents the carboxyl functional group found in carboxylic acids. It includes a carbon atom double bonded to an oxygen atom (C=O) and also bonded to a hydroxyl group (–OH). This group gives the compound its acidic properties.

Q194. How can you tell from a formula that a compound is a carboxylic acid?
Answer: You can tell a compound is a carboxylic acid from its formula if it contains the –COOH group. This group includes both a C=O and a –OH bonded to the same carbon atom. For example, CH_3COOH indicates a carboxylic acid because it includes the carboxyl group.

Q195. List the first four carboxylic acids in the homologous series.
Answer: The first four carboxylic acids in the homologous series are:

1. Methanoic acid (HCOOH)
2. Ethanoic acid (CH_3COOH)
3. Propanoic acid (CH_3CH_2COOH)
4. Butanoic acid ($CH_3CH_2CH_2COOH$)
Each one has one more $–CH_2–$ group than the one before.

Q196. What type of bonding is found in the functional group of carboxylic acids?
Answer: The functional group of carboxylic acids (–COOH) involves both covalent bonding and hydrogen bonding. The carbon is covalently bonded to both the hydroxyl (–OH) and the double-bonded oxygen (=O). Additionally, carboxylic acids can form hydrogen bonds with water and with other acid molecules due to the presence of the –OH group.

Q197. What type of reaction is it when a carboxylic acid reacts with a carbonate?
Answer: The reaction between a carboxylic acid and a carbonate is an acid–carbonate reaction. It is a type of neutralisation reaction in which an acid reacts with a base (carbonate) to form a salt, water, and carbon dioxide gas.

Q198. What is the general pH range for carboxylic acids?
Answer: The general pH range for carboxylic acids is around 3 to 6, depending on the concentration

and specific acid. Because they are weak acids, their pH is lower than neutral (7), but not as low as that of strong acids like hydrochloric acid.

Q199. Describe a test to show that carbon dioxide is produced in the reaction with a carbonate.
Answer: To test for carbon dioxide gas, pass the gas produced during the reaction into limewater (a solution of calcium hydroxide). If carbon dioxide is present, the limewater turns milky or cloudy due to the formation of calcium carbonate. This confirms that CO_2 was produced during the reaction.

Q200. What would you observe if ethanoic acid was added to sodium carbonate solution?
Answer: If ethanoic acid is added to sodium carbonate solution, you would observe bubbling or fizzing due to the production of carbon dioxide gas. This is a sign of a chemical reaction taking place. Additionally, a salt (sodium ethanoate) and water are also formed.

Q201. What is meant by the term "addition polymerisation"?
Answer: Addition polymerisation is a chemical reaction where many small molecules called monomers join together to form a large molecule called a polymer. This happens without the loss of any small molecules like water. In addition polymerisation, the monomers must have a double bond, which opens up and links with other monomers to create long chains.

Q202. What type of small molecules are used to make addition polymers?
Answer: The small molecules used to make addition polymers are usually alkenes or other molecules that contain a carbon-carbon double bond. These molecules are reactive because the double bond can open up and allow each monomer to link together in a chain.

Q203. Why are alkenes suitable monomers for addition polymerisation?
Answer: Alkenes are suitable monomers for addition polymerisation because they contain a carbon-carbon double bond. This double bond can break open and allow the carbon atoms to form new bonds with other alkene molecules, which is how the polymer chain is formed. Their reactivity makes them ideal for forming long chains.

Q204. What is the functional group present in alkene monomers?
Answer: The functional group present in alkene monomers is the carbon-carbon double bond, written as C=C. This double bond is responsible for the reactivity of the alkene and is what allows the polymerisation reaction to happen.

Q205. What happens to the double bond in alkenes during polymerisation?
Answer: During polymerisation, the double bond in the alkene monomer breaks. This allows each carbon atom that was part of the double bond to form a new single bond with another monomer. As a result, a long chain of monomers is formed, making up the polymer.

Q206. Give an example of an addition polymer made from ethene.
Answer: An example of an addition polymer made from ethene is poly(ethene), commonly known as

polythene. It is widely used in plastic bags, bottles, and containers. It is formed when many ethene molecules (monomers) join together in a long chain.

Q207. Give an example of an addition polymer made from propene.
Answer: An example of an addition polymer made from propene is poly(propene), also known as polypropylene. It is commonly used in packaging, ropes, plastic parts, and containers. It is made when many propene monomers join together in a chain.

Q208. What does the term "monomer" mean in polymer chemistry?
Answer: In polymer chemistry, the term "monomer" refers to a small molecule that can join together with other similar molecules through chemical reactions to form a polymer. Monomers are the building blocks of polymers, and in addition polymerisation, they usually contain a double bond.

Q209. What does the term "polymer" mean in polymer chemistry?
Answer: In polymer chemistry, a "polymer" is a large molecule made up of many repeating units called monomers that are chemically bonded together. Polymers can be natural, like proteins and DNA, or synthetic, like poly(ethene). They are formed through reactions like addition or condensation polymerisation.

Q210. What is meant by the term "repeating unit" in a polymer chain?
Answer: The repeating unit in a polymer chain is a specific arrangement of atoms that repeats over and over in the polymer. It represents the structure of one monomer after it has joined the polymer chain. It shows the pattern that forms the long chain structure of the polymer.

Q211. How can you identify the repeating unit in a polymer chain?
Answer: You can identify the repeating unit in a polymer chain by looking for the section of the polymer that repeats itself. This is often shown inside brackets with a subscript 'n' to show it repeats many times. The repeating unit corresponds to the monomer but with the double bond removed and extra bonds shown extending out of the brackets.

Q212. Draw the structure of ethene and show how it forms poly(ethene).
Answer:
Solution:
Ethene monomer:
$H_2C=CH_2$
Poly(ethene) repeating unit:
$[–CH_2–CH_2–]$□
The double bond in ethene breaks and each carbon forms a new bond with another CH_2 group, creating a long chain.

Q213. Draw the structure of propene and show how it forms poly(propene).
Answer:
Solution:

Propene monomer:
$CH_2=CH-CH_3$
Poly(propene) repeating unit:
$[-CH_2-CH(CH_3)-]$□
During polymerisation, the double bond breaks and the carbon atoms link to form a chain, with a CH_3 group as a side branch on alternate carbon atoms.

Q214. Why is no other molecule formed in addition polymerisation?
Answer: No other molecule is formed in addition polymerisation because the entire monomer is used up in forming the polymer. The double bonds simply open up and connect directly to other monomers. Unlike condensation polymerisation, there is no by-product like water or HCl.

Q215. What is the difference between a monomer and a repeating unit?
Answer: A monomer is the small molecule that starts the reaction and contains a double bond. The repeating unit is what the monomer becomes once it has joined the polymer chain. The repeating unit has single bonds where the double bond used to be and shows the basic structure that repeats.

Q216. Describe how the atoms in the monomer are arranged in the polymer.
Answer: In the polymer, the atoms from the monomer are rearranged so that the carbon-carbon double bond becomes a single bond. Each carbon then bonds to two hydrogen atoms and to other carbon atoms in the chain. Side groups, if present, remain attached in the same position as in the monomer.

Q217. How can you recognise an addition polymer from a diagram?
Answer: You can recognise an addition polymer from a diagram by looking for a repeating pattern of carbon atoms joined by single bonds. The diagram often includes square brackets around the repeating unit and an ‘n’ outside the brackets to show it repeats many times. No other molecules are shown as products.

Q218. How does the molecular structure of a monomer change during polymerisation?
Answer: During polymerisation, the double bond in the monomer opens up and becomes a single bond. This allows the carbon atoms to bond with carbon atoms from other monomers, forming a continuous chain. The atoms in the side groups remain unchanged, but the bonding arrangement changes to form the polymer.

Q219. Explain why the polymer has the same atoms as the monomer.
Answer: The polymer has the same atoms as the monomer because no atoms are lost or gained during addition polymerisation. The double bond in the monomer simply opens up and allows the molecule to link with others, so the atoms are rearranged but not removed or added.

Q220. Why are addition polymers called "addition" polymers?
Answer: They are called "addition" polymers because the monomers add together without the loss

of any small molecules. The name refers to the fact that the monomer units are added in a chain by opening up their double bonds and connecting directly, forming a polymer.

Q221. What is meant by the term "poly(ethene)"?
Answer: The term "poly(ethene)" means a polymer made from many ethene monomers. "Poly" means "many," so poly(ethene) refers to a long chain made by linking many ethene molecules together through addition polymerisation.

Q222. Why are the names of polymers usually written with "poly" in front?
Answer: The names of polymers are written with "poly" in front to show that they are made from many repeating monomer units. For example, poly(ethene) means the polymer is made from many ethene monomers. This naming helps to identify the type of monomer used to make the polymer.

Q223. Give the full name of the polymer made from chloroethene.
Answer: The full name of the polymer made from chloroethene is poly(chloroethene), but it is commonly known as PVC (polyvinyl chloride). It is used in products like pipes, window frames, and flooring.

Q224. Write the displayed formula of ethene and its polymer.
Answer:
Ethene:
$H_2C=CH_2$
Poly(ethene):
$[–CH_2–CH_2–]_n$
The double bond in ethene breaks during polymerisation, allowing the carbon atoms to form single bonds with neighbouring monomers, creating a long chain.

Q225. How can you use the monomer structure to draw the repeating unit?
Answer: To draw the repeating unit from the monomer structure, first remove the double bond between the carbon atoms. Then draw single bonds extending out from both carbon atoms to show where they will connect with other units. Keep all side groups in the same position. Finally, put the structure in square brackets and add an 'n' outside.

Q226. What does the square bracket in a polymer structure represent?
Answer: The square brackets in a polymer structure represent the repeating unit of the polymer. This is the specific part of the molecule that repeats over and over to form the long chain. It helps to simplify the drawing of a very large polymer by showing only one section and indicating that it repeats many times, as shown by the small letter "n" placed outside the bracket.

Q227. What does the small letter "n" mean in a polymer diagram?
Answer: The small letter "n" in a polymer diagram shows that the repeating unit inside the square brackets is repeated many times to form a long chain. The "n" stands for a large number, not a fixed

amount, because polymers can be made from thousands of repeating units, depending on the desired length and properties.

Q228. What is the general structure of a polymer made from an alkene?
Answer: The general structure of a polymer made from an alkene shows a repeating unit where the carbon-carbon double bond from the alkene monomer has opened up and formed single bonds. These single bonds connect to other repeating units, making a long chain. Each repeating unit has two carbon atoms with side groups from the original monomer and single bonds connecting them to the next unit.

Q229. Draw the repeating unit for poly(butene).
Answer:
Solution:
To draw the repeating unit for poly(butene), first note that the monomer is butene (CH2=CHCH2CH3). During polymerisation, the double bond opens up. The repeating unit would be:
[-CH2-CH(CH2CH3)-]□
This shows that the side group (CH2CH3) is attached to every second carbon in the chain.

Q230. Why must the carbon-carbon double bond open in addition polymerisation?
Answer: The carbon-carbon double bond must open in addition polymerisation because it allows each carbon atom in the monomer to form a new bond with neighbouring monomers. This bond formation is essential to link the monomers into a long polymer chain. Without breaking the double bond, the monomers could not connect together in a straight chain.

Q231. Describe how you would draw a polymer from a given alkene monomer.
Answer: To draw a polymer from an alkene monomer, first remove the double bond from the monomer and replace it with two single bonds extending outwards to indicate connections to other units. Keep the atoms and groups attached to the original double-bonded carbons in the same position. Then place the new structure inside square brackets and write a small letter "n" outside to show it repeats.

Q232. What is the role of the double bond in forming a polymer?
Answer: The double bond in an alkene monomer plays a key role in polymer formation because it breaks open to form new single bonds. These new bonds connect one monomer to another, allowing the formation of a long chain. Without the double bond, the monomers wouldn’t have the necessary reactivity to join and create a polymer.

Q233. How does the number of carbon atoms in a monomer affect the polymer?
Answer: The number of carbon atoms in a monomer affects the size, flexibility, and physical properties of the resulting polymer. More carbon atoms usually mean larger side groups or longer chains, which can make the polymer stronger, more rigid, or more resistant to heat. Fewer carbon atoms usually result in more flexible or lightweight polymers.

Q234. Can addition polymers be made from molecules without a double bond? Explain.
Answer: No, addition polymers cannot be made from molecules without a double bond because the double bond is needed to break and form new bonds that link monomers together. Without a double bond or another reactive group, the molecules cannot react in the way needed to form a continuous polymer chain.

Q235. Why are addition polymers usually unreactive?
Answer: Addition polymers are usually unreactive because they consist of strong carbon-carbon single bonds and lack reactive functional groups. This stable structure makes them resistant to reacting with acids, alkalis, or other chemicals, which is useful in products that need to be durable and long-lasting.

Q236. Why are addition polymers useful in making plastic products?
Answer: Addition polymers are useful in making plastic products because they are strong, lightweight, unreactive, and can be moulded into many shapes. Their chemical stability means they don't easily degrade or react with substances, making them ideal for packaging, containers, toys, pipes, and many other everyday items.

Q237. Why are addition polymers difficult to break down in the environment?
Answer: Addition polymers are difficult to break down in the environment because their strong carbon-carbon bonds and lack of reactive groups make them chemically stable. Microorganisms and natural enzymes cannot easily break these polymers down, so they persist in landfills and the natural environment for many years.

Q238. What is meant by the term "non-biodegradable" when referring to polymers?
Answer: The term "non-biodegradable" means that the polymer cannot be broken down by natural biological processes, such as those carried out by bacteria or fungi. As a result, non-biodegradable polymers remain in the environment for a long time, leading to pollution and waste problems.

Q239. Give one environmental problem caused by waste addition polymers.
Answer: One environmental problem caused by waste addition polymers is plastic pollution. Because these polymers do not decompose easily, they can build up in landfills, oceans, and other habitats. This can harm wildlife that may eat or get tangled in plastic waste and can also damage ecosystems.

Q240. Suggest one way to reduce the amount of plastic waste.
Answer: One way to reduce the amount of plastic waste is to recycle used plastic products. By collecting, melting, and reshaping them into new items, we can reduce the need for new plastic production and prevent plastics from ending up in landfills or the environment.

Q241. What is meant by the term "recycling" in the context of polymers?
Answer: Recycling in the context of polymers means collecting and processing used plastic

materials so they can be reused. This usually involves sorting, cleaning, melting, and remoulding the plastic into new products. Recycling helps save raw materials and reduces environmental pollution.

Q242. Explain how the structure of poly(propene) differs from poly(ethene).
Answer: The structure of poly(propene) differs from poly(ethene) because each repeating unit in poly(propene) has a side group, CH3 (a methyl group), attached to every second carbon atom, while poly(ethene) only has hydrogen atoms. This difference gives poly(propene) different properties, such as being more rigid and having a higher melting point than poly(ethene).

Q243. Name the polymer made from the monomer CH2=CHCl.
Answer: The polymer made from the monomer CH2=CHCl is called poly(chloroethene), commonly known as PVC (polyvinyl chloride). It contains chlorine atoms as side groups in its repeating units, which gives it special properties like toughness and chemical resistance.

Q244. Give one use of poly(ethene) in everyday life.
Answer: One common use of poly(ethene) is in plastic shopping bags. It is also used for making bottles, food packaging, and containers because it is flexible, waterproof, and cheap to produce. Its durability and lightweight nature make it ideal for these everyday uses.

Q245. Why is poly(propene) more rigid than poly(ethene)?
Answer: Poly(propene) is more rigid than poly(ethene) because its repeating units contain a methyl group (CH3) as a side chain. This side group causes the polymer chains to pack less closely, which limits their movement. As a result, the material becomes stiffer and more resistant to bending.

Q246. Why do polymers have high melting points?
Answer: Polymers have high melting points because their long chains of repeating units are held together by strong intermolecular forces. These forces require a lot of energy to break, especially in polymers with longer chains or strong side group interactions, so they do not melt easily.

Q247. How does the length of the polymer chain affect its properties?
Answer: The length of the polymer chain affects its properties in several ways. Longer chains have more intermolecular forces, making the polymer stronger, less flexible, and having a higher melting point. Shorter chains usually result in weaker, softer materials with lower melting points.

Q248. Draw a repeating unit from a monomer with four carbon atoms and one double bond.
Answer:
Solution:
If the monomer is butene (CH2=CHCH2CH3), the repeating unit would be:
[-CH2-CH(CH2CH3)-]□
This structure shows the single bonds and the side chain (CH2CH3) attached to the carbon in the chain.

Q249. How do you identify the monomer from a given repeating unit?
Answer: To identify the monomer from a given repeating unit, first look for the part of the structure

inside the square brackets. Reconnect the two end bonds to form a double bond between the central carbon atoms. This will give you the structure of the original monomer, which must have a carbon-carbon double bond.

Q250. Describe the steps to convert a displayed alkene formula into its polymer form.
Answer: To convert a displayed alkene formula into its polymer form, follow these steps:

1. Break the carbon-carbon double bond in the monomer.
2. Replace the double bond with single bonds extending outwards to connect to other units.
3. Keep all atoms and side groups attached in the same positions.
4. Place the structure in square brackets and add a small letter "n" to show repetition.

Q251. What is meant by condensation polymerisation?
Answer: Condensation polymerisation is a chemical reaction where monomers with two functional groups join together to form a long polymer chain, with the elimination of small molecules such as water or methanol. Each time a new bond forms between two monomers, a small molecule is released. This process is used to make many natural and synthetic polymers like polyesters and polyamides.

Q252. Why is a small molecule such as water formed during condensation polymerisation?
Answer: A small molecule such as water is formed during condensation polymerisation because each reaction between the functional groups of the monomers involves the removal of atoms that form water. For example, when a hydroxyl group (–OH) from an alcohol reacts with a carboxylic acid group (–COOH), they form an ester linkage and release water as a by-product.

Q253. Describe the two functional groups needed on a monomer for condensation polymerisation to occur.
Answer: The two functional groups typically needed are –OH (hydroxyl group) and –COOH (carboxylic acid group). These groups allow the monomers to join together through a condensation reaction. For example, diols have two –OH groups, and dicarboxylic acids have two –COOH groups. These allow the monomers to link and form long chains.

Q254. Explain how ethanediol and hexanedioic acid react to form a polyester.
Answer: Ethanediol has two –OH groups, and hexanedioic acid has two –COOH groups. When they react, one –OH group from ethanediol reacts with a –COOH group from hexanedioic acid to form an ester linkage and release a molecule of water. This process repeats on both ends, forming a long-chain polyester with ester bonds linking the repeating units.

Q255. What type of bond forms between the monomers during polyester formation?
Answer: An ester bond forms between the monomers during polyester formation. This bond is

formed by the reaction of a hydroxyl group (–OH) from an alcohol with a carboxylic acid group (–COOH), releasing water in the process. The ester bond links the repeating units together in the polymer chain.

Q256. How is the repeating unit in a polyester different from the monomers used?
Answer: The repeating unit in a polyester is different from the monomers because parts of the monomers are lost when the ester bond is formed. For example, an –OH group from the alcohol and a hydrogen from the carboxylic acid are removed to form water. The remaining parts of the monomers are joined by ester linkages to form the repeating unit.

Q257. Draw the structure of the repeating unit formed when ethanediol reacts with hexanedioic acid.
Answer:
Solution:
The repeating unit would be:
–[O–CH2CH2–OOC–(CH2)4–CO]–
This shows the ester linkages (–COO–) formed between ethanediol and hexanedioic acid. The repeating unit is enclosed in brackets and can repeat many times in a polyester chain.

Q258. How many different monomers are usually involved in simple condensation polymerisation?
Answer: In simple condensation polymerisation, usually two different monomers are involved. Each monomer has two of the same functional groups, such as a diol (with two –OH groups) and a dicarboxylic acid (with two –COOH groups), allowing them to react and form long polymer chains through repeated condensation reactions.

Q259. What functional group is formed when an alcohol reacts with a carboxylic acid in a condensation reaction?
Answer: An ester functional group (–COO–) is formed when an alcohol reacts with a carboxylic acid. This reaction releases water and links the molecules together through an ester bond, which is a key feature in polyester polymers.

Q260. Why are the monomers used in condensation polymerisation described as bifunctional?
Answer: Monomers used in condensation polymerisation are described as bifunctional because each monomer contains two reactive functional groups. These groups allow the monomers to connect at both ends to form long chains. For example, a diol has two hydroxyl groups and a dicarboxylic acid has two carboxyl groups.

Q261. Describe the role of each functional group in forming a polyester.
Answer: The hydroxyl (–OH) group from the alcohol monomer reacts with the carboxylic acid (–COOH) group from the acid monomer to form an ester bond. This reaction also produces water. The two ends of each monomer participate in similar reactions, allowing the formation of long chains of repeating units connected by ester linkages.

Q262. Explain how models can help represent condensation polymerisation.
Answer: Models help represent condensation polymerisation by visually showing how monomers join together and how small molecules like water are removed. Ball-and-stick or molecular diagrams can clearly display the breaking and forming of bonds, helping students understand the process and recognise functional groups and repeating units.

Q263. Why are the properties of a polymer different from the monomers used to make it?
Answer: The properties of a polymer differ from its monomers because the structure and bonding change during polymerisation. Monomers are usually small and simple, but once joined into long chains with strong intermolecular forces and new bonding patterns, the resulting polymer has different melting points, strength, flexibility, and chemical resistance.

Q264. What is a diol and why is it important in condensation polymerisation?
Answer: A diol is a molecule that contains two hydroxyl (–OH) groups. It is important in condensation polymerisation because its two –OH groups allow it to react with two other molecules, such as dicarboxylic acids, to form ester bonds and build up long polymer chains. Diols are key monomers in polyester formation.

Q265. Give one example of a natural condensation polymer.
Answer: Proteins are an example of a natural condensation polymer. They are made by the condensation polymerisation of amino acids, where the amino group (–NH2) of one amino acid reacts with the carboxylic acid group (–COOH) of another, forming a peptide bond and releasing water as a by-product.

Q266. What is the difference between addition and condensation polymerisation in terms of by-products?
Answer: In addition polymerisation, no by-products are formed—the atoms in the monomers are simply rearranged to form the polymer. In condensation polymerisation, a small molecule like water or methanol is released each time a bond is formed between monomers, making it a key difference between the two types of reactions.

Q267. Compare the structures of a polyester and a polyalkene.
Answer: A polyester has repeating units joined by ester bonds (–COO–), formed through condensation polymerisation, and it contains oxygen atoms in the backbone. A polyalkene, made by addition polymerisation, has a carbon-carbon backbone with no other elements. The structure of a polyester allows for more polar interactions and possible breakdown, while polyalkenes are more chemically inert.

Q268. What feature of a monomer allows it to form long chains in condensation polymerisation?
Answer: The presence of two reactive functional groups in a monomer allows it to form long chains in condensation polymerisation. These groups must be able to react with the functional groups of

other monomers, so the chain can grow from both ends. This feature makes the monomer bifunctional and suitable for chain formation.

Q269. Describe how the length of a polyester chain might affect its physical properties.
Answer: The longer the polyester chain, the stronger the intermolecular forces such as van der Waals or hydrogen bonds, making the polymer tougher, less flexible, and having a higher melting point. Shorter chains may result in polymers that are more flexible, less durable, and easier to melt or break.

Q270. Why can polyesters be broken down more easily than polyalkenes?
Answer: Polyesters can be broken down more easily than polyalkenes because the ester bonds in polyesters are more reactive and can be hydrolysed by acids, alkalis, or enzymes. In contrast, the strong and stable carbon-carbon bonds in polyalkenes make them resistant to chemical attack and degradation.

Q271. Name the functional group found in all esters.
Answer: The functional group found in all esters is the ester group, which is written as –COO–. It consists of a carbon atom double bonded to one oxygen and single bonded to another oxygen, which is in turn bonded to a carbon atom. This group is formed in condensation reactions between alcohols and carboxylic acids.

Q272. Write the general formula for a condensation reaction between a diol and a dicarboxylic acid.
Answer:
Solution:
$HO{-}R{-}OH + HOOC{-}R'{-}COOH \rightarrow {-}[O{-}R{-}OOC{-}R'{-}CO]{-}_n + nH_2O$
This shows the diol (with two –OH groups) reacting with the dicarboxylic acid (with two –COOH groups) to form a polyester with ester linkages and water as a by-product.

Q273. What is meant by a repeating unit in a polymer?
Answer: A repeating unit in a polymer is the specific group of atoms that repeats over and over in the polymer chain. It is derived from the original monomers and shows how they are connected. The repeating unit is the smallest section of the polymer that, when repeated many times, forms the whole polymer.

Q274. How do you identify the repeating unit from a polymer chain?
Answer: To identify the repeating unit from a polymer chain, look for the section that repeats itself consistently along the chain. This usually includes atoms from two or more monomers and any bonds connecting them. Once located, draw that section inside square brackets and show it repeating with the letter “n” outside.

Q275. How does condensation polymerisation occur in two dimensions?
Answer: In two dimensions, condensation polymerisation can occur when monomers have

functional groups that allow them to form cross-links between polymer chains. This results in a network structure rather than a linear one. Such polymers form materials like thermosetting plastics, where the polymer expands in more than one direction due to bonding between chains.

Q276. What is meant by 2D representation of a polymer?
Answer: A 2D representation of a polymer is a simplified drawing that shows the repeating unit of the polymer on a flat surface using straight lines and letters to represent atoms and bonds. It does not show the 3D shape but helps in understanding the structure by showing how monomers are joined in a repeating pattern.

Q277. Explain how a polymer can be drawn to show the loss of water in condensation polymerisation.
Answer: In condensation polymerisation, each bond between monomers forms by removing a small molecule like water. To show this in a drawing, you depict two monomers with their functional groups reacting, and draw a water molecule (H_2O) as a product. The monomers are shown linking with a new bond while a -OH from one and an -H from another are removed to form water.

Q278. What happens to the end groups of monomers during condensation polymerisation?
Answer: During condensation polymerisation, the end groups of monomers, usually functional groups like -OH or -COOH, react with each other to form covalent bonds. As they bond, small molecules like water are removed. This process connects the monomers into a long chain, and the end groups are no longer present as they were before.

Q279. How many water molecules are lost when three monomers join in a condensation reaction?
Answer: When three monomers join together in a condensation reaction, two water molecules are lost. Each time two monomers link, one molecule of water is removed. So, joining three monomers involves two linkages, and thus, two water molecules are released.

Q280. What is the main difference in the monomers used in condensation polymerisation compared to addition polymerisation?
Answer: In condensation polymerisation, the monomers have two different functional groups (such as -OH and -COOH) and form bonds by losing small molecules like water. In addition polymerisation, the monomers are usually alkenes with a carbon-carbon double bond and no molecules are lost during the reaction.

Q281. What are the two functional groups present in an amino acid molecule?
Answer: An amino acid contains two functional groups: an amine group ($-NH_2$) and a carboxylic acid group (-COOH). These groups allow amino acids to link together in condensation reactions, forming polypeptides and proteins.

Q282. Describe what happens when amino acids react together.
Answer: When amino acids react together, the amine group of one amino acid reacts with the

carboxylic acid group of another. This reaction forms a peptide bond and releases a water molecule. The result is a dipeptide, and continued reactions can form longer chains called polypeptides.

Q283. What type of polymer is formed from amino acids?
Answer: When amino acids react, they form a natural polymer known as a polypeptide. When the chain of amino acids is long and folded in a specific structure, it becomes a protein. These are essential biological polymers found in all living organisms.

Q284. Explain what a peptide bond is and how it forms.
Answer: A peptide bond is a covalent bond that forms between the carboxylic acid group (-COOH) of one amino acid and the amine group ($-NH_2$) of another. During this reaction, a water molecule is removed in a condensation reaction, and the remaining atoms form the peptide linkage (-CONH-).

Q285. Why are amino acids described as having two functional groups?
Answer: Amino acids are described as having two functional groups because each molecule contains both an amine group ($-NH_2$) and a carboxylic acid group (-COOH). These groups allow amino acids to react and join with others to form long chains in condensation polymerisation.

Q286. Draw the structure of glycine and identify its functional groups.
Answer: The structure of glycine is NH_2-CH_2-COOH. The amine group is NH_2 and the carboxylic acid group is COOH. Glycine is the simplest amino acid, and both functional groups are clearly visible in its structure.

Q287. What small molecule is lost when two amino acids react together?
Answer: When two amino acids react together, a water molecule (H_2O) is lost. This happens during the condensation reaction where a peptide bond forms between the carboxylic acid group of one amino acid and the amine group of another.

Q288. What is a polypeptide and how is it related to proteins?
Answer: A polypeptide is a long chain of amino acids linked by peptide bonds. When a polypeptide folds into a specific 3D shape, it becomes a functional protein. Proteins are made from one or more polypeptides and perform various roles in living organisms.

Q289. Describe how different amino acids form proteins.
Answer: Different amino acids combine in various sequences through condensation reactions, forming peptide bonds and creating long polypeptide chains. The order of amino acids determines the protein's structure and function. These chains then fold into complex shapes to become functional proteins.

Q290. How does the sequence of amino acids affect the structure of a protein?
Answer: The sequence of amino acids determines how the polypeptide will fold into its final 3D shape. This folding affects the protein's properties and function. A change in the sequence can result in a completely different structure and may cause the protein to malfunction.

Q291. What is the general formula of an amino acid?
Answer: The general formula of an amino acid is NH_2–CHR–COOH, where NH_2 is the amine group, COOH is the carboxylic acid group, and R is a side group that varies between different amino acids. This structure allows amino acids to link together to form proteins.

Q292. Why are proteins described as natural polymers?
Answer: Proteins are called natural polymers because they are made by living organisms through the polymerisation of amino acids. They are not synthetic, and their formation and function occur naturally in biological systems.

Q293. Explain how a chain of amino acids is different from a polyester.
Answer: A chain of amino acids, or polypeptide, is made by joining amine and carboxylic acid groups in a condensation reaction, forming peptide bonds. A polyester, on the other hand, is made by reacting diols with dicarboxylic acids, forming ester bonds. Also, amino acids have varying side groups, whereas polyesters are made from repeating identical units.

Q294. What bond forms between amino acids in a polypeptide?
Answer: The bond that forms between amino acids in a polypeptide is called a peptide bond. It is a covalent bond formed during a condensation reaction between the carboxylic acid group of one amino acid and the amine group of another.

Q295. Describe the functional group that links amino acids in a polypeptide chain.
Answer: The functional group that links amino acids in a polypeptide is called a peptide linkage or amide bond. It has the structure -CONH-, formed by the reaction of the -COOH group of one amino acid and the $-NH_2$ group of another with the elimination of water.

Q296. How many water molecules are formed when four amino acids polymerise?
Answer: When four amino acids join together, three peptide bonds are formed, and three water molecules are released. Each bond formation results in the loss of one water molecule in a condensation reaction.

Q297. What role do proteins play in living organisms?
Answer: Proteins play many important roles in living organisms. They function as enzymes, hormones, antibodies, and structural components of cells and tissues. Proteins are essential for growth, repair, and the regulation of body processes.

Q298. How can 3D models help in understanding protein structure?
Answer: 3D models help visualise how a protein folds and fits into specific shapes, which is important for understanding how proteins work. The 3D structure affects how proteins interact with other molecules, so models help in studying their function, especially in enzymes and drug design.

Q299. What is meant by the term 'condensation reaction' in protein formation?
Answer: A condensation reaction in protein formation is a chemical reaction where amino acids join

together and release a small molecule, usually water, as a by-product. This forms peptide bonds and builds long chains of amino acids, called polypeptides.

Q300. Describe how the polymerisation of amino acids is similar to the polymerisation of diols and dicarboxylic acids.
Answer: The polymerisation of amino acids is similar to that of diols and dicarboxylic acids because both involve condensation reactions, where monomers join by losing small molecules like water. In both cases, bonds form between different functional groups, and repeating units are created to build a long polymer chain.

Q301. What type of polymer is DNA made from?
Answer: DNA is a natural polymer made from nucleotide monomers. It is called a polynucleotide because it is made by joining many nucleotide units together in a long chain. These chains form a double strand in the DNA structure. DNA is classified as a condensation polymer because water is removed when the monomers join together.

Q302. What are the monomers called that make up DNA?
Answer: The monomers that make up DNA are called nucleotides. Each nucleotide contains three parts: a sugar molecule (deoxyribose), a phosphate group, and a nitrogenous base. These nucleotides are joined together to form the DNA polymer.

Q303. How many different types of nucleotide monomers are found in DNA?
Answer: There are four different types of nucleotide monomers in DNA. Each one has the same sugar and phosphate group but a different nitrogenous base. The four bases are adenine (A), thymine (T), cytosine (C), and guanine (G), making four distinct nucleotides.

Q304. What shape does the DNA polymer form?
Answer: The DNA polymer forms a double helix shape. This means it has two strands that twist around each other like a spiral staircase. This twisted ladder-like structure is held together by the base pairs between the two strands.

Q305. Which two components make up the backbone of a DNA molecule?
Answer: The sugar (deoxyribose) and phosphate groups form the backbone of the DNA molecule. They are connected by strong covalent bonds and run along the sides of the DNA, while the bases connect the two strands in the middle.

Q306. What are the four different bases found in DNA?
Answer: The four different bases in DNA are adenine (A), thymine (T), cytosine (C), and guanine (G). These bases pair in a specific way: adenine with thymine, and cytosine with guanine. This base pairing helps maintain the structure of the DNA.

Q307. What type of bond holds the two strands of DNA together?
Answer: Hydrogen bonds hold the two strands of DNA together. These are weak bonds compared to

covalent bonds, but they are strong enough to keep the two strands connected and allow them to unzip easily during replication.

Q308. What is meant by a double helix structure in DNA?
Answer: A double helix structure in DNA means that the molecule is made of two long strands twisted around each other. These strands are held together by base pairs between the nitrogenous bases. This shape helps the DNA to be compact and stable in the cell.

Q309. How are the nucleotide bases arranged in DNA?
Answer: The nucleotide bases in DNA are arranged in pairs between the two strands. Adenine always pairs with thymine, and cytosine always pairs with guanine. These pairs form the rungs of the DNA ladder and are held together by hydrogen bonds.

Q310. Why is DNA described as a polymer?
Answer: DNA is described as a polymer because it is made from repeating monomer units called nucleotides. These nucleotides are chemically bonded to form a long chain, making DNA a natural polymer. This structure gives DNA its length and ability to carry genetic information.

Q311. Which part of the nucleotide varies between the four DNA monomers?
Answer: The part of the nucleotide that varies is the nitrogenous base. The sugar and phosphate group remain the same in all nucleotides, but the base can be adenine, thymine, cytosine, or guanine. This variation allows DNA to store different genetic codes.

Q312. Name one naturally occurring polymer made from amino acids.
Answer: One naturally occurring polymer made from amino acids is a protein. Proteins are formed by linking amino acids in a specific sequence using peptide bonds. The chain then folds into a unique shape, allowing it to perform various functions in the body.

Q313. What type of biological molecule is starch?
Answer: Starch is a carbohydrate and a naturally occurring polymer. It is made up of glucose monomers joined together in long chains. Starch is used by plants to store energy and is a common part of the human diet, providing a source of glucose when digested.

Q314. What type of monomer forms starch?
Answer: Starch is formed from glucose monomers. These glucose units are joined together by glycosidic bonds to create long chains. In plants, starch is stored in cells and can be broken down into glucose when needed for energy.

Q315. What is the monomer unit of cellulose?
Answer: The monomer unit of cellulose is also glucose. However, the glucose units in cellulose are arranged differently compared to starch. This difference in structure gives cellulose different properties, such as making it rigid and strong for plant cell walls.

Q316. How do the structures of starch and cellulose differ?
Answer: Although both starch and cellulose are made of glucose monomers, they differ in how the glucose units are linked. In starch, the glucose units are joined in a way that allows the chains to coil. In cellulose, the units are linked to form straight, rigid chains that form strong fibres.

Q317. How do the functions of proteins and DNA differ in the body?
Answer: DNA carries genetic information and instructions for making proteins. It stores the hereditary information needed for growth and development. Proteins, on the other hand, carry out tasks in the body such as building tissues, transporting substances, and acting as enzymes to speed up reactions.

Q318. What is the role of proteins in living organisms?
Answer: Proteins perform many roles in living organisms. They act as enzymes to speed up chemical reactions, form structural parts of cells and tissues, transport substances like oxygen, and help fight infections as antibodies. Proteins are essential for growth, repair, and overall function.

Q319. How are the monomers in DNA joined together?
Answer: The nucleotide monomers in DNA are joined together by covalent bonds between the phosphate group of one nucleotide and the sugar of the next. These strong bonds form the sugar-phosphate backbone, while hydrogen bonds between bases hold the two strands together.

Q320. What is the function of DNA in a cell?
Answer: The function of DNA in a cell is to store genetic information. This information is used to control cell activities by giving instructions for making proteins. DNA also ensures that genetic information is passed from one generation to the next during reproduction.

Q321. What elements are found in a nucleotide?
Answer: A nucleotide contains the elements carbon (C), hydrogen (H), oxygen (O), nitrogen (N), and phosphorus (P). These elements form the sugar (C, H, O), phosphate group (P, O), and nitrogenous base (C, H, N, sometimes O) that make up the nucleotide.

Q322. Which two naturally occurring polymers are made from sugars?
Answer: Starch and cellulose are two naturally occurring polymers made from sugar monomers, specifically glucose. Starch is used for energy storage in plants, while cellulose provides structural support in plant cell walls.

Q323. What is the difference between a polymer and a monomer?
Answer: A monomer is a small molecule that can join with other similar molecules to form a larger chain. A polymer is the large molecule formed when many monomers are chemically bonded together. Polymers can be natural, like DNA or proteins, or synthetic like plastics.

Q324. How is the sequence of bases in DNA important?
Answer: The sequence of bases in DNA determines the genetic code. Each sequence corresponds

to a specific instruction for making proteins. A change in the base sequence can lead to changes in the protein made, which can affect how the body functions or lead to genetic disorders.

Q325. What process copies DNA in cells?
Answer: The process that copies DNA in cells is called DNA replication. During this process, the two strands of DNA separate, and each strand serves as a template for making a new complementary strand. This ensures that each new cell receives an exact copy of the DNA.

Q326. What kind of reaction forms DNA polymers from nucleotides?
Answer: DNA polymers are formed from nucleotides through a condensation reaction. In this reaction, each time two nucleotides join together, a molecule of water is removed. This reaction helps link the sugar of one nucleotide to the phosphate group of the next nucleotide, forming a sugar-phosphate backbone. This process repeats to build the long DNA polymer chain.

Q327. What does each nucleotide in DNA consist of?
Answer: Each DNA nucleotide is made up of three components: a phosphate group, a deoxyribose sugar, and a nitrogenous base. The nitrogenous base can be adenine, thymine, cytosine, or guanine. These components are bonded together, and the structure of the nucleotide allows it to join with other nucleotides to form DNA.

Q328. What is the difference between RNA and DNA?
Answer: RNA differs from DNA in three main ways: (1) RNA contains the sugar ribose, while DNA contains deoxyribose; (2) RNA uses the base uracil instead of thymine found in DNA; and (3) RNA is usually single-stranded, while DNA is double-stranded and forms a double helix. These differences allow RNA and DNA to carry out different roles in the cell.

Q329. What is a gene?
Answer: A gene is a short section of DNA that contains the instructions for making a specific protein. It is made up of a sequence of nucleotide bases that determines the order of amino acids in a protein. Genes act as the basic units of heredity and are passed from parents to offspring.

Q330. Why is DNA called a naturally occurring polymer?
Answer: DNA is called a naturally occurring polymer because it is made up of many repeating nucleotide units joined together in a long chain, and it is found naturally in all living organisms. A polymer is a substance made of repeating monomers, and DNA fits this definition perfectly.

Q331. Name two polymers formed from glucose monomers.
Answer: Two polymers formed from glucose monomers are starch and cellulose. Starch is a storage form of glucose found in plants, while cellulose is used to build strong cell walls in plant cells. Both are made by joining glucose units through different types of bonds.

Q332. What is the role of cellulose in plants?
Answer: Cellulose provides structural support to plant cells. It forms strong fibres that make up the plant cell wall, giving the plant its rigidity and strength. This helps plants maintain their shape and

stand upright. Cellulose is made from glucose units arranged in a straight chain with hydrogen bonds between them.

Q333. What feature makes proteins different from each other?
Answer: The sequence and number of amino acids make each protein different from the others. Even a small change in the order of amino acids can result in a completely different protein with a different shape and function. This sequence is determined by the DNA in a gene.

Q334. What is the name of the bond that links amino acids?
Answer: The bond that links amino acids together is called a peptide bond. It is formed during a condensation reaction between the amino group of one amino acid and the carboxyl group of another, with the release of a water molecule.

Q335. How are amino acids different from nucleotides?
Answer: Amino acids and nucleotides are different in structure and function. Amino acids are the building blocks of proteins, while nucleotides are the building blocks of DNA and RNA. Amino acids have an amino group, a carboxyl group, and a side chain, while nucleotides consist of a phosphate group, a sugar, and a nitrogenous base.

Q336. What type of reaction joins amino acids in proteins?
Answer: Amino acids are joined in proteins through condensation reactions. In this reaction, the carboxyl group of one amino acid reacts with the amino group of another, releasing a molecule of water and forming a peptide bond between them.

Q337. What determines the function of a protein?
Answer: The function of a protein is determined by its shape, which is based on the sequence of amino acids. The order of amino acids affects how the protein folds into its three-dimensional structure, and this shape decides how the protein interacts with other molecules and what role it plays in the body.

Q338. What are enzymes made from?
Answer: Enzymes are made from proteins. They are long chains of amino acids that fold into specific shapes to catalyse biological reactions. The shape of an enzyme's active site is key to its ability to speed up reactions.

Q339. Why are proteins called polymers?
Answer: Proteins are called polymers because they are made from many repeating monomer units—amino acids—joined together in a chain. These long chains form through peptide bonds, making proteins an example of a naturally occurring polymer.

Q340. How do plants make starch?
Answer: Plants make starch by joining many glucose molecules together through condensation reactions. These glucose units are produced during photosynthesis, and the starch serves as a way to store the energy from glucose for later use.

Q341. What part of a nucleotide contains nitrogen?
Answer: The nitrogenous base in a nucleotide contains nitrogen. These bases—adenine, thymine, cytosine, and guanine—are responsible for the genetic code in DNA and include atoms of nitrogen in their structures.

Q342. How many strands are there in a molecule of DNA?
Answer: A molecule of DNA consists of two strands. These strands are arranged in a double helix and are held together by hydrogen bonds between complementary nitrogenous bases.

Q343. What makes each protein unique?
Answer: Each protein is unique due to its specific sequence of amino acids. This sequence determines how the protein folds and what shape it takes, which then determines its specific function in the body. No two proteins have the exact same sequence unless they serve the same purpose.

Q344. What is the function of starch in a plant cell?
Answer: Starch acts as a storage form of energy in plant cells. When the plant makes glucose during photosynthesis, it converts it into starch to store it. When energy is needed, the plant breaks down the starch back into glucose.

Q345. What is the sugar component of DNA?
Answer: The sugar component of DNA is deoxyribose. It is a five-carbon sugar that forms part of the DNA nucleotide and helps create the sugar-phosphate backbone of the DNA molecule.

Q346. How are cellulose molecules arranged in plant cell walls?
Answer: Cellulose molecules are arranged in long straight chains that are bundled together with hydrogen bonds between them. This arrangement forms strong fibres that provide rigidity and strength to the plant cell wall.

Q347. Why can starch be broken down into glucose?
Answer: Starch can be broken down into glucose because it is made of glucose monomers linked by glycosidic bonds. Enzymes in plants and animals can break these bonds during digestion, releasing the glucose units for energy.

Q348. How are DNA and proteins similar in structure?
Answer: DNA and proteins are similar because both are polymers made from repeating monomer units. DNA is made from nucleotides, and proteins are made from amino acids. Both have specific sequences of monomers that determine their function, and both fold into specific shapes.

Q349. What does the order of bases in DNA determine?
Answer: The order of bases in DNA determines the sequence of amino acids in a protein. This base sequence is read in triplets (codons) during protein synthesis, and each triplet codes for a specific amino acid, affecting the structure and function of the resulting protein.

Q350. Name one difference between starch and cellulose.

Answer: One key difference between starch and cellulose is the way their glucose monomers are linked. In starch, the glucose units are joined in a way that allows the chain to coil, making it good for storage. In cellulose, the glucose units are linked differently, resulting in straight chains that form strong fibres for structural support in plant cell walls.