**ANSWERS: Polymers**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **2022** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| (i)(ii) | Ethene has a (reactive) double covalent bond between two carbon atoms. Under high temperatures, high pressure, and catalytic conditions the double bond can be broken, resulting in a single covalent bond and a spare single bond that can covalently bond to the next monomer to form a long chain /polymer, whereas ethane has only an (unreactive) single bond so ethane does not undergo polymerisation. | Draws at least two repeatingunits (includes bonds/wiggles on ends)Polymerisation is described.OREthane no double bond/ethene has double bond thatcan break | Correctly explainsrequirements for adouble bond betweencarbon atoms ANDmonomers joiningtogether to form a chain. | Correctly explains therequirements for a carbon double bond in polymerisation includingrequired conditions, and lack of alkane reaction. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **2021** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| (i) (ii) (iii) | polymerisationhigh temperature, catalyst, pressure |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **2020** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| (i)(ii)(iii)(iv) | Polymers can be made from ethene and propene because alkenes ontain a C=C. The **C to C double bond** can be broken during polymerisation, and **carbon atoms from adjacent molecules** can then form **single bonds** between them, forming **long chains** of carbons.High temperature / pressure / catalyst required.Propane only contains carbon to carbon single bonds so this processcannot occur.Plastic bags made from polyethene are waterproof, relatively strong, light, cheap to make, stretchy, resistant to spills, so they are useful for carrying a variety of supermarket goods.However they are unreactive, so they don’t break down easily, they are light so they float in the ocean. They are not strong enough for more than one or two uses or for carrying heavy loads so they are replaced regularly and are thrown away. | Two structures correctLinks formation of polymer topresence of double bond.One condition stated.CorrectStates a property of polyethene. | Links a property to the use of plastic bags or not using the bags. | Links properties to BOTH the use of plastic bags and the reasons why they should not be used. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **2019** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| (a) (b)  | Ethene monomers contain double bonds between C atoms.Many monomers / ethene molecules form chains / very large molecules. The double bond between C atoms in the monomers break, and single bonds form between C atoms of monomer units, resulting in a polymer / chain. The polymer contains only single bonds between C atoms.For example:• Plastic (e.g. polyethene) is used for packaging because it helps protect and preserve goods.• Plastic (e.g. polypropene) is used to make pipes as it is hard and not reactive.• Plastic is used for raincoats, as it is waterproof. | • One correct point described.• Correct polymer structure(may not be 4 repeatingunits).• Two uses given. | • Explains process ordifference between monomer and polymer in terms of double and single bonds.• Two uses linked torelevant properties. | • Correct explanations referring to structure of ethene and polyetheneand 4 correct repeating units. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **2018** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| (i)(ii) | Ethene is an alkene containing a double (covalent) bond, which acts as a functional group / is reactive, allowing ethene to act as a monomer.High temperatures and high pressures, with a catalyst are required to break thestrong double bond in the ethene molecules, allowing the different molecules to join together with single covalent bonds forming a long chain polymer, polyethene. | • Ethene contains doublebond.• High temp, pressure andcatalyst are required. | • Explains how ethenemolecules are linked to form polyethene molecules via thebreaking of double bonds to form single bonds.• Explains why theconditions are required. | • Elaborates on the polymerisation reaction, including explaining whyethene can form polyethene;conditions identified and structure of polyethene given. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **2017** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| (a)  | Propene contains a carbon to carbon double bond whereas propane only contains carbon to carbon single bonds.Many small propene molecules are joined to form long-chain molecules. The (covalent) double bond between each carbon atom in the propene molecule is broken, and a single (covalent) bond formed between these carbon atoms and between carbon atoms of neighbouring molecules, forming a long carbon chain molecule (the polypropene molecule).(Suitable diagram may be used showing the breaking of C=C double bonds and the formation of C–C single bonds in the chain.) | • States that the small propene molecules are joining to form the long-chain polypropenemolecule.• States that propene contains double bonds whereaspropane only has (carbon to carbon) single bonds. | Explains how propene molecules are linked to form polypropene molecules via the breaking of double bonds to form single bonds. | Explains the polymerisationreaction, linking to **carbon carbon double bonds** beingbroken and **carbon-carbon single bonds** being formed.AND explains that propane cannot undergo polymerisation asit only contains carbon to carbon single bonds.(Annotated diagrams may be used to illustrate an answer.) |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **2016** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| (a)  |   | * BOTH structures correct.
 |  |  |
| (b)(i)(ii) | Type of bonding found in propane is covalent bonding.This is because it is made up of the non-metal atoms C and H, which share electrons. Non-metal atoms share their valence electrons to gain full outer shells, resulting in stable bonds.Propene has a carbon to carbon double bond, while propane has carbon to carbon single bonds. Thus propene contains two less hydrogen atoms than propane. | * Covalent.
* Describes the bonding in propene (double bond) and propane (single bonds).
 | * Explains that the non-metal atoms / C and H, share electrons to gain a full outer shell / become stable.
* Links the C to C double bond in propene to fewer hydrogen atoms / unsaturation and C to C single bond in propane to more H atoms / saturation.
 |  |

© <https://www.chemical-minds.com>

NCEA questions and answers reproduced with permission from NZQA