AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.7.2.2

# Reactions of alkenes

## Mark schemes and examiner comments

| | |
|---|---|
| Tier | **Higher** |
| Question groups | **69** |
| Available paper years | **2007–2025** |

## Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

**Name:** _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

### 4.7.2.2 Reactions of alkenes

**Answer 01 · Mark scheme** March 2007 | CHY1B | Original Q6 | Legacy

| | | | |
|---|---|---|---|
| Six | **A** | hydrocarbons undergo thermal decomposition | **3** |
| | **B** | hydrocarbons are heated | **1** |
| | **C** | hydrocarbons vaporise | **2** |
| | **D** | small hydrocarbon molecules | **4** |

| | | | | |
|---|---|---|---|---|
| | **A** | **B** | **C** | **D** |

**Answer 02 · Mark scheme** June 2007 | CHY1B | Original Q1 | Legacy

| **Question** | ***Key*** | | |
|---|---|---|---|
| One | **A** | Corn | **1** |
| | **B** | Olive | **4** |
| | **C** | Rapeseed | **2** |
| | **D** | Sunflower | **3** |

**Answer 03 · Mark scheme** June 2007 | CHY1B | Original Q2 | Legacy

| | | |
|---|---|---|
| Two | **A** | **2** |
| | **B** | **4** |
| | **C** | **1** |
| | **D** | **3** |

| | | | | |
|---|---|---|---|---|
| | **A** | **B** | **C** | **D** |

**Answer 04 · Mark scheme** June 2007 | CHY1H | Original Q5 | Legacy

The full source mark scheme begins on page 81. Follow original question 5 in that document.

**Answer 05 · Mark scheme** November 2007 | CHY1B | Original Q6 | Legacy

| | | | | |
|---|---|---|---|---|
| Six | **4** | **2** | **3** | **4** |

**Answer 06 · Mark scheme** November 2007 | CHY1B | Original Q8 | Legacy

| | | | | |
|---|---|---|---|---|
| Eight | **1** | **2** | **2** | **3** |

### 4.7.2.2 Reactions of alkenes

**Answer 07 · Mark scheme**

January 2008 | CHY1H | Original Q6 | Legacy

No matching mark scheme was available in the supplied archive for this question.

**Answer 08 · Mark scheme**

March 2008 | CHY1BP | Original Q1 | Legacy

| | | | |
|---|---|---|---|
| One | **A** | Molecule A | **1** |
| | **B** | Molecule B | **4** |
| | **C** | Molecule C | **2** |
| | **D** | Molecule D | **3** |
| | | | |

**Answer 09 · Mark scheme**

March 2008 | CHY1BP | Original Q9 | Legacy

| | | | | |
|---|---|---|---|---|
| Nine | **2** | **1** | **1** | **3** |

* This question is removed

**Answer 10 · Mark scheme**

June 2008 | CHY1BP | Original Q1 | Legacy

| | | | |
|---|---|---|---|
| One | **A** | catalysis | **2** |
| | **B** | polymerisation | **3** |
| | **C** | combustion | **4** |
| | **D** | thermal decomposition | **1** |
| | | | |

### 4.7.2.2 Reactions of alkenes

**Answer 11 · Mark scheme** June 2008 | CHY1BP | Original Q2 | Legacy

| | | | | |
|---|---|---|---|---|
| Two | **A** Carbon compound **A** | **4** | | |
| | **B** Carbon compound **B** | **2** | | |
| | **C** Carbon compound **C** | **3** | | |
| | **D** Carbon compound **D** | **1** | | |
| | | | | |
| | **A** | **B** | **C** | **D** |

**Answer 12 · Mark scheme** June 2008 | CHY1BP | Original Q3 | Legacy

| | | | | |
|---|---|---|---|---|
| Three | **1** | **1** | **4** | **1** |

**Answer 13 · Mark scheme** June 2008 | CHY1BP | Original Q7 | Legacy

| | | | | |
|---|---|---|---|---|
| Seven | **4** | **4** | **1** | **3** |

### 4.7.2.2 Reactions of alkenes

**Answer 14 · Mark scheme** June 2008 | CHY1H | Original Q7 | Legacy

| question | answers | extra information | mark |
|---|---|---|---|
| **7**(a) | any **two** from: | asks for cause therefore no marks for just describing the change<br>must link reason to a correct change in a gas | 2 |
| | **carbon dioxide has decreased due to:** | accept idea of 'used' to indicate a decrease | |
| | • plants / micro organisms / bacteria / vegetation / trees | | |
| | • photosynthesis | ignore respiration | |
| | • 'locked up' in (sedimentary) rocks / carbonates / fossil fuels | | |
| | • dissolved in oceans | ignore volcanoes | |
| | **oxygen has increased due to:** | accept idea of 'given out / produced' | |
| | • plants / bacteria / micro organisms / vegetation / trees | | |
| | • photosynthesis | ignore respiration | |
| | **nitrogen increased due to:** | accept idea of 'given out / produced' | |
| | • ammonia reacted with oxygen | | |
| | • bacteria / micro organisms | ignore (increase in) use of fossil fuels / deforestation | |
| **7**(b) | (because methane's) boiling point is greater than the average / surface temperature **or** Titan's (average / surface) temperature is below methane's boiling point | ignore references to nitrogen **or** water | 1 |
| | any methane that evaporates will condense | accept boils for evaporates<br>accept cooling and produce rain for condensing | 1 |

**Question 7 continued on next page…**

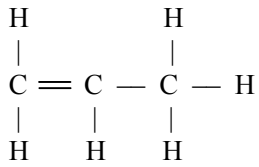
**COMPONENT NUMBER: CHY1H**

**COMPONENT NAME: Science B / Chemistry**

**STATUS: Final**

**DATE: June 2008**

**Question 7 continued…**

| question | answers | extra information | mark |
|---|---|---|---|
| **7**(c)(i) |  | bonds must be displayed correctly<br><br>ignore bond angles | 1 |
| **7**(c)(ii) | poly(propene) / polypropene / polypropylene<br><br>any **two** from:<br><br>• double bonds open up / break / become single<br><br>• propene molecules / monomers / they join / undergo addition polymerisation<br><br>• form chains / long molecules | do **not** allow polypropane<br><br>correct chemical equation gains **2** marks<br><br>ignore large<br><br>using monomer incorrectly max **2** marks | 1<br><br>2 |
| **Total** | | | **8** |

### 4.7.2.2 Reactions of alkenes

**Answer 15 · Mark scheme**

June 2008 | CHY2H | Original Q8 | Legacy

| question | answers | extra information | mark |
|---|---|---|---|
| **8**(a) | 25.4(%) | correct answer with **or** without working<br>accept 25(%)<br>accept 25.433……..(%)<br>allow 26(%) for **1** mark<br>if incorrect answer **1** mark for identification of 44 as $M_r$ of useful product<br>**or** 173 as total $M_r$ of reactants / products | 2 |
| **8**(b) | any **two** sensible ideas from eg:<br>• no / less waste<br>• less materials / reactants needed / used<br>• fewer / no environmental problems **or** less / no pollution<br>• better for sustainable development / resources running out<br>• more useful use of atoms<br>• less purification / separation of products owtte | ignore references to energy / cheaper / profit / cost / efficient | 2 |

**Question 8 continued on next page…**

**COMPONENT NUMBER: CHY2H**

**COMPONENT NAME: Additional Science / Chemistry**

**STATUS: Final**

**DATE: June 2008**

**Question 8 continued...**

| question | answers | extra information | mark |
|---|---|---|---|
| **8**(c) | increase yield<br><br>more (gaseous) reactant molecule than (gaseous) product molecule owtte | owtte<br><br>accept more molecules on left hand side **or** converse<br><br>accept Le Chatelier based answers for second mark<br><br>ignore rate of reaction | 1<br><br>1 |
| **8**(d) | reduce yield<br>**or**<br>less product owtte | allow no yield<br><br>ignore waste / less efficient | 1 |
| **Total** | | | **7** |

### 4.7.2.2 Reactions of alkenes

**Answer 16 · Mark scheme** March 2009 | CHY1BP | Original Q4 | Legacy

| | | | | |
|---|---|---|---|---|
| Four | **3** | **3** | **4** | **2** |

**Answer 17 · Mark scheme** March 2009 | CHY1BP | Original Q6 | Legacy

| | | | | |
|---|---|---|---|---|
| Six | **4** | **1** | **4** | **2** |

**Answer 18 · Mark scheme** March 2009 | CHY1BP | Original Q7 | Legacy

| | | | | |
|---|---|---|---|---|
| Seven | **2** | **3** | **3** | **2** |

**Answer 19 · Mark scheme** June 2009 | CHY1BP | Original Q1 | Legacy

| | | | |
|---|---|---|---|
| One | **A** | Molecule **A** | **1** |
| | **B** | Molecule **B** | **4** |
| | **C** | Molecule **C** | **2** |
| | **D** | Molecule **D** | **3** |

**Answer 20 · Mark scheme** June 2009 | CHY1BP | Original Q2 | Legacy

| | | | |
|---|---|---|---|
| Two | **A** | polymerisation | **4** |
| | **B** | thermal decomposition | **1** |
| | **C** | unsaturation | **2** |
| | **D** | hydration (addition of water) | **3** |

| | | | | |
|---|---|---|---|---|
| | **A** | **B** | **C** | **D** |

**Answer 21 · Mark scheme** June 2009 | CHY1BP | Original Q5 | Legacy

| | | | | |
|---|---|---|---|---|
| Five | **4** | **3** | **1** | **1** |

4.7.2.2 Reactions of alkenes

Answer 22 · Mark scheme

June 2009 | CHY1H | Original Q6 | Legacy

## Question 6

| question | answers | extra information | mark |
|---|---|---|---|
| **6**(a)(i) | many ethene / molecules / monomers<br><br>join to form a long hydrocarbon / chain / large molecule | accept double bonds open / break<br><br>accept addition polymerisation<br><br>ignore references to ethane<br><br>correct equation gains **2** marks | 1<br><br>1 |
| **6**(a)(ii) | (can be deformed but) return to their original shape (when heated or cooled) | ignore 'it remembers its shape' | 1 |
| **6**(a)(iii) | cross links / extra bonds in PEX<br><br>molecules / chains in PEX are held in position<br><br>molecules / chains in PEX unable to slide past each other / move | it = PEX throughout<br><br>accept inter-molecular bonds<br>ignore inter-molecular forces<br><br>accept rigid structure | 1<br><br>1<br><br>1 |

**Question 6 continues on the next page…**

**CHY1H**

**Question 6 Continued**

| question | answers | extra information | mark |
|---|---|---|---|
| **6**(b) | any **four** from:<br><br>• less (hydrocarbon) fuels used<br><br>• less / no electrical energy used<br><br>• reduce carbon / carbon dioxide emissions<br><br>• reduce / no pollution by sulfur dioxide / acid rain<br><br>• continuous process<br><br>• conserve copper which is running out or only low-grade ores available<br><br>• reduce the amount of solid waste rock that needs to be disposed<br><br>• reduce the need to dig large holes (to extract copper ores) | ignore costs / sustainability / non-renewable<br><br>allow less energy<br><br>allow no electrolysis<br><br>allow less global warming<br><br>allow less / no transportation<br><br>allow less waste<br><br>allow less mining | 4 |
| **Total** | | | **10** |

### 4.7.2.2 Reactions of alkenes

**Answer 23 · Mark scheme**

November 2009 | CHY1BP | Original Q5 | Legacy

No matching mark scheme was available in the supplied archive for this question.

**Answer 24 · Mark scheme**

November 2009 | CHY1BP | Original Q8 | Legacy

No matching mark scheme was available in the supplied archive for this question.

4.7.2.2 Reactions of alkenes

Answer 25 · Mark scheme



## Question 6

| question | answers | extra information | mark |
|---|---|---|---|
| **6**(a) | vaporise / evaporate<br><br>different condensing points / temperatures | allow boil for vaporise<br><br>accept condense at different levels<br>ignore different size molecules or different densities<br><br>mention of cracking = max **1**<br><br>allow boils at different temperatures and condenses for **2** marks<br><br>if no other marks awarded allow fractional distillation for **1** mark | 1<br><br>1 |
| **6**(b)(i) | 3 ($C_2H_4$) | accept +$C_4H_8$ | 1 |
| **6**(b)(ii) | (decane / naphtha / hydrocarbon) vaporise / evaporate<br><br>(passed over) a catalyst / alumina / porous pot | allow crude oil<br>allow boil for vaporise<br><br>ignore other names of catalysts | 1<br><br>1 |
| **6**(c) | any **two** from:<br>• alkanes / butane (molecules) do not have a (carbon carbon) double bond / are saturated / have (carbon carbon) single bonds<br>• alkenes / ethene (molecules) have (carbon carbon) double bonds **or** are unsaturated<br>• alkenes / ethene molecules are able to bond to other molecules | 'they' must be clarified | 2 |
| **6**(d) | single bonds between carbon atoms<br><br>the $–CH_3$ group appears on each pair of carbons on the 'chain' | — C – C —<br><br>NB any double bonds = **0** marks | 1<br><br>1 |
| **Total** | | | **9** |

### 4.7.2.2 Reactions of alkenes

**Answer 25 · Mark scheme** January 2010 | CHY1H | Original Q6 | Legacy

**CHY1H**

**Answer 26 · Mark scheme** March 2010 | CHY1BP | Original Q2 | Legacy

| | | | | | |
|---|---|---|---|---|---|
| Two | **A** | Ethane | | **1** | |
| | **B** | Ethene | | **2** | |
| | **C** | Ethanol | | **4** | |
| | **D** | Hydrogen | | **3** | |
| | | | | | |
| | **A** | | **B** | **C** | **D** |

**Answer 27 · Mark scheme** March 2010 | CHY1BP | Original Q3 | Legacy

| | | | | |
|---|---|---|---|---|
| Three | **3** | **2** | **1** | **1** |

**Answer 28 · Mark scheme** March 2010 | CHY1BP | Original Q5 | Legacy

| | | | | |
|---|---|---|---|---|
| Five | **2** | **3** | **3** | **2** |

**Answer 29 · Mark scheme** June 2010 | CHY1BP | Original Q2 | Legacy

| | | | | | |
|---|---|---|---|---|---|
| Two | **A** | Formula **A** | | **2** | |
| | **B** | Formula **B** | | **4** | |
| | **C** | Formula **C** | | **3** | |
| | **D** | Formula **D** | | **1** | |
| | | | | | |
| | **A** | | **B** | **C** | **D** |

**Answer 30 · Mark scheme** June 2010 | CHY1BP | Original Q3 | Legacy

| | | | | |
|---|---|---|---|---|
| Three | **2** | **3** | **1** | **2** |

4.7.2.2 Reactions of alkenes

Answer 31 · Mark scheme

June 2010 | CHY1H | Original Q6 | Legacy

**Question 6**

| question | answers | extra information | mark |
|---|---|---|---|
| **6**(a) | it is a mixture (of hydrocarbons) **or** contains hydrocarbons with different boiling points | accept 'to separate (crude) oil (into fractions) **or** obtain the naphtha (fraction)<br><br>accept to get useful products<br><br>ignore removal of impurities | 1 |
| **6**(b)(i) | heat / vaporise | mention of hydrogen = max **1**<br>accept thermal (decomposition) for heat<br><br>allow boil<br>do not allow temperatures below 100°C<br>ignore steam | 1 |
| | catalyst | allow alumina / porous pot<br>ignore other catalysts | 1 |
| **6**(b)(ii) | 4 × C – H **and** C = C | ignore brackets with or without an 'n' before them<br><br>do not allow poly(ethene) | 1 |

**Question 6 continues on the next page**

### 4.7.2.2 Reactions of alkenes

**Answer 31 · Mark scheme**



| question | answers | extra information | mark |
|---|---|---|---|
| **6**(c) | any **four** from:<br>**must** be at least **one** advantage and **one** disadvantage for all four marks<br><br><u>crops</u><br>advantages eg:<br>• renewable (resource) / sustainable<br>• low / less energy / fuel needed for process **or** lower temperature [ignore heat or quoted temperatures]<br>• can use waste plant / crop material<br>• carbon neutral<br>• low safety risk (processes)<br>• low technology<br><br>disadvantages eg:<br>• batch process / process is slow<br>• many steps in the process<br>• ethanol is impure / may contain water<br>• food shortages<br>• need very large areas of (arable) land to grow crops **or** can only grow in certain areas / climates<br>• destruction of woodland / habitat<br>• slow growth of crops<br>• labour intensive<br><br>a conclusion<br>with a reasoned argument based on | ignore ideas about carbon dioxide formation / photosynthesis or cost / economics / environmentally friendly<br><br>candidates are only awarded **1** mark if they use equivalent pairs of bulleted points<br><br><u>crude oil</u><br>disadvantages eg:<br>• *non*-renewable (resource) / finite / running out<br>• high / more energy needed for process **or** higher temperature<br>• not carbon neutral **or** releases locked up carbon<br>• high safety risk (process)<br>• high technology<br>• risk of major oil spillage<br>• can be used to make other products<br><br>advantages eg:<br>• continuous process / process is fast<br>• few steps in the process<br>• ethanol is pure<br>• 'conserves' food<br><br>• can accept reverse arguments<br><br>there must be at least one advantage and one disadvantage, however, a | 4 |

### 4.7.2.2 Reactions of alkenes

**Answer 31 · Mark scheme**



| | | | |
|---|---|---|---|
| | valid advantages **and** disadvantages | matched pair, although only awarded one mark would allow the conclusion mark to be awarded | 1 |
| **Total** | | | **9** |

### 4.7.2.2 Reactions of alkenes

**Answer 32 · Mark scheme**

November 2010 | CHY1BP | Original Q2 | Legacy

| | | | | |
|---|---|---|---|---|
| Two | **A** Formula **A** | **4** | | |
| | **B** Formula **B** | **1** | | |
| | **C** Formula **C** | **2** | | |
| | **D** Formula **D** | **3** | | |
| | **A** | **B** | **C** | **D** |

**Answer 33 · Mark scheme**

November 2010 | CHY1BP | Original Q4 | Legacy

| | | | | |
|---|---|---|---|---|
| Four | **3** | **2** | **4** | **3** |

**Answer 34 · Mark scheme**

November 2010 | CHY1BP | Original Q7 | Legacy

| | | | | |
|---|---|---|---|---|
| Seven | **3** | **1** | **4** | **2** |

4.7.2.2 Reactions of alkenes

Answer 35 · Mark scheme

January 2011 | CHY1H | Original Q5 | Legacy

**Question 5**

| Question | Advantages | Disadvantages | |
|---|---|---|---|
| Reused | • saves raw materials / crude oil<br>• saves energy / fuel / transport<br>• fewer bags needed / made<br>• reduces carbon / $CO_2$ emissions<br>• reduces use of landfill<br>• saves cost of a new bag<br>• no waste | • unable to reuse many times<br>• bags easily split | 1 |
| Recycled | • saves raw materials / crude oil<br>• saves energy / use of fuel<br>• reduces carbon / $CO_2$ emissions<br>• reduces use of landfill<br>• can be used for new products | • has to be collected / transported / washed / separated / melted<br>ignore uses energy | 1 |
| Burned | • heat / energy released can be used (for heating / generating electricity)<br>• reduces use of landfill | • has to be collected / transported<br>• wastes the resource / plastic<br>• releases harmful gases / toxic gases / $CO_2$ | 1 |
| Dumped | • collected / transported with household waste<br>• (slowly) biodegrades **or** produces methane which can be used as a fuel<br>• (not biodegradable so) does not release $CO_2$ / green house gas into the air | • wastes the resource<br>• plastic uses landfill<br>• produces methane which is a greenhouse gas / could cause explosions<br>• not biodegradable / take years to decompose | 1 |
| ignore cost / litter / waste / global warming / habitats unless mentioned above | | | |

| | | | |
|---|---|---|---|
| **Total** | | | **4** |

### 4.7.2.2 Reactions of alkenes

**Answer 35 · Mark scheme** January 2011 | CHY1H | Original Q5 | Legacy

**CHY1H**

**Answer 36 · Mark scheme** March 2011 | CHY1BP | Original Q1 | Legacy

| Question | Key | | |
|---|---|---|---|
| One | **A** | Formula **A** | **2** |
| | **B** | Formula **B** | **3** |
| | **C** | Formula **C** | **1** |
| | **D** | Formula **D** | **4** |

**Answer 37 · Mark scheme** March 2011 | CHY1BP | Original Q2 | Legacy

| | | | | |
|---|---|---|---|---|
| Two | **A** | Molecule **A** | **1** | |
| | **B** | Molecule **B** | **4** | |
| | **C** | Molecule **C** | **2** | |
| | **D** | Molecule **D** | **3** | |
| | | | | |
| | **A** | **B** | **C** | **D** |

**Answer 38 · Mark scheme** March 2011 | CHY1BP | Original Q4 | Legacy

| | | | | |
|---|---|---|---|---|
| Four | **3** | **2** | **3** | **2** |

**Answer 39 · Mark scheme** March 2011 | CHY1BP | Original Q7 | Legacy

| | | | | |
|---|---|---|---|---|
| Seven | **4** | **4** | **1** | **2** |

**Answer 40 · Mark scheme** June 2011 | CHY1BP | Original Q7 | Legacy

| | | | | |
|---|---|---|---|---|
| Seven | **2** | **2** | **3** | **2** |

**Answer 41 · Mark scheme** June 2011 | CHY1BP | Original Q8 | Legacy

| | | | | |
|---|---|---|---|---|
| Eight | **1** | **4** | **2** | **3** |

4.7.2.2 Reactions of alkenes

Answer 42 · Mark scheme

June 2011 | CHY1H | Original Q2 | Legacy

**Question 2**

| question | answers | extra information | mark |
|---|---|---|---|
| 2(a)(i) | heat / high temperature / hot / vaporise | if (fractional) distillation / hydrogenation mentioned as the method = max 1<br>allow thermal decomposition<br>ignore evaporation<br>do **not** accept 'burns'<br>do **not** accept temperature < 100 | 1 |
| | catalyst **or** silica / alumina / porous pot<br>**or** steam | ignore other named catalyst<br>allow heat (the vapour) to a very high temperature / >800°C for **2** marks | 1 |
| 2(a)(ii) | $C_2H_3Cl$ | ignore attempts to balance equation | 1 |
| 2(a)(iii) | single bonds between C – H, C – Cl **and** C – C | do **not** accept symbols outside the bracket | 1 |
| 2(b)(i) | so that the amount of plasticiser / (sample of) PVC is the independent / only variable that affects the bending / flexibility of the samples | allow because different sizes would give different results<br>accept because size is a control variable<br>ignore references to reliability / precision etc | 1 |
| 2(b)(ii) | to improve the reliability (of the investigation) | accept to calculate a mean<br>accept to check for anomalous results **or** to check the range of results<br>ignore accuracy / precision etc | 1 |

**Question 2 continues on the next page . . .**

4.7.2.2 Reactions of alkenes

Answer 42 · Mark scheme



**CHY1H**

**Question 2 continued . . .**

| question | answers | extra information | mark |
|---|---|---|---|
| **2(b)(iii)** | 23 | correct answer with or without working = **2** marks<br><br>if answer is incorrect<br>allow $\frac{22+23+24}{3}$<br>**or** 21 for **1** mark | 2 |
| **2(b)(iv)** | (PVC) sample had been stretched / used / tested in first three tests | accept higher temperature<br>allow worn **or** become weaker<br>ignore (human) error<br>ignore more flexible / softer<br>ignore intermolecular forces | 1 |
| **2(c)** | does not bend (easily / much)<br><br>**or** it is not flexible **or** it is rigid | ignore non-biodegradable / low maintenance<br>ignore sturdy / stronger / harder | 1 |
| **Total** | | | **10** |

### 4.7.2.2 Reactions of alkenes

**Answer 42 · Mark scheme** June 2011 | CHY1H | Original Q2 | Legacy

**CHY1H**

**Answer 43 · Mark scheme** November 2011 | CHY1BP | Original Q2 | Legacy

| | | | | |
|---|---|---|---|---|
| Two | **A** Ethane | | | **4** |
| | **B** Ethanol | | | **3** |
| | **C** Ethene | | | **2** |
| | **D** Poly(ethene) | | | **1** |
| | **A** | **B** | **C** | **D** |

**Answer 44 · Mark scheme** November 2011 | CHY1BP | Original Q5 | Legacy

| | | | | |
|---|---|---|---|---|
| Five | **1** | **4** | **1** | **4** |

4.7.2.2 Reactions of alkenes

Answer 45 · Mark scheme

January 2012 | CH1HP | Original Q7 | Legacy

## Question 7

| question | answers | extra information | mark |
|---|---|---|---|
| 7(a)(i) | $C_{11}H_{24}$<br><br>it does not have a (carbon carbon) double bond **or** it has only single (carbon carbon) bonds. | <br><br>linked to first mark point<br>accept it is an alkane **or** it is (a) saturated (hydrocarbon)<br><br>accept converse statement | 1<br><br>1 |
| 7(a)(ii) | ethene 4 x single C-H bonds<br><br>1 x double C=C bond<br><br>ethanol 5 x single C-H bonds<br><br>1 x single C-C bond | <br><br><br><br><br><br>if additional bonds are given on water molecule then both ethene and ethanol must be correct for **1** mark | 1<br><br><br><br>1 |
| 7(b) | Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 2, and apply a 'best-fit' approach to the marking. | | 6 |

| 0 marks | Level 1 (1-2 marks) | Level 2 (3-4 marks) | Level 3 (5-6 marks) |
|---|---|---|---|
| No relevant content. | There is a simple description of advantages **and / or** disadvantages of environmental or economic or social factors why Brazil should produce ethanol from crude oil or from sugar cane.<br><br>There is a weak or no conclusion. | There a clear description of advantages **and /or** disadvantages of environmental **and** economic or social factors why Brazil should produce ethanol from crude oil or from sugar cane.<br><br>There is a conclusion based on the factors described. | There is a detailed description of the advantages **and / or** disadvantages of environmental **and** economic or social factors why Brazil should produce ethanol from crude oil or from sugar cane, considering both processes.<br><br>There is a justified conclusion. |

| examples of the chemistry points made in the response | | | |
|---|---|---|---|
| **Sugar cane**<br><br>Advantage<br>**Environmental:**<br>• it is renewable / sustainable<br>• it grows absorbing $CO_2$ which makes it 'carbon neutral'<br><br>**Economical / Social:**<br>• growing it is labour intensive so provides (local, rural) employment<br>• low amount of energy / fuel needed so process costs are low<br>• simple / low technology process so process / investment costs are low<br><br>Disadvantage<br>**Environmental:**<br>• destruction of habitats / biodiversity to provide land to grow sugar cane<br><br>**Economical / Social:**<br>• land should be used to grow food (shortage / cost / population increase)<br>• growing or process is slow / batch / unreliable (crop failure) | | **Crude oil**<br><br>Disadvantage<br>**Environmental:**<br>• it is non-renewable / will run out<br>• it contains 'locked up' carbon / $CO_2$ **or** when released increases global warming<br>• destruction of marine habitats caused by accidents / spillages<br>**Economical / Social:**<br>• process requires small number of trained workers<br>• high amount of energy / fuel needed so process costs are high<br>• complex / high tech process so process / investment costs are high<br><br>Advantage<br>**Environmental:**<br>• does not use land as it is offshore<br><br>**Economical / Social:**<br>• no loss of food crops<br>• extracting or process is fast / continuous / reliable | |
| **Total** | | | **10** |

**UMS Conversion Calculator** www.aqa.org.uk/umsconversion

4.7.2.2 Reactions of alkenes

Answer 46 · Mark scheme

June 2012 | CH1HP | Original Q3 | Legacy

## Question 3

| question | answers | extra information | mark |
|---|---|---|---|
| 3(a)(i) | (1)<br>5<br>3<br>(6)<br>4<br>2 | all numbers in the correct order gains both marks<br>any two numbers in the correct position gains **1** mark | 2 |
| 3(a)(ii) | water<br>carbon dioxide | ignore formula if correct name given<br>accept hydrogen oxide<br>allow $H_2O$<br>allow $CO_2$<br>accept carbon monoxide / CO **or** carbon / C | 1<br>1 |

**Question 3 continues on the next page . . .**

**CH1HP**

**Question 3 cont'd…**

| question | answers | extra information | mark |
|---|---|---|---|
| **3(b)** | Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. **Examiners should also refer to the information on page 2**, and apply a 'best-fit' approach to the marking. | | 6 |

| 0 marks | Level 1 (1-2 marks) | Level 2 (3-4 marks) | Level 3 (5-6 marks) |
|---|---|---|---|
| No relevant content. | There is a **basic** description of at least one advantage **or** one disadvantage caused by using plastic shopping bags made from poly(ethene). | There is a **clear** description of both an advantage **and** a disadvantage caused by using plastic shopping bags made from poly(ethene). | There is a **detailed** description of both advantages **and** disadvantages caused by using plastic shopping bags made from poly(ethene). |

**examples of the chemistry/social points made in the response:**
ignore cost unqualified

**Advantages:**

- Simple properties eg strong / low density / water resistant
- Bags can be reused (for shopping) **or** another specified use eg bin liners
- Money charged for bags can go to good causes **or** encourage reuse
- Poly(ethene) bags can be recycled eg made into milk bottle crates
- Poly(ethene) bags can be burned to provide heat for buildings/generation of electricity
- New bags are now made that can biodegrade

**Disadvantages:**

- (Older) bags can take many years to biodegrade
- There is a shortage of landfill space
- Bags are made from (crude) oil which is a non-renewable resource/running out
- Large amounts of energy/fuel are used for the production of poly(ethene)
- Production of poly(ethene) releases carbon dioxide/causes global warming
- Specified issue caused by litter eg visual pollution or effect on wildlife
- Burning bags release carbon dioxide / causes global warming

| Total | | | 10 |
|---|---|---|---|

### 4.7.2.2 Reactions of alkenes

**Answer 46 · Mark scheme**

June 2012 | CH1HP | Original Q3 | Legacy

**CH1HP**

4.7.2.2 Reactions of alkenes

Answer 47 · Mark scheme

June 2012 | CH1HP | Original Q7 | Legacy

## Question 7

| question | answers | extra information | mark |
|---|---|---|---|
| 7(a) | $C_2H_4$<br><br>a correct other product **and** balanced eg $C_4H_{10}$ | | 1<br><br>1 |
| 7(b) | bubbling / fizzing / frothing / effervescence | ignore gas given off **or** solution goes cloudy | 1 |
| 7(c) | any **five** from the following bullet points:<br><br>To gain full marks there should be both advantageous and disadvantageous issues and their importance<br><br>**Advantageous issues using sugar cane:**<br><br>• sugar cane/plants absorb carbon dioxide / photosynthesise<br>• sugar cane / plants are renewable / sustainable<br><br>• low energy process | allow converse for ethanol from crude oil<br><br>ignore costs – unless specified<br>ignore safety<br>ignore simple/low technology process<br>ignore labour intensive as an advantage<br><br>**linked importance**<br><br>so is carbon neutral **or** reduce global warming<br><br>and so save resources / oil **or** crude oil is non-renewable<br><br>and so it saves fuel **or** / making ethanol from crude oil needs fuel for fractional distillation / cracking | 5 |

**Question 7(c) continues on the next page . . .**

**Question 7(c) cont'd…**

| question | answers | extra information | mark |
|---|---|---|---|
| 7(c) | **Disadvantageous issues using sugar cane:** | ignore fermentation releases carbon dioxide; destruction of habitats/land to build production plants; types of pollution; waste products | |
| | • large areas of land are needed | which leads to destruction of habitats / forest | |
| | • land could be used for food crops | may cause food shortages **or** increases the price of food **or** increasing world population | |
| | • slow process | so limits supply / production of ethanol | |
| | • ethanol is impure **or** contains 50% ethanol | so needs further separation or ethanol from crude oil is 100% pure | |
| | • batch process | so uses more labour | |
| | • the crop yield / supply of ethanol is unreliable | because growth is seasonal / weather dependent **or** possibility of crop failure | |
| | **a justified conclusion** | **compensation mark,** if no other mark awarded allow one mark for two or more issues | |
| **Total** | | | **9** |

### 4.7.2.2 Reactions of alkenes

**Answer 47 · Mark scheme**

June 2012 | CH1HP | Original Q7 | Legacy

**CH1HP**

### 4.7.2.2 Reactions of alkenes

**Answer 48 · Mark scheme**

January 2013 | CH1HP | Original Q6 | Legacy

| question | answers | extra information | mark |
|---|---|---|---|
| 6(a) | $CO_2$ (+) $H_2O$ | correct products | 1 |
| | **3**($O_2$) **2**($CO_2$) **3**($H_2O$) | correct balancing | 1 |
| 6(b)(i) | add bromine water | allow iodine | 1 |
| | changes (from orange) to colourless / decolourised | ignore clear | 1 |
| 6(b)(ii) | | ignore any references to butane ($C_4H_{10}$)<br>ignore incorrect names of catalysts | |
| | octane vapours | | 1 |
| | are passed over a catalyst (to produce ethene) | | 1 |
| | **OR** | | |
| | octane mixed with steam (1) | for steam cracking, second mark is conditional on 'steam' | |
| | at a (very) high temperature (1) | | |
| | steam is added (to ethene) | ignore the formula $H_2O$ / water | 1 |
| | in the presence of a catalyst (to produce ethanol) | | 1 |
| | | if no other marks awarded then allow **1** mark for cracking of octane **or** hydration of ethene | |
| **Total** | | | **8** |

### 4.7.2.2 Reactions of alkenes

**Answer 48 · Mark scheme**

January 2013 | CH1HP | Original Q6 | Legacy

**CH1HP**

4.7.2.2 Reactions of alkenes

Answer 49 · Mark scheme

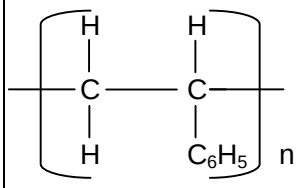
June 2013 | CH1HP | Original Q4 | Legacy

## Question 4

| question | Answers | extra information | Mark |
|---|---|---|---|
| 4(a) | any **one** advantage from:<br>• conserves resources (of crude oil / metal ores)<br>• reduces use of landfill<br>• less use of fuels/energy<br>• less carbon dioxide produced<br>any **one** disadvantage from:<br>• made of different polymers / alloys / materials<br>• difficulty / cost of separating the different materials | ignore can be made into other items<br>allow the materials (in the pen) are non-renewable<br>allow less expensive than producing from the raw material<br>ignore less waste<br>ignore global warming unqualified<br>allow not all the materials can be recycled | 1<br>1 |
| 4(b) | hard / strong / durable<br>resistant to corrosion **or** unreactive | allow do not rust<br>do **not** allow corrosive | 1<br>1 |
| 4(c)(i) | vapours (of decane)<br>passed over a catalyst **or** porous pot **or** aluminium oxide<br>**or**<br>mixed with steam (1)<br>at a (very) high temperature (1) | ignore pressure / hot / heat<br>allow high temperature (≥150 °C)<br>allow catalyst even if incorrectly named<br>if temperature quoted, must be ≥500 °C | 1<br>1 |

**Question 4 continues on the next page**

**Question 4 continued**

| question | Answers | extra information | Mark |
|---|---|---|---|
| 4(c)(ii) | many monomers **or** many ethene molecules | | 1 |
| | join / bond<br>**OR**<br>monomers / ethene molecules (1)<br>form chains **or** very large molecules (1) | allow addition polymerisation for second mark<br>if no other mark awarded allow double bond breaks / opens up **or** double bond forms a single bond for **1** mark | 1 |
| 4(d) |  | allow bonds that do not extend through brackets<br>7 single bonds are used and are in the correct places with no additional atoms (1)<br>the brackets and the n are in the correct place (1) | 2 |
| **Total** | | | **10** |

### 4.7.2.2 Reactions of alkenes

**Answer 50 · Mark scheme**

June 2014 | CH1HP | Original Q2 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. | ID |
|---|---|---|---|---|---|
| **2(a)(i)** | reaction with water / steam | allow add water / steam *(to produce ethanol)*<br>*allow $H_2O$ or hydrogen oxide for water*<br>*ignore mix* | 1 | 1 / 1.5.3a | E |
| **2(a)(ii)** | filter / decant (to remove the yeast) | *allow answers in either order*<br>*accept description of decanting*<br>*ignore sieve* | 1 | 2 / 1.5.3b | E |
| | *(fractional) distillation / distil* | *accept evaporation then condensation* | 1 | | |

4.7.2.2 Reactions of alkenes

Answer 50 · Mark scheme

June 2014 | CH1HP | Original Q2 | Legacy

<table>
<tr><td colspan="4">2(b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a ‘best-fit’ approach to the marking.</td><td>1+2+3 / 1.4.3e</td><td>E</td></tr>
<tr><td>0 marks</td><td>Level 1 (1–2 marks)</td><td>Level 2 (3–4 marks)</td><td>Level 3 (5–6 marks)</td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>No relevant content</td><td>There is a stated advantage or disadvantage of using biodiesel or petroleum diesel.</td><td>There is a stated advantage or disadvantage of using biodiesel or petroleum diesel with a linked consequence.</td><td>There is at least one stated advantage and at least one stated disadvantage of using biodiesel or petroleum diesel with a linked consequence for each.</td></tr>
<tr><td colspan="4">Examples of points made in the response could include:<br>Advantages of biodiesel:<br>• Produces less carbon dioxide<br>• Produces no sulfur dioxide<br>• Produces less particulates<br>• Sustainable / renewable<br>• Growing crops absorb carbon dioxide<br>• Carbon neutral<br>• Produces less acid rain<br>• Conserves the limited amount of petroleum diesel<br>Disadvantages of biodiesel:<br>• Produces more nitrogen oxides<br>• Deforestation for land<br>• Destruction of habitats for land<br>• Uses land that could be used for food crops<br>• Creates food shortages<br>• Crops are not reliable</td><td></td><td></td></tr>
</table>

| | | | |
|---|---|---|---|
| **Total** | | | **9** |

### 4.7.2.2 Reactions of alkenes

**Answer 50 · Mark scheme**

June 2014 | CH1HP | Original Q2 | Legacy



### 4.7.2.2 Reactions of alkenes

**Answer 51 · Mark scheme**

June 2014 | CH1HP | Original Q7 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. | ID |
|---|---|---|---|---|---|
| **7(a)(i)** | alkanes **and** alkenes | any order<br>allow saturated **and** unsaturated (hydrocarbons) | 1 | 1 / 1.4.2a | E |
| **7(a)(ii)** | high temperature<br><br><br><br>catalyst **or** steam | *allow temperatures from 300 – 900 °C*<br>*allow vapours*<br>*ignore heat / hot **or** pressure*<br>*allow zeolite / aluminium oxide*<br>*ignore names of other catalysts* | 1<br><br><br>1 | 1 / 1.5.1a | E |
| **7(a)(iii)** | *oxygen* could react / *burn* with the hydrocarbons | allow *oxygen* could cause an explosion | 1 | 2 / 1.5.1a | E |
| **7(a)(iv)** | *(fractional)* distillation | | 1 | 2 / 1.4.2b | E |
| **7(b)(i)** | displayed structure of butene drawn | | 1 | 2 / 1.5.1c | E |
| **7(b)(ii)** | many monomers **or** many butene molecules<br>*form chains **or** very large molecules* | <br><br>if no other mark awarded allow double bond breaks / opens up **or** double bond forms a single bond for **1** mark | 1<br>1 | 1 / 1.5.2a | E |
| **Total** | | | **8** | | |

4.7.2.2 Reactions of alkenes

Answer 52 · Mark scheme

June 2015 | CH2HP | Original Q3 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 3(a) | | first 3 marks can be obtained from a suitably labelled diagram<br>incorrect structure or bonding or particle = max 3 | | **AO1**<br>2.1.h,i<br>2.2.4a |
| | giant structure / lattice / layers / close packed | | 1 | |
| | made up of atoms / positive ions | | 1 | |
| | with delocalized / free electrons | | 1 | |
| | so electrons can move / flow through the metal | accept so electrons can carry charge through the metal<br>accept so electrons can form a current | 1 | |
| 3(b) | | accept converse for pure metal throughout<br>both marks can be obtained from suitable diagrams | | **AO1**<br>2,2,4c |
| | an alloy (is a metal which) has different types / sizes of atoms | allow made of different metals<br>allow mixture of metals / atoms / elements<br>ignore particles<br>ignore properties<br>do **not** accept compound | 1 | |
| | alloy has distorted layers | allow layers are unable to slide | 1 | |
| 3(c)(i) | can return to its original shape | accept shape memory alloy<br>accept smart alloy<br>ignore other properties | 1 | **AO1**<br>2.2.4d |

**Question 3 continues on the next page**

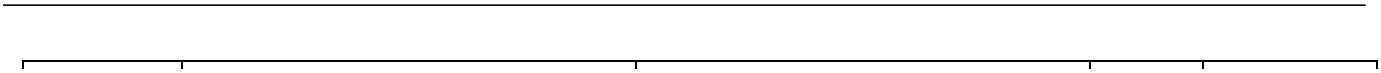
**Question 3 continued**

| | | | | |
|---|---|---|---|---|
| **3(c)(ii)** | (pure copper is too) soft | accept converse<br>accept malleable or bends<br>accept copper is running out<br>ignore references to strength and weakness | 1 | **AO2**<br>2.2.4c<br>2.7.1d |
| **3(c)(iii)** | aluminium oxide | accept alumina<br>accept $Al_2O_3$<br>ignore bauxite / aluminium ore | 1 | **AO1**<br>2.7.1h |
| **3(c)(iv)** | any **one** from:<br>• different conditions<br>• different catalyst<br>• different pressure<br>• different temperature | allow different concentration<br>do **not** accept different monomers | 1 | **AO1**<br>2.2.5a |
| **3(d)** | any **two** from:<br>• accurate<br>• sensitive<br>• rapid<br>• small sample | both needed for 1 mark | 1 | **AO1**<br>2.3.2a |
| **Total** | | | **11** | |

### 4.7.2.2 Reactions of alkenes

**Answer 52 · Mark scheme**

June 2015 | CH2HP | Original Q3 | Legacy

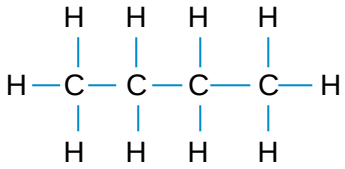


4.7.2.2 Reactions of alkenes

Answer 53 · Mark scheme

June 2016 | CH1HP | Original Q2 | Legacy

## Question 2

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 2(a)(i) | high temperature<br><br>catalyst or steam | allow heating / hot / 250-900 °C<br><br>allow named catalyst eg zeolite, $Al_2O_3$, silica, ceramic<br>allow in the absence of air / oxygen<br><br>ignore any references to pressure | 1<br><br>1 | AO1<br>1.5.1a |
| 2(a)(ii) | colourless | allow decolourised<br>ignore clear / discoloured | 1 | AO1<br>1.5.1d |
| 2(a)(iii) |  | | 1 | AO2<br>1.4.2a |
| 2(b)(i) | 20.3(0) (kJ) | if answer incorrect allow **1** mark for 24.36/1.2 | 2 | AO2<br>1.4.3b |
| 2(b)(ii) | use a lid<br><br>reduce energy / heat loss | allow insulate beaker or use draught shield<br><br>ignore references to thermometer or repeats or distance of flame or loss of water vapour<br>allow stir (1) to distribute energy / heat (1)<br>allow use a metal can (1) as it's a better conductor (1) | 1<br><br>1 | AO3<br>4.3.2b/c/d |
| 2(b)(iii) | carbon/soot<br>(produced by) incomplete combustion | ignore tar, smoke<br>allow from a limited supply of oxygen/air | 1<br>1 | AO1+AO2<br>1.4.3a/b |
| 2(b)(iv) | hexane gives out the greatest energy (per 1.0 g)<br>hexane produces the least smoke / carbon / soot | ignore more energy<br><br>allow has the cleanest flame<br>ignore less smoke / carbon / soot | 1<br><br>1 | AO3<br>1.4.2c;<br>1.4.3a/b |

**QWC Mark Scheme**

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **2(c)** | | | 6 | AO1+AO2+ AO3 1.1.3b; 1.4.1b/c; 1.4.3a/b/c/d ;1.7.2h/i |

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.

| 0 marks | Level 1 (1–2 marks) | Level 2 (3–4 marks) | Level 3 (5–6 marks) |
|---|---|---|---|
| No relevant content | Statements made from the information that indicate whether at least one statement is an advantage **or** a disadvantage<br>**or**<br>a linked advantage or disadvantage | Descriptions of an advantage **and** a disadvantage with some use of their knowledge to add value. | Descriptions of advantages **and** disadvantages that are linked to their own knowledge. |

**Examples of the added value statements and links made in the response could include:**
**Note that link words are in bold; links can be either way round.**
**Accept reverse arguments and ignore cost throughout.**

**Advantages of using hydrogen:**

- Combustion only produces water **so** causes no pollution
- Combustion does not produce carbon dioxide **so** this does not contribute to global warming or climate change
- Combustion does not produce sulfur dioxide **so** this does not contribute to acid rain
- Incomplete combustion of petrol produces carbon monoxide **that is** toxic
- Incomplete combustion of petrol produces particulates **that** contribute to global dimming
- Petrol comes from a non-renewable resource **but** there are renewable/other methods of producing hydrogen
- Hydrogen releases more energy **so** less fuel needed or more efficient

**Disadvantages of using hydrogen:**

- Hydrogen is a gas **so** is difficult to store or transfer to vehicles
- Hydrogen gas is very flammable **so** leaks cause a greater risk of explosion
- Most hydrogen is produced from fossil fuels **which** are running out
- Cannot be used in existing car engines **so** modification / development or replacement is needed
- Lack of filling stations **so** difficult to refuel your vehicle

| Total | | | 18 |
|---|---|---|---|

4.7.2.2 Reactions of alkenes

Answer 54 · Mark scheme

June 2016 | CH1HP | Original Q4 | Legacy

## Question 4

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 4(a)(i) | add yeast | | 1 | AO1 |
| | and ferment **or** by fermentation | allow in a warm place **or** temperatures within the range 20-45$^{o}$C **or** with an airlock/absence of air | 1 | 1.5.3b |
| 4(a)(ii) | by hydration with steam | allow react with/addition of steam | 1 | AO1 1.5.3a |
| | in the presence of a catalyst | ignore names of catalyst and any other conditions<br>allow a correctly named catalyst e.g. phosphoric acid | 1 | |
| 4(b) | | "it" = crude oil | | AO1+AO2 1.4; 1.4.3e |
| | | allow the link pairs in either order | | |
| | | ignore cost throughout | | |
| | Advantages | | | |
| | crude oil is reliable source of ethanol | **or** produces pure ethanol | 1 | |
| | because it is not affected by weather conditions or plant growth is affected by weather condition | so purification/separation is not required | 1 | |
| | **or** does not cause food shortages | **or** quick / continuous process | | |
| | because farmland not used | whereas fermentation takes a long time/is a batch process | | |
| | Disadvantages | | | |
| | crude oil is a non-renewable / finite resource | allow production of ethanol from crude oil uses more energy or a higher temperature or burns more fossil fuels | 1 | |
| | so it will run out / plants grow again | so releases more carbon dioxide or causes global warming (or an effect) | 1 | |

### 4.7.2.2 Reactions of alkenes

**Answer 54 · Mark scheme**

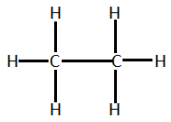
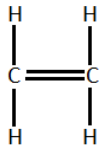


| | | | | |
|---|---|---|---|---|
| **4(c)** | heat (the mixture)<br><br>ethanol has a lower boiling point than water **or** more ethanol than water vaporises **or** ethanol evaporates first or when the temperature reaches 78°C<br><br>condense (the vapour) | <br><br>allow ethanol and water boil at different temperatures<br><br><br><br>allow condense at different temperatures for the last two marking points<br><br>if no other mark is awarded, allow repeat distillation or use fractional distillation apparatus for 1 mark | 1<br><br>1<br><br><br><br>1 | AO2<br><br>1.4.1 b;<br>1.5.3 b |
| **Total** | | | **11** | |

### 4.7.2.2 Reactions of alkenes

**Answer 55 · Mark scheme**



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **2(a)(i)** | electronic structure drawn | allow any representation of an electron<br>allow 2,4 | 1 | **AO2**<br>1.1.1h |
| **2(a)(ii)** | six / 6<br>protons<br><br><br>(protons) are positively charged | <br>do **not** allow electrons in nucleus otherwise ignore electrons<br>do **not** allow nucleus is neutral<br>allow (protons are) + / +1 / 1+<br>ignore statements about mass<br>if no other mark awarded allow one mark for nucleus | 1<br>1<br><br><br>1 | **AO1**<br>**AO2**<br>1.1.1c;d;e |
| **2(b)** | (a hydrocarbon is) made up of hydrogen and carbon (atoms) only | do **not** allow mixture | 1 | **AO1**<br>1.4.1a;c |
| **2(c)(i)** | <br> | ethane correctly drawn with another hydrogen on each carbon and another three single bonds<br>ethene correctly drawn with a double bond between the carbon atoms | 1<br>1 | **AO1**<br>1.4.2a<br>1.5.1c |
| **2(c)(ii)** | as the number of carbon atoms increases the boiling point increases | allow converse<br>ignore alkene | 1 | **AO3**<br>1.4.2c |

Answer 55 · Mark scheme

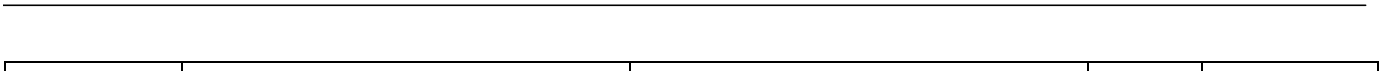


| | | | | |
|---|---|---|---|---|
| **2(c)(iii)** | the boiling points of alkanes are higher than the boiling points of alkenes<br><br>that have the same number of carbon atoms<br><br>**or** state a correct example | allow the boiling points of alkenes are lower than the boiling points of alkanes<br><br>consequential on first marking point<br><br>e.g. hexane has a higher boiling point than hexene **or** hexane boils at 69ºC hexene boils at 64ºC<br><br>if no other mark awarded allow both alkanes and alkenes have the same pattern of the more carbon atoms the higher the boiling point for one mark | 1<br><br>1 | **AO2**<br>1.4.2b;c |
| **2(d)** | (alkane molecules are) cracked<br><br>to produce small(er) molecules / alkanes / hydrocarbons<br><br>and alkenes **or** a named alkene | allow break down / up **or** decompose **or** split up<br>ignore separate<br><br>allow short chain for small<br><br>allow molecules that have a double bond **or** are unsaturated<br><br>if no other mark awarded allow evaporate **or** boil for one mark<br><br>ignore turns to gas | 1<br><br>1<br><br>1 | **AO1**<br>**AO2**<br>**AO3**<br>1.5.1a;b;d |
| **Total** | | | **13** | |

### 4.7.2.2 Reactions of alkenes

**Answer 55 · Mark scheme**

June 2017 | CH1HP | Original Q2 | Legacy



**Answer 56 · Mark scheme**

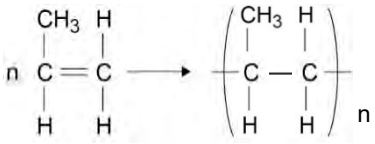
June 2017 | CH2HP | Original Q4 | Legacy

The full source mark scheme begins on page 94. Follow original question 4 in that document.

4.7.2.2 Reactions of alkenes

Answer 57 · Mark scheme

June 2018 | 8462/2H | Original Q6

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.1** | water | allow $H_2O$<br><br>allow hydrogen chloride **or** HCl | 1 | AO1<br>4.7.3.2 |
| **06.2** | | an answer of<br><br>scores **3** marks | | AO2<br>4.7.3.1 |
| | single C–C bond and nothing added to the trailing bonds | | 1 | |
| | 3 × H and $CH_3$ correct | must be four single bonds | 1 | |
| | n at bottom right | | 1 | |
| | | must be fully correct to score all **3** marks | | |
| **06.3** | any **two** from:<br>• poly(propene) comes from a non-renewable source<br>• poly(propene) requires a lot of energy to make<br>• poly(propene) is not biodegradable<br>• a wool carpet needs replacing more often<br>• wool requires the use of large areas of land (which could be used to grow food crops) | allow converse arguments<br><br>allow poly(propene) will run out<br><br>must refer to the carpet, not just the fibre<br><br>ignore references to cost<br>ignore pollution<br>ignore landfill | 2 | AO3<br>4.10.1.1 |

### 4.7.2.2 Reactions of alkenes

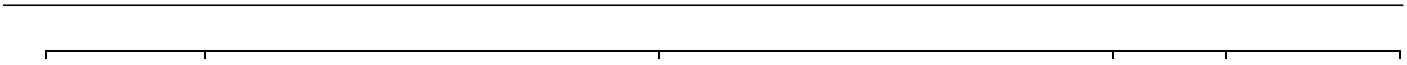
**Answer 57 · Mark scheme** June 2018 | 8462/2H | Original Q6

| Question | Answers | Extra information | Mark | AO/ Spec. Ref. |
|---|---|---|---|---|
| **06.4** | any **four** from:<br><br>advantages of polyester<br>• better flame resistance (so burns less easily)<br>• higher melting point (so melts less easily)<br>• absorbs water so less likely to ignite<br><br>disadvantages of polyester:<br>• high density so uniform is heavy<br>• absorbs water so firefighter gets wet<br>• absorbs water so uniform becomes heavy<br>• justified conclusion | allow converse arguments throughout.<br><br>**max 3** marks if only advantages or only disadvantages of one type of fibre<br><br>allow good flame resistance so protects the firefighter<br><br>allow high melting point so uniform is not damaged | 4 | AO3<br>4.7.3.1<br>4.7.3.2 |
| **Total** | | | **10** | |

### 4.7.2.2 Reactions of alkenes

**Answer 57 · Mark scheme**

June 2018 | 8462/2H | Original Q6



4.7.2.2 Reactions of alkenes

Answer 58 · Mark scheme

June 2019 | 8462/2H | Original Q8

## Question 8

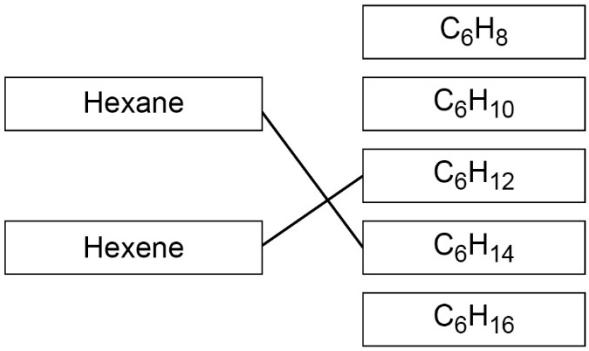
| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 08.1 | (Titan has) little / no oxygen | ignore references to respiration | 1 | AO3 4.9.1.3 |
| | (so) photosynthesis has not occurred (on Titan) | allow (so) no plants / algae to produce oxygen (on Titan) | 1 | |
| | (therefore) little / no carbon dioxide present (on Titan) **or** (therefore) oxygen-using animals cannot have evolved (on Titan) | | 1 | |
| 08.2 | (methane) allows short(er) wavelength radiation to pass through (from the sun) | allow (methane) allows uv / ultraviolet radiation to pass through (from the sun) | 1 | AO1 4.9.2.1 |
| | (which is) re-emitted from the surface as long(er) wavelength radiation | allow (which is) re-emitted from the surface as ir / infra-red radiation | 1 | |
| | (which is) absorbed (by methane in the atmosphere) | allow (which is) trapped (by methane in the atmosphere)<br><br>if no other mark is awarded, allow **1** mark for methane absorbs long(er) wavelength radiation **or** methane absorbs ir / infra-red radiation | 1 | |
| 08.3 | (add) bromine (water) | do **not** accept bromide | 1 | AO1 4.7.1.4 4.7.2.1 4.7.2.2 |
| | (changes from) orange to colourless | dependent on correct test in MP1<br>allow (changes from) brown to colourless<br><br>ignore clear | 1 | |
| **Total** | | | **8** | |

4.7.2.2 Reactions of alkenes

Answer 59 · Mark scheme

November 2020 | 8462/2H | Original Q3

## Question 3

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 03.1 | <br>additional line from a box on the left negates the mark for that box | | 1<br><br><br><br>1 | AO2<br>4.7.1.1<br>4.7.2.1 |
| 03.2 | (remains) orange<br><br>(becomes) colourless | must be in this order<br><br>allow no (colour) change<br><br>ignore initial colour<br>ignore clear | <br>1<br><br>1 | AO2<br>4.7.1.4 |

**Question 3 (continued)**

| Question | Answers | Mark | AO/ Spec. Ref |
|---|---|---|---|
| 03.3 | **Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar/different is made clear and (where appropriate) the magnitude of the similarity/difference is noted. | 4–6 | AO1 AO2 |
| | **Level 1**: Relevant features are identified and differences noted. | 1–3 | |
| | **No relevant content** | 0 | 4.7.1.1 4.7.1.3 4.7.1.4 4.7.2.1 4.7.2.2 4.9.3.1 |
| | **Indicative content**<br><br>**Structure and bonding**<br><br>• both are hydrocarbons<br>• both contain two carbon atoms (per molecule)<br>• ethane contains six hydrogen atoms (per molecule)<br>• (but) ethene contains four hydrogen atoms (per molecule)<br><br>• both have covalent bonds<br>• ethane contains a single C—C bond<br>• (but) ethene contains a double bond<br>• both contain C—H bonds<br><br>• both small molecules<br><br>**Reactions**<br><br>• both react with oxygen in complete combustion reactions<br>• to produce water and carbon dioxide<br>• both react with oxygen in incomplete combustion reactions<br>• to produce water, carbon monoxide and carbon<br>• incomplete combustion is more likely with ethene<br><br>• ethene decolourises bromine water<br>• (but) ethane does not decolourise bromine water<br><br>• ethene is more reactive (than ethane)<br>• ethene can react with hydrogen (to produce ethane)<br>• ethene can react with water (to produce ethanol)<br>• ethene can react with halogens (to produce halogenoalkanes)<br>• ethene can undergo addition reactions<br>• ethene can polymerise (to produce poly(ethene))<br><br>ignore physical properties<br>ignore references to flammability | | |

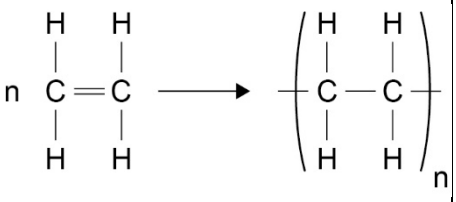
| Total | | | 10 |
|---|---|---|---|

4.7.2.2 Reactions of alkenes

Answer 60 · Mark scheme

November 2021 | 8462/2H | Original Q4

## Question 4

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.1 |  | if equation incorrect<br>allow **1** mark for 5 single bonds<br>**or**<br>allow **1** mark for n | 2 | AO1<br>4.7.3.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.2 | | allow converse statements about thermosetting polymers | | |
| | (poly(ethene)) melts | allow thermosoftening polymers melt | 1 | AO1 |
| | (so) can be reshaped (into new products) | | 1 | AO3<br>4.10.3.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.3 | use different (reaction) conditions | allow use different temperatures / pressures | 1 | AO1<br>4.10.3.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.4 | | allow converse statements about LDPE | | AO3<br>4.10.3.3 |
| | (in HDPE) polymer chains / molecules are closer together | allow (HDPE has) unbranched polymer chains / molecules | 1 | |
| | (so) more atoms per unit volume | allow (so) more molecules per unit volume | 1 | |

**Question 4 continued**

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.5** | circle around HO– **or** –OH on monomer **A** | | 1 | AO2 4.7.2.3 4.7.3.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.6** | $H_2O$ **and** HCl | must be in this order | 1 | AO3 4.7.3.2 |

| Total | | | 9 |
|---|---|---|---|

4.7.2.2 Reactions of alkenes

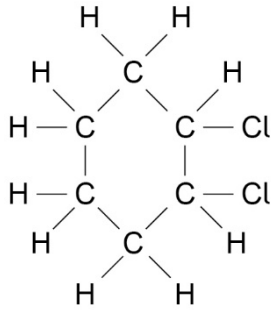
Answer 61 · Mark scheme

November 2021 | 8462/2H | Original Q6

## Question 6

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.1 | (test)<br>(add) bromine (water)<br><br>(result)<br>(changes from) brown / orange to colourless | <br><br><br>ignore clear | <br>1<br><br><br>1 | AO1<br>4.7.1.4<br>4.7.2.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.2 | $C_nH_{2n-2}$ | | 1 | AO2<br>4.7.2.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.3 |  | allow **1** mark for the structure of<br>1, 1-dichlorocyclohexane **or**<br>1, 3-dichlorocyclohexane **or**<br>1, 4-dichlorocyclohexane | 2 | AO2<br>4.7.2.2 |

4.7.2.2 Reactions of alkenes

Answer 61 · Mark scheme

November 2021 | 8462/2H | Original Q6

**Question 6 continued**

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.4** | ($M_r$ ($C_6H_{10}Cl_2$) =) 153 | | 1 | AO2 4.3.1.2 |
| | (% chlorine=) $\frac{71}{153}$ × 100 | allow correct use of an incorrectly calculated value of $M_r$ | 1 | |
| | = 46.4 (%) | allow 46.405228758 (%) correctly rounded to at least 2 significant figures | 1 | |

| | | | |
|---|---|---|---|
| **Total** | | | **8** |

4.7.2.2 Reactions of alkenes

Answer 62 · Mark scheme

November 2021 | 8462/2H | Original Q10

## Question 10

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 10.1 | (steam / catalytic) cracking | allow thermal decomposition | 1 | AO1 4.7.1.4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 10.2 | high temperature<br><br>steam / catalyst | allow a temperature in the range 300 – 900 °C | 1<br><br>1 | AO1 4.7.1.4 |

**Question 10 continued**

| Question | Answers | Mark | AO/ Spec. Ref |
|---|---|---|---|
| 10.3 | **Level 3:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account. | 5–6 | AO2<br>4.6.1.3<br>4.6.2.4<br>4.6.2.6<br>4.6.2.7<br>4.7.2.2 |
| | **Level 2:** Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear. | 3–4 | |
| | **Level 1:** Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking. | 1–2 | |
| | **No relevant content** | 0 | |
| | **Indicative content**<br><br>**Rate**<br>• higher temperature gives higher rate<br>• because more frequent collisions<br>• higher pressure gives higher rate<br>• because more frequent collisions<br>• a catalyst can be used to give a higher rate<br>• because the activation energy is reduced<br><br>**Yield**<br>• higher temperature gives lower yield<br>• because the reaction is exothermic<br>• higher pressure gives higher yield<br>• because there are more molecules on left hand side<br><br>**Other factors**<br>• higher temperatures use more energy so costs increase<br>• higher pressures use more energy so costs increase<br>• higher pressures require stronger reaction vessels so costs increase<br><br>**Compromise**<br>• chosen temperature is a compromise between rate and yield<br>• chosen temperature is a compromise between rate and cost (of energy used)<br>• chosen pressure is a compromise between rate and cost (of energy used)<br>• chosen pressure is a compromise between yield and cost (of energy used) | | |

**Question 10 continued**

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.4** | fermentation | allow ferment(ing) | 1 | AO1<br>4.7.2.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.5** | warm<br><br>anaerobic (conditions) | allow a value in the range 25 °C to 45 °C<br><br>allow without oxygen / air | 1<br><br>1 | AO2<br>4.7.2.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.6** | (conversion)<br>200 km = 200,000 m<br><br>(moles = ) $\frac{200000 \times 1.95 \text{ (mol)}}{1300}$<br><br>= 300 (mol) | <br><br>allow correct use of incorrect / no conversion for distance | 1<br><br>1<br><br>1 | AO2<br>4.7.2.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.7** | $C_4H_9OH + 6\,O_2 \rightarrow 4\,CO_2 + 5\,H_2O$ | allow $C_4H_{10}O$ for $C_4H_9OH$<br><br>allow multiples<br><br>allow **1** mark for<br>$C_4H_9OH + O_2 \rightarrow CO_2 + H_2O$<br>with incorrect / no multipliers<br><br>ignore state symbols | 2 | AO2<br>4.1.1.1<br>4.3.1.1<br>4.7.2.3 |

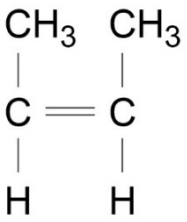
| Total | | | 17 |
|---|---|---|---|

4.7.2.2 Reactions of alkenes

Answer 63 · Mark scheme

June 2022 | 8462/2H | Original Q1

## Question 1

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.1 | C=C bond | | 1 | AO2 4.7.3.1 |
| | 2x C-H bonds **and** 2x C-$CH_3$ bonds | do **not** accept extra bonds | 1 | |
| | | an answer of  scores **2** marks | | |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.2 | any **one** from:<br>• (otherwise) the copper (produced) would be impure<br>• (otherwise) the copper (produced) would be a mixture<br>• (otherwise) the insulation would burn / melt (during recycling)<br>• copper and poly(butene) are recycled by different methods | allow (otherwise) the copper (produced) would be contaminated<br>allow (otherwise) poly(butene) could produce toxic fumes | 1 | AO3 4.10.2.2 |

4.7.2.2 Reactions of alkenes

Answer 63 · Mark scheme



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.3 | (wire heated until) copper melts<br><br>(re)cast / reformed (into pipes) | <br><br>allow (re)shaped / extruded / (re)moulded | 1<br><br>1 | AO1<br>4.10.2.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.4 | <br><br><br><br>any **two** from:<br>(recycling scrap copper)<br>• uses less energy<br>• conserves copper (ore)<br>• (produces) less waste<br>• specified environmental impact | allow converse statements for extracting copper from ores<br><br>ignore references to cost<br><br><br><br><br><br>allow less landfill required | <br><br><br><br>2 | AO1<br>4.10.1.1<br>4.10.2.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.5 | <br><br>sodium hydroxide (solution)<br><br>blue precipitate | MP2 dependent on MP1<br><br>allow NaOH for sodium hydroxide<br><br>allow blue solid | <br><br>1<br><br>1 | AO1<br>4.8.3.2<br>RPA7 |

4.7.2.2 Reactions of alkenes

Answer 63 · Mark scheme



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.6 | (add acidified) barium chloride (solution) | MP2 dependent on MP1<br>allow $BaCl_2$ for barium chloride<br>allow (add acidified) barium nitrate (solution)<br>do **not** accept add sulfuric acid | 1 | AO1<br>4.8.3.5<br>RPA7 |
| | white precipitate | allow white solid | 1 | |

| Total Question 1 | | 11 |
|---|---|---|

4.7.2.2 Reactions of alkenes

Answer 64 · Mark scheme

June 2023 | 8462/1H | Original Q4

## Question 4

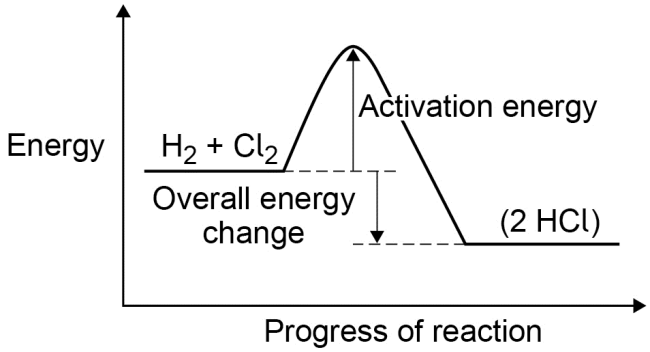
| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.1** | 436 + 346 − (2 × 432) kJ/mol | | 1 | AO2<br>4.5.1.3 |

| Question | Answers | Extra | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.2** | energy is needed to break bonds<br>**and**<br>energy is released when bonds form | | 1 | AO1<br>4.5.1.3 |
| | (and) the energy released is greater than the energy needed | allow the energy transferred in bond making is greater than the energy transferred in bond breaking<br><br>allow 2 x 432 (kJ/mol) is greater than 436 + 346 (kJ/mol)<br><br>allow the overall energy change is negative | 1 | |

4.7.2.2 Reactions of alkenes

Answer 64 · Mark scheme

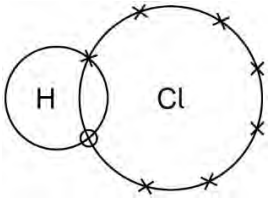
June 2023 | 8462/1H | Original Q4

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.3 | | ignore arrow heads | | |
| | profile completed with product energy below reactant energy | | 1 | AO1 |
| | activation energy labelled from reactant energy to top of curve | | 1 | AO1 |
| | overall energy change labelled from reactant energy to product energy | | 1 | AO2 |
| | | | | 4.5.1.2 |
| | an answer of   | | | |
| | scores **3** marks | | | |

4.7.2.2 Reactions of alkenes

Answer 64 · Mark scheme

June 2023 | 8462/1H | Original Q4

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.4 | | allow any combination of x, o, $e^{(-)}$, • for electrons<br><br>do **not** accept molecules containing more than 2 atoms | | AO1<br>4.2.1.4 |
| | bonded pair of electrons in the overlap | | 1 | |
| | chlorine with 6 non-bonded electrons | do **not** accept if extra electrons on H<br><br>an answer of<br><br><br>scores **2** marks<br>**or**<br>an answer of<br><br>scores **2** marks | 1 | |

4.7.2.2 Reactions of alkenes

Answer 64 · Mark scheme

June 2023 | 8462/1H | Original Q4

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.5 | (methane)<br><br>methane has (much) smaller molecules | | 1 | AO1<br>4.2.2.4<br>4.2.2.5 |
| | (so) has weaker intermolecular forces | do **not** accept reference to weak(er) covalent bonds | 1 | |
| | (so the intermolecular forces) need less energy to overcome | do **not** accept reference to breaking covalent bonds | 1 | |
| | (so) the boiling / melting point is lower (and methane is a gas)<br><br>**OR**<br><br>(poly(ethene))<br><br>poly(ethene) has (much) larger molecules (1) | | 1 | |
| | (so) has stronger intermolecular forces (1) | do **not** accept reference to weak(er) covalent bonds | | |
| | (so the intermolecular forces) need more energy to break (1) | do **not** accept reference to breaking covalent bonds | | |
| | (so) the melting / boiling point is higher (and poly(ethene) is a solid) (1) | | | |

| Total Question 4 | 12 |
|---|---|

4.7.2.2 Reactions of alkenes

Answer 65 · Mark scheme

June 2023 | 8462/2H | Original Q2

## Question 2

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.1** | (mass =) $\frac{39.8}{29.6}$ (×1)<br><br>= 1.34 (g) | <br><br>allow 1.34459459 (g) correctly rounded to at least 2 significant figures | 1<br><br>1 | AO2<br>4.7.2.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.2** | all six points plotted correctly | allow a tolerance of ± ½ a small square<br><br>allow **1** mark for four or five points plotted correctly | 2 | AO2<br>4.7.2.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.3** | 40.6 (kJ) | allow a value in the range 40.4 – 40.8 kJ<br>allow a value consistent with the plotted points | 1 | AO2<br>4.7.2.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.4** | calcium hydroxide | | 1 | AO1<br>4.8.2.3 |

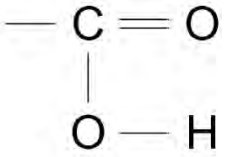
| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.5** | (limewater turns) milky / cloudy | allow white precipitate (formed)<br><br>allow calcium carbonate is produced | 1 | AO1<br>4.8.2.3 |

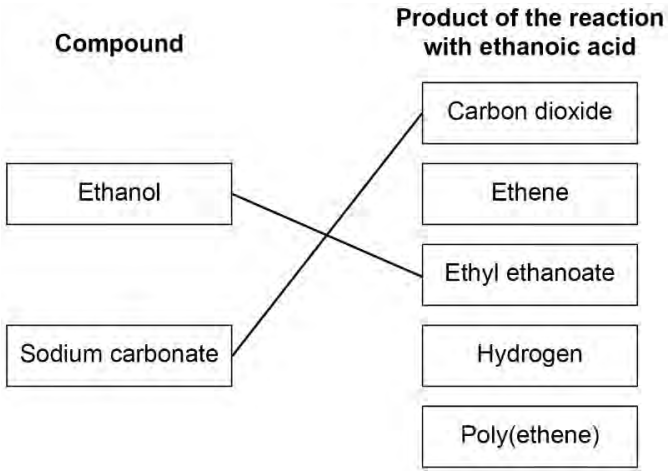
### 4.7.2.2 Reactions of alkenes

**Answer 65 · Mark scheme**



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.6** | an oxidising agent | | 1 | AO1<br>4.7.2.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.7** |  | | 1 | AO1<br>4.7.2.4 |

| Question | Answers | Mark | AO / Spec. Ref. |
|---|---|---|---|
| **02.8** | <br>do **not** accept more than **one** line from a box on the left | 1<br>1 | AO1<br>4.7.2.4 |

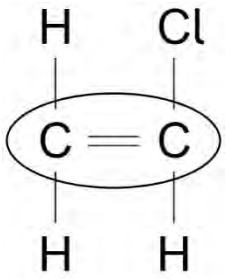
| Total Question 2 | 11 |
|---|---|

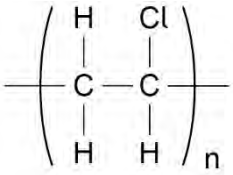
4.7.2.2 Reactions of alkenes

Answer 66 · Mark scheme

June 2023 | 8462/2H | Original Q8

## Question 8

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 08.1 |  | | 1 | AO1<br>4.7.3.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 08.2 | C-C bond<br><br>3x C-H **and** 1x C-Cl bonds<br><br>2x single bonds extending through brackets<br>**and**<br>n below halfway | an answer of<br><br>scores **3** marks | 1<br><br>1<br><br>1 | AO2<br>4.7.3.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 08.3 | composites | | 1 | AO1<br>4.10.3.3 |

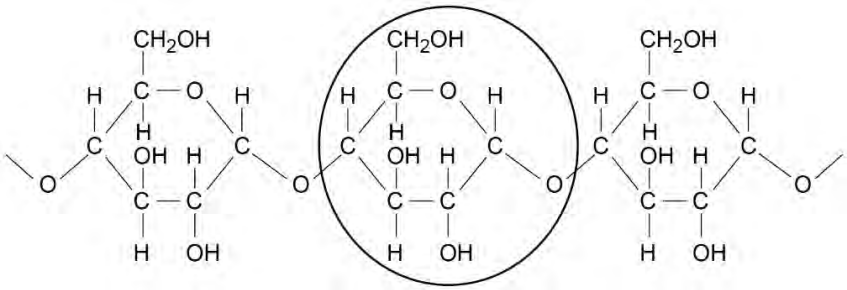
| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 08.4 | water | allow $H_2O$ | 1 | AO1<br>4.7.3.3 |

4.7.2.2 Reactions of alkenes

Answer 66 · Mark scheme



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 08.5 | ($M_r$ of $NH_2$ and COOH) = (2 × 1) + 14 + 12 + (2 × 16) + 1 =) 61<br><br>($M_r$ of section = 75 – 61) = 14 | <br><br>allow correct use of incorrectly determined $M_r$ of $NH_2$ and COOH | 1<br><br>1 | AO2<br>4.3.1.2<br>4.7.3.3 |

| Question | Answers | Mark | AO / Spec. Ref. |
|---|---|---|---|
| 08.6 |  | 1 | AO2<br>4.7.3.1<br>4.9.1.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 08.7 | starch | allow cellulose<br>allow glycogen<br>allow polysaccharide | 1 | AO3<br>4.7.3.4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 08.8 | nucleotides | | 1 | AO1<br>4.7.3.4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 08.9 | double helix | ignore DNA | 1 | AO1<br>4.7.3.4 |

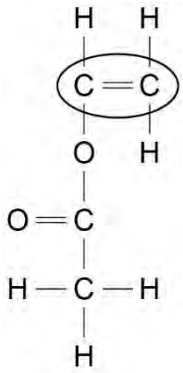
| Total Question 8 | 12 |
|---|---|

4.7.2.2 Reactions of alkenes

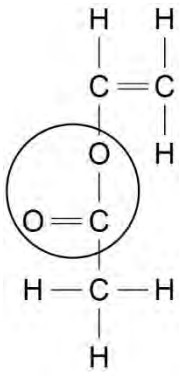
Answer 67 · Mark scheme

June 2024 | 8462/2H | Original Q8

## Question 8

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 08.1 |  | | 1 | AO2<br>4.7.2.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 08.2 | orange (bromine water)<br><br>turns colourless | allow yellow / brown<br><br>allow is decolourised<br><br>ignore clear | 1<br><br>1 | AO2<br>4.7.1.4 |

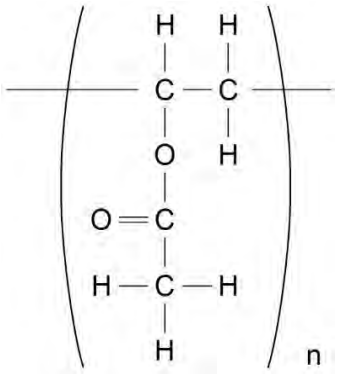
| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 08.3 |  | | 1 | AO3<br>4.7.2.4<br>4.7.3.2 |

4.7.2.2 Reactions of alkenes

Answer 67 · Mark scheme



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **08.4** | $2\ C_4H_6O_2 + 9\ O_2 \rightarrow 8\ CO_2 + 6\ H_2O$ | allow multiples<br><br>allow **1** mark for<br>$C_4H_6O_2 + O_2 \rightarrow$<br>with incorrect / no multipliers<br><br>allow **1** mark for<br>$\rightarrow CO_2 + H_2O$<br>with incorrect / no multipliers<br><br>ignore state symbols | 3 | AO2<br>4.7.2.1<br>4.1.1.1<br>4.3.1.1<br>4.7.2.1<br>4.7.2.4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **08.5** | single C-C bond in polymer repeating unit<br><br>n after polymer repeating unit | do **not** accept extra atoms added to trailing bonds<br><br>an answer of<br><br><br><br>scores **2** marks | 1<br><br>1 | AO2<br>4.7.3.1 |

4.7.2.2 Reactions of alkenes

Answer 67 · Mark scheme



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **08.6** | addition polymer | | 1 | AO2<br>4.7.3.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **08.7** | thermosoftening | allow thermoplastic | 1 | AO1<br>4.10.3.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **08.8** | cross-links between (polymer) chains<br><br>(so) too much energy needed to overcome the cross-links | allow covalent bonds between (polymer) chains<br><br>allow (so) too much energy needed to overcome the covalent bonds between (polymer) chains | 1<br><br>1 | AO1<br>4.2.2.5<br>4.10.3.3 |

| Total Question 8 | 13 |
|---|---|

4.7.2.2 Reactions of alkenes

Answer 68 · Mark scheme

June 2025 | 8462/1H | Original Q2

## Question 2

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.1** | CaS | | 1 | AO2<br>4.2.1.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.2** | calcium (atom) loses electrons | | 1 | AO2<br>4.2.1.1<br>4.2.1.2 |
| | sulfur (atom) gains electrons | | 1 | |
| | reference to transfer of two electrons | | 1 | |
| | calcium forms positive ions **and** sulfur forms negative ions | allow $Ca^{2+}$ (ions) **and** $S^{2-}$ (ions) are formed<br><br>allow calcium ions **and** sulfide ions are formed | 1 | |

Answer 68 · Mark scheme



| Question | Answers | Mark | AO / Spec. Ref. |
|---|---|---|---|
| 02.3 | **Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account. | 3–4 | AO1<br>4.2.1.1<br>4.2.1.4<br>4.2.2.6<br>4.2.3.2 |
| | **Level 1:** Facts, events or processes are identified and simply stated but their relevance is not clear. | 1–2 | |
| | **No relevant content** | 0 | |
| | **Indicative content**<br><br>• giant structure<br>• layers<br>• of hexagonal rings<br>• each (carbon) atom forms three bonds<br><br>• has no covalent bonds between layers<br>• with delocalised electrons<br>• one delocalised electron from each carbon atom<br><br>• the bonds are covalent<br>• with shared (pairs of) electrons<br>• the (covalent) bonds are strong | | |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.4 | the molecules do not have an (overall electric) charge | allow there are no ions<br><br>allow there are no delocalised electrons | 1 | AO1<br>4.2.2.4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.5 | poly(ethene) has stronger intermolecular forces to overcome than methane | | 1 | AO1<br>4.2.2.4<br>4.2.2.5 |

| Total Question 2 | 11 |
|---|---|

Answer 69 · Mark scheme

June 2025 | 8462/2H | Original Q7

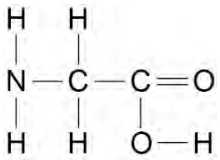
## Question 7

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 07.1 | (**A**)<br>ethanediol<br><br>(**B**)<br>hexanedioic acid | | 1<br><br>1 | AO1<br>4.7.3.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 07.2 | polyester | | 1 | AO1<br>4.7.3.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 07.3 | water | allow $H_2O$ | 1 | AO1<br>4.7.3.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 07.4 | polypeptide | allow polyamide<br><br>ignore protein | 1 | AO1<br>4.7.3.3 |

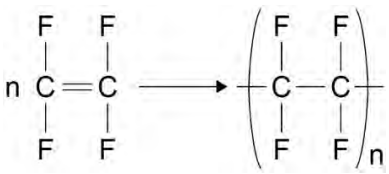
| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 07.5 |  | | 1 | AO2<br>4.7.2.4<br>4.7.3.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 07.6 | protein | | 1 | AO1<br>4.7.3.3 |

4.7.2.2 Reactions of alkenes

Answer 69 · Mark scheme



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **07.7** | 4 × C-F **and** 1 × C-C bonds | | 1 | AO2 4.7.3.1 |
| | 2 × single bonds extending through brackets | | 1 | |
| | n after polymer repeating unit | | 1 | |
| | | an answer of  scores **3** marks | | |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **07.8** | long chain molecules | allow long chains of monomers | 1 | AO1 4.10.3.3 |
| | with covalent bonds between the chains | allow with cross links between the chains<br><br>ignore intermolecular forces | 1 | |

| Total Question 7 | 12 |
|---|---|

Version 1.0: 0707

ASSESSMENT and QUALIFICATIONS ALLIANCE

## General Certificate of Secondary Education

# Science B 4462 / Chemistry 4421

## CHY1H Unit Chemistry 1

# Mark Scheme

*2007 examination - June series*

### 4.7.2.2 Reactions of alkenes



Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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*Dr Michael Cresswell*, Director General.

### 4.7.2.2 Reactions of alkenes





## MARK SCHEME

## Information to Examiners

### 1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

### 2. Emboldening

**2.1** In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

**2.2** A bold **and** is used to indicate that both parts of the answer are required to award the mark.

**2.3** Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.)

### 3. Marking points

#### 3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

| Candidate | Response | Marks awarded |
|---|---|---|
| 1 | 4,8 | 0 |
| 2 | green, 5 | 0 |
| 3 | red*, 5 | 1 |
| 4 | red*, 8 | 0 |

Example 2: Name two planets in the solar system. (2 marks)

| Candidate | Response | Marks awarded |
|---|---|---|
| 1 | Pluto, Mars, Moon | 1 |
| 2 | Pluto, Sun, Mars, Moon | 0 |

**3.2 Use of chemical symbols / formulae**

If a candidate writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

**3.3 Marking procedure for calculations**

Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.

However if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column;

**3.4 Interpretation of 'it'**

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

**3.5 Errors carried forward**

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

**3.6 Phonetic spelling**

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

**3.7 Brackets**

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

**3.8 Unexpected Correct Answers not in the Mark Scheme**

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

### 4.7.2.2 Reactions of alkenes





**CHY1H Question 1**

| | answers | extra information | mark |
|---|---|---|---|
| (a) | any **two** from:<br>• nitrogen<br>• carbon dioxide<br>• water (vapour) / steam | <br>accept formulae N / $N_2$<br>accept formula $CO_2$<br>ignore CO<br>accept formula $H_2O$ | 2 |
| (b) | any **three** from:<br><br><u>limestone</u><br>• abundant / local<br>• natural material **or** no 'processing' needed<br>• relatively easy to cut<br>• appearance better<br><br><u>concrete</u><br>• <u>raw materials</u> are abundant<br>• can be reinforced (by steel rods) / strong(er) / supported (by steel rods)<br>• concrete mixture can be poured / moulded / constructed on site<br>• less reactive with acid rain / weathering / erosion | no mark for 'limestone' or 'concrete' on first line – mark advantages only<br><br>ignore ideas of speed of production or easier to use<br><br>accept 'can build higher'<br><br>ignore density / extraction / quarrying / pollution / cost | 3 |
| total | | | 5 |

### 4.7.2.2 Reactions of alkenes





**CHY1H Question 2**

| | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | $Cu_2S + 2O_2 \rightarrow 2CuO + SO_2$ | accept fractions and multiples | 1 |
| (ii) | any **two** from:<br>• sulfur dioxide<br>• causes acid rain<br>• consequence of acid rain<br>eg kills fish / plants | <br>accept sulphur dioxide / sulphur oxide / $SO_2$<br>ignore other comments<br>eg global warming / ozone / global dimming / greenhouse effect | 2 |
| (b) | any **two** from:<br>• heat (copper oxide with carbon)<br>• oxygen is removed by carbon<br>**or**<br>carbon monoxide / carbon dioxide is produced<br>**or**<br>carbon displaces copper<br>• because carbon is more reactive than copper | <br><br>accept copper (oxide) loses oxygen<br>**or**<br>carbon gains oxygen<br>accept carbon oxide<br><br>accept a correct word or balanced symbol equation<br>allow a correct comparison of reactivity | 2 |
| (c)(i) | electrolysis | accept electroplating | 1 |
| (ii) | (electrical) wiring / appliances / coins / pipes / cladding for buildings / jewellery / making alloys<br>**or**<br>named alloys | | 1 |

**Continued on next page**

### 4.7.2.2 Reactions of alkenes





**Question 2 continued**

| | answers | extra information | mark |
|---|---|---|---|
| (d) | any **three** explanations from:<br><br><u>for recycling</u><br>• less acid rain (pollution)<br>• copper reserves last longer / conserved<br>**or**<br>do not run out<br>• energy for extraction (saved)<br>**or**<br>less energy required<br>• less mining / quarrying<br>• less waste (copper) / electrical appliances dumped<br>**or**<br>less landfill<br><br><u>against recycling</u><br>• collection problems<br>• transport problems<br>• difficult to separate copper from appliances<br>• energy used to melt the collected copper | ignore electrolysis / pollution<br><br>ignore ideas about less machinery / plant<br><br>ignore idea of cost | 3 |
| total | | | 10 |

### 4.7.2.2 Reactions of alkenes





**CHY1H Question 3**

| | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | core | | 1 |
| (ii) | plate (boundaries) | accept parts of the crust<br><br>ignore crust alone | 1 |
| | sudden movement / colliding<br><br>**or**<br>normally move a few centimetres per year | accept movement but ignore movement apart<br><br>accept continental drift | 1 |
| | convection currents / driven by heat from radioactive processes / decay | idea of source of energy for the movement | 1 |
| | the idea of uncertainty with an explanation<br>eg scientists do not know (with any certainty)<br>• what happens under the crust<br>• where the forces / pressure are building up<br>• we cannot measure the forces<br>• when the forces reach their limit | ignore references to volcanoes | 1 |
| (b)(i) | 78 | | 1 |

**Continued on next page**

### 4.7.2.2 Reactions of alkenes





**Question 3 continued**

| | answers | extra information | mark |
|---|---|---|---|
| (ii) | marks awarded for any 2 gases from the following 3 gases | max **3** marks from $CO_2$ | |
| | any **four** from:<br>carbon dioxide has decreased:<br>• used by plants / bacteria (stromatolites)<br>• during photosynthesis (must be linked to $CO_2$ decrease)<br>• 'locked up' in (sedimentary) rocks / carbonates / fossil fuels<br>• dissolved in oceans<br>**and / or**<br>oxygen has increased because:<br>• released by plants / bacteria (stromatolites)<br>• during photosynthesis (must be linked to $O_2$ increase)<br>**and / or**<br>nitrogen has increased because<br>• ammonia reacted with oxygen (to release nitrogen)<br>• nitrogen is released by bacteria | ignore references to respiration | 4 |
| total | | | 10 |

### 4.7.2.2 Reactions of alkenes





**CHY1H Question 4**

| | answers | extra information | mark |
|---|---|---|---|
| (a) | permitted additive / (added) chemicals<br>**or**<br>names / types of additives | accept the chemical name<br><br>ignore food additive alone | 1 |
| (b)(i) | water and oil do not mix / are immiscible<br>**or**<br>don't dissolve each other | ignore density<br><br>ignore emulsifier alone | 1 |
| (ii) | any **two** from:<br>• emulsifier<br>• forms an emulsion<br>• holds the two components together<br><br>• by lowering the surface tension | <br><br>accept description of an emulsion<br>accept stops them separating / they mix<br>allow bonds / binds for holds<br>accept a description of how an emulsifier works for **two** marks<br>eg 'tadpole' diagram or dispersal of oil drops | 2 |
| (c)(i) | (because they contain) a double (carbon carbon) bond | accept unsaturated<br><br>ignore poly or mono | 1 |
| (ii) | results suggest sunflower oil is best<br>**or**<br>'the one that took the least time'<br><br>because (sunflower oil) has the highest amount of unsaturation / most double bonds / least saturated | <br><br><br>ignore uses up $I_2$ most quickly<br><br>second mark is dependent on first | 1<br><br>1 |

**Continued on next page**

### 4.7.2.2 Reactions of alkenes





**Question 4 continued**

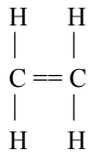
| | answers | extra information | mark |
|---|---|---|---|
| (d)(i) | any **one** from:<br>• have a higher melting point than (vegetable) oil<br>• are solid at (room temperature) / hardened / harder | <br><br>accept useful as spreads **or** doesn't soak into bread<br><br>ignore hard / soft(er) | 1 |
| (ii) | any **two** from:<br>• hydrogen added<br>• to carbon carbon double bond / to saturate<br>• (nickel) catalyst / temperature 60 - 150°C | <br>do **not** accept 'water'<br><br>wrong catalyst doesn't get this mark<br><br>ignore high / warm temperature | 2 |
| total | | | 10 |

### 4.7.2.2 Reactions of alkenes





**CHY1H Question 5**

| | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | by (fractional) distillation<br>**or**<br>fractionation | accept a description of the distillation process (heat and how separation works)<br>eg heat **and** condense<br>accept boil / vapourise etc for heat | 1 |
| (ii) | $CO_2$<br><br>$H_2O$ | note the order of these products must be correct<br>wrong way round = **1** mark | 1<br><br>1 |
| (b)(i) | (hexane) has been broken down (into smaller hydrocarbons / molecules) | accept (thermal) decomposition / cracked / split / broken up owtte | 1 |
| (ii) |  | accept $CH_2=CH_2$ | 1 |
| (iii) | water / hydrogen oxide / steam | accept $H_2O$ | 1 |

**Continued on next page**

### 4.7.2.2 Reactions of alkenes





**Question 5 continued**

| | answers | extra information | mark |
|---|---|---|---|
| (c) | candidates must include both sugar cane and crude oil in their evaluation **and** both an advantage and a disadvantage to gain full marks.<br>if they do not then the maximum mark is three<br><br>any **four** from:<br><br><u>advantages of using sugar</u><br>• country has no wealth to buy (large quantities of) crude oil<br>• country has limited technological development<br>**or**<br>underdeveloped / third world country<br>• able / suitable climate to grow sugar cane<br>• enough land to grow sugar cane / land cannot be used to grow food / deforestation<br>• sugar is a renewable source<br>**or**<br>crude oil is a non-renewable resource / finite resource / limited resources<br>• $CO_2$ / carbon neutral<br><br><u>advantages of using alkanes:</u><br>• economic costs are low<br>• continuous process<br>• country has large oil resources<br>• country has oil refineries / cracking plants<br>• very pure product<br>• faster process | not 'expensive' alone | 4 |
| total | | | 10 |

4.7.2.2 Reactions of alkenes



GCSE

# Additional Science / Chemistry

CH2HP
Final Mark scheme

4408 / 4402
June 2017

Version/Stage: v1.0

### 4.7.2.2 Reactions of alkenes



Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

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**Information to Examiners**

**1. General**

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.
At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.
In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

**2. Emboldening and underlining**

**2.1** In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

**2.2** A bold **and** is used to indicate that both parts of the answer are required to award the mark.

**2.3** Alternative answers acceptable for a mark are indicated by the use of **or**.
Different terms in the mark scheme are shown by a / ; eg allow smooth/free movement.

**2.4** Any wording that is underlined is essential for the marking point to be awarded.

**3. Marking points**

**3.1 Marking of lists**

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

**[1 mark]**

| Student | Response | Marks awarded |
|---|---|---|
| 1 | green, 5 | 0 |
| 2 | red*, 5 | 1 |
| 3 | red*, 8 | 0 |

Example 2: Name two planets in the solar system.

**[2 marks]**

| Student | Response | Marks awarded |
|---|---|---|
| 1 | Pluto, Mars, Moon | 1 |
| 2 | Pluto, Sun, Mars, Moon | 0 |

**3.2 Use of chemical symbols/formulae**

If a student writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

**3.3 Marking procedure for calculations**

Full marks can be given for a correct numerical answer, without any working shown. However, if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column or by each stage of a longer calculation.

**3.4 Interpretation of 'it'**

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

**3.5 Errors carried forward**

Any error in the answers to a structured question should be penalised once only. Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation 'ecf' in the marking scheme.

**3.6 Phonetic spelling**

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

**3.7 Brackets**

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

**3.8 Accept/allow**

Accept is used to indicate an equivalent answer to that given on the left-hand side of the mark scheme. Allow is used to denote lower-level responses that just gain credit.

**3.9 Ignore/Insufficient/Do not allow**

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain a marking point. Any further correct amplification could gain the marking point.
Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

**4 Quality of Written Communication and levels marking**

In Question 2 students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:
- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

**Level 1: Basic**

- Knowledge of basic information.
- Simple understanding.
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail.
- The spelling, punctuation and grammar are very weak.

**Level 2: Clear**

- Knowledge of accurate information.
- Clear understanding.
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given.
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

**Level 3: Detailed**

- Knowledge of accurate information appropriately contextualised.
- Detailed understanding, supported by relevant evidence and examples.
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

### 4.7.2.2 Reactions of alkenes





| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **1(a)(i)** | a smooth curve through or close to all points except (30,12) | | 1 | **AO2** 2.4 |
| **1(a)(ii)** | correct reading from the curve in 1(a)(i) ($cm^3$) | allow a tolerance of +/- 0.5 $cm^3$ | 1 | **AO2** 2.4 |
| **1(a)(iii)** | 45-50 (seconds) | | 1 | **AO3** 2.4 |
| **1(a)(iv)** | line becomes less steep<br><br>because gas is produced more slowly | ignore line levels out or plateaus<br><br>allow examples with figures, eg 12 $cm^3$ gas from 0 to 20s but 1.5 $cm^3$ gas in last 20s<br>ignore reaction has stopped or no more gas produced | 1<br><br>1 | **AO3** 2.4 |
| **1(a)(v)** | 0.6 ($cm^3$ per second) | allow 0.55 to 0.65 | 1 | **AO2** 2.4 |
| **1(b)(i)** | <br><br>temperature<br>volume (of hydrogen peroxide) | concentration of hydrogen peroxide = max **1**<br><br>ignore amount (of hydrogen peroxide) | <br><br>1<br>1 | **AO3** 2.4 |
| **1(b)(ii)** | <br><br>rate increases<br>because more particles (in the same volume)<br>so frequency of collisions increases | incorrect reference to energy = max **2**<br><br>accept particles closer together<br>allow greater chance of collisions<br>ignore more collisions | <br><br>1<br>1<br>1 | **AO1** 2.4.1e |

### 4.7.2.2 Reactions of alkenes





| | | | | |
|---|---|---|---|---|
| **1(c)** | (increasing the amount of catalyst) increases rate<br><br>same final volume of gas | accept steeper graph or graph levels off earlier | 1<br><br>1 | **AO2**<br>2.4.1g |
| **Total** | | | **13** | |

### 4.7.2.2 Reactions of alkenes





<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>2</td><td></td><td></td><td>6</td><td rowspan="6">AO1<br>2.1.1h<br>2.2.4b,c<br>2.2.5a,b</td></tr>
<tr><td colspan="4">Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a ‘best-fit’ approach to the marking.</td></tr>
<tr><td colspan="4"><table>
<tr><th>0 marks</th><th>Level 1<br>(1–2 marks)</th><th>Level 2<br>(3–4 marks)</th><th>Level 3<br>(5–6 marks)</th></tr>
<tr><td>no relevant information given</td><td>a statement about the structure or a property of a metal<br>or<br>a statement about the structure or a property of a polymer</td><td>a statement about the structure or a property of a metal<br>and<br>a statement about the structure or a property of a polymer</td><td>a statement about the structure or a property of a metal<br>and<br>a statement about the structure or a property of a polymer<br>and<br>at least one statement linking structure and property</td></tr>
</table></td></tr>
<tr><td colspan="4">Statements shown as HT only are credited on both FT and HT.<br>However, HT only means that these statements are not expected in a FT answer.</td></tr>
<tr><td colspan="4">Examples of chemistry points made in response<br><br>Metal:<br><br>Properties<ul><li>shiny</li><li>hardness</li><li>(tensile) strength</li><li>melting point/boiling point</li><li>density</li><li>malleable/flexible</li><li>ductile</li><li>conduct electricity or thermal energy</li></ul></td></tr>
</table>

| | |
|---|---|
| **Structure**<br>• metals contain atoms /((positive) ions HT only)<br>• (the atoms/(positive) ions/particles are) closely packed / in a regular pattern / in a giant structure/in layers / in a lattice<br>• strong bonds/(electrostatic attractions HT only)<br>• (metal has delocalised electrons HT only)<br>**Polymer:**<br>**Properties**<br>• flexible<br>• melting/boiling point<br>• density<br>• can be shaped/moulded<br>• poor conductor of electricity or thermal energy<br>**Structure**<br>• polymer consists of chains<br>• polymer chains may be tangled<br>• polymer has no cross links.<br>• (polymer has weak intermolecular forces HT only)<br><br>**Level 3:**<br>**Examples of linked statements:**<br>• metal can be bent and shaped because the layers can slide<br>• some metals are soft because layers can slide<br>• some metals are hard because they have strong bonds and/ or (the atoms/(positive) ions/particles) are closely packed / in a regular pattern / in a giant structure/ in a lattice<br>• metal has high melting/boiling point because they have strong bonds and/ or (the atoms/(positive) ions/particles) are closely packed / in a regular pattern / in a giant structure / in a lattice<br>• metal is strong because of strong bonds<br>• some metals are dense because the atoms are closely packed<br>• (metal can conduct thermal energy and electricity because metal has delocalised electrons HT only)<br>• thermosoftening polymer melts when heated because it has no cross-links (or has weak intermolecular forces HT only)<br>• thermosoftening polymer is flexible because the chains can move over each other | |

| | | | |
|---|---|---|---|
| **Total** | | | **6** |

### 4.7.2.2 Reactions of alkenes





| Question | Answers | Extra Information | Mark | AO / Spec. Ref |
|---|---|---|---|---|
| **3(a)(i)** | 2 bonding pairs<br>4 unbonded electrons on each atom | accept dots, crosses, e, - or any combination<br>ignore any electrons on any inner shells<br>if no other mark awarded allow **1** mark for 1 bonding pair and 6 unbonded electrons on each atom | 1<br>1 | **AO2**<br>2.1.1g |
| **3(a)(ii)** | covalent | allow convalent and covelant<br>ignore single or double<br>ignore shared, shared bond or sharing | 1 | **AO1**<br>2.1.1g |
| **3(a)(iii)** | weak intermolecular forces<br>require little energy to overcome | reference to weak covalent or weak ionic bonds = **0**<br>accept weak intermolecular bonds<br>MP2 dependent on MP1<br>if no other mark awarded allow 1 mark for simple/small molecules | 1<br>1 | **AO1**<br>**AO2**<br>2.2.1a,b |

### 4.7.2.2 Reactions of alkenes





| | | | | |
|---|---|---|---|---|
| **3(b)(i)** | **2** Mg + $O_2$ → **2** MgO | accept multiples | 1 | **AO2**<br>2.2.2 |
| **3(b)(ii)** | | reference to incorrect particles **or** incorrect bonding **or** incorrect structure = max **2** | | **AO1**<br>**AO2**<br>2.1.1a,b,c,f |
| | magnesium loses (electrons) **and** oxygen gains (electrons) | | 1 | |
| | two (electrons transferred) | | 1 | |
| | noble gas structure **or** 8 electrons in outer shells **or** (electrostatic) attraction between ions **or** forms ionic bonds | accept full outer shell (of electrons) | 1 | |
| **3(b)(iii)** | particles 1-100 nm in size | accept contain a few hundred atoms/ions<br>accept have a high surface area to volume ratio<br>ignore reference to (very) small particles<br>do **not** accept smaller than an atom/ion | 1 | **AO1**<br>2.2.6a |

### 4.7.2.2 Reactions of alkenes





| | | | | |
|---|---|---|---|---|
| **3(c)** | has a high melting point | allow will not melt<br>allow a lot of energy needed to melt<br>ignore boiling point<br>reference to incorrect particles or incorrect bonding or incorrect structure = max **1** from MP2 and MP3 | 1 | **AO1**<br>**AO2**<br>2.2.3a |
| | because all atoms linked to other atoms | allow giant structure/lattice<br>ignore many bonds | 1 | |
| | by covalent bonds | allow strong bonds<br>allow a lot of energy needed to break bonds<br>accept giant covalent structure for MP2 and MP3 | 1 | |
| **Total** | | | **13** | |

### 4.7.2.2 Reactions of alkenes





| Question | Answers | Extra Information | Mark | AO / Spec. Ref |
|---|---|---|---|---|
| 4(a) | add copper oxide and (sulfuric) acid | | 1 | **AO1** **AO2** 2.6.1b,c |
| | excess (copper oxide) | | 1 | |
| | filter (to remove excess) | ignore impurities | 1 | |
| | heat /boil / evaporate / leave (to crystallise) | do **not** accept to dryness | 1 | |
| 4(b) | ($M_r$ CuO =) 79.5 | | 1 | **AO2** 2.3.3c |
| | 24.95/249.5 **or** 0.1 **OR** 79.5/249.5 **or** 0.3186… | allow ecf for $M_r$ CuO from step 1<br>allow correct rounding to min 2SF | 1 | |
| | (24.95/249.5 x 79.5=) 7.95 | allow ecf for $M_r$ CuO from step 1<br>allow ecf from step 2 of incorrect calculation/ rounding of correct ratio<br>allow correct rounding to min 2SF<br>correct answer with or without working gains 3 marks | 1 | |
| 4(c)(i) | as wealth decreases, ethene production decreases (with the exception of country C or D) | accept converse | 1 | **AO2** **AO3** 2.6 |
| | sulfuric acid production is not linked to wealth | | 1 | |

### 4.7.2.2 Reactions of alkenes





| | | | | |
|---|---|---|---|---|
| **4(c)(ii)** | use of products of ethene has increased | allow use of polymers / plastics / ethanol / poly(ethene) has increased<br>ignore use of ethene as a (bio)fuel<br>ignore cost | 1 | **AO3**<br>2.2.5 |
| **Total** | | | **10** | |

### 4.7.2.2 Reactions of alkenes





| Question | Answers | Extra Information | Mark | AO / Spec. Ref |
|---|---|---|---|---|
| **5(a)(i)** | draw line on paper<br><br>put (dots of) inks on line<br><br>place (bottom of) paper in solvent / water<br><br>any **one** from:<br>line drawn in pencil<br>allow dots of ink to dry<br>line above solvent<br>lid | | 1<br><br>1<br><br>1<br><br>1 | **AO1**<br>2.3.2b |
| **5(a)(ii)** | any **two** from:<br>• A has 3 colours **and** B has 4 colours<br>• 2 colours are the same<br>• **A** has 1 colour not in **B and B** has 2 colours not in **A** | accept 3 colours are different<br><br>if no other mark awarded allow **one** more colour in ink **B** than in ink **A** (or converse) | 2 | **AO3**<br>2.3.2b |
| **5(b)(i)** | substances carried by gas<br><br>through column / tube / coil (packed with solid)<br><br>(different substances move through the column) at different speeds | <br><br><br><br>accept (different) substances come out at different times or have different retention times | 1<br><br>1<br><br>1 | **AO1**<br>2.3.2c |
| **5(b)(ii)** | (relative) molecular mass | allow (relative) formula mass<br>allow RFM, RMM, $M_r$ | 1 | **AO1**<br>2.3.2c |
| **Total** | | | **10** | |

### 4.7.2.2 Reactions of alkenes





| Question | Answers | Extra Information | Mark | AO / Spec. Ref |
|---|---|---|---|---|
| 6(a)(i) | tick (✓) by:<br>the initial temperature reading was too low | | 1 | AO3<br>2.5 |
| 6(a)(ii) | the reaction is exothermic | allow energy is given out | 1 | AO3<br>2.5.1b |
| 6(b)(i) | (positive/hydrogen) ions gain electrons<br>hydrogen is below sodium in the reactivity series<br>so hydrogen / $H_2$ is produced | accept (positive/hydrogen) ions are reduced<br>accept reference to high reactivity of sodium<br>If no other mark awarded allow hydrogen (and sodium) ions **or** positive ions are attracted to negative electrode for **1** mark | 1<br>1<br>1 | AO1<br>AO2<br>2.7.1c,f,i |
| 6(b)(ii) | **2** $(Cl^-)$ → **$Cl_2$ + 2$e^-$** | must be completely correct<br>allow multiples | 1 | AO1<br>2.7.1g |
| 6(b)(iii) | solution is alkaline<br>because sodium hydroxide / NaOH is produced **or** sodium hydroxide / NaOH is left over | accept hydroxide (ions) / $OH^-$ is produced **or** hydroxide (ions) / $OH^-$ is left over | 1<br>1 | AO1<br>AO2<br>2.7.1i; 2.6.2d |
| Total | | | 8 | |

Answer 57 · Examiner comments

June 2018 | 8462/2H | Original Q6

# Question 6 (standard / high & high demand)

**06.1** There was a variety of incorrect answers for the small molecule lost during condensation polymerisation, some of which were not molecules. However, 56% of students knew the answer was water.

**06.2** Of those students who lost marks here, there was no clear-cut marking point that caused the problem. Some students did not make it clear that the bond joined on to the C atom of the methyl group, but were given benefit of the doubt provided it didn't join to the $H_3$. 28% of students gave faultless answers.

**06.3** This question was not answered well, mainly because students did not appreciate that they were making a comparison with both of the fibres used alone.

- Some students restated the question stem by saying 'wool wears out quickly'.
- There was little mention of land usage for wool production or that poly(propene) is not biodegradable.
- There were many uncreditworthy references to cost, and the greater comfort of wool.
- Many students failed to make it clear whether they were talking about the fibre or the carpet, or whether they were comparing the mixed fibre carpet with wool or poly(propene) alone.

Most students who achieved any marks at all (39%) were only able to score one of the available marks.

**06.4** This was generally well answered with 99% of students achieving at least one mark. There were various advantages and disadvantages given for the uniform absorbing water as covered by the marking points on the mark scheme (including an advantage of 'it would absorb lots of sweat'). 44% of the students were able to achieve all four marks.

4.7.2.2 Reactions of alkenes

**Answer 59 · Examiner comments** November 2020 | 8462/2H | Original Q3

**Question 3 (standard demand)**

**03.1** The vast majority of students scored both marks here. Again some reversed the responses and there was no pattern in the selection of the distractors.

**03.2** Quite well answered, with the majority of students gaining at least one mark. A very wide range of colours for bromine water were seen in addition to orange, including red, yellow, brown and intermediate shades. A common error was to assert that the bromine water **becomes** orange upon addition to hexane. The difference between colourless and clear is now well understood by most.

**03.3** This part was not very well answered by many, usually because they focused exclusively on structure and bonding at the expense of reactions, which could indicate that they didn't read the question carefully enough or didn't refer back to the question when constructing their response. Structure and bonding were well understood, but few of the reactions were mentioned. Additionally, students often reversed their answers because they confused ethane and ethene or the formation of their handwriting made it unclear whether a compound name ended 'ane' or 'ene'. The command word 'compare' demands that students mention both compounds to access level 2 and there were some imprecise comparisons such as 'ethane undergoes complete combustion whereas ethene undergoes incomplete combustion'. Because of these points, rather fewer than half of students were able to access level 2.

**Answer 60 · Examiner comments** November 2021 | 8462/2H | Original Q4

**Question 4 (standard, standard / high and high demand)**

**04.1** Around half of the students either drew five single bonds or wrote 'n'. Around one third provided a completely correct response.

**04.2** Many of the students scored one mark, usually for stating that poly(ethene) melts. The consequence in terms of recycling was less well known.

**04.3** How poly(ethene) is produced from ethene was not well known.

**04.4** Approaching half of the students scored one mark but only a tiny number scored both. The fact that the chains are closer together or unbranched was well known but not how that linked to density.

**04.5** Some students seem to think that any -OH is an alcohol group even if it is part of a carboxylic acid group. Other students circled whole molecules rather than functional groups.

**04.6** Very few students were able to use the diagrams to work out that hydrogen chloride was the small molecule formed when a polyester was produced from monomers **A** and **B**.

### 4.7.2.2 Reactions of alkenes

**Answer 61 · Examiner comments** November 2021 | 8462/2H | Original Q6

**Question 6 (standard / high and high demand)**

**06.1** The bromine water test was known by many students, but some of these were then unable to gain the second mark, usually because an incorrect colour change was stated.

**06.2** A large number of students were able to apply their knowledge of general formulae to the unfamiliar context of cycloalkenes.

**06.3** Only around a third of students gained at least one mark in this demanding question.

**06.4** The vast majority of students were able to calculate the relative formula mass of $C_6H_{10}Cl_2$ as 153, although a few used 35 as the relative atomic mass for chlorine even though 35.5 was given in the question stem. Over half of students scored all three marks.

**Answer 62 · Examiner comments** November 2021 | 8462/2H | Original Q10

**Question 10 (standard, standard / high and high demand)**

**10.2** More than two thirds of students knew one condition (high temperature) and more than one third knew two.

**10.3** There was a very wide range of marks but many did not score above Level 1. The main failure to reach Level 2 was that the question focuses on economics so that an answer which fails to mention energy, cost or a compromise in reaction conditions does not meet the level descriptor for Level 2. Similarly, the requirements for Level 3 were not usually met if the references did not mention the impact of reaction conditions on both rate and yield. Only a handful of students gave a Level 3 answer.

Answer 62 · Examiner comments



**10.4** Fermentation was well known.

**10.5** Around half of students scored one mark by extending their knowledge of fermentation to this unfamiliar context, 'warm' was seen much more often than 'anaerobic'.

**10.6** This was completely correct in the responses of nearly half of students. Where a mark was not obtained, this was usually caused by a failure to convert kilometres to metres.

**10.7** A challenging concluding equation with no scaffolding which students found difficult.

**Concluding Remarks**

There is still some evidence that command words are misunderstood or ignored. This limits the marks awarded, especially in extended response questions. This is particularly true where a command word demands a reasoned judgement.

Students seemed well prepared for questions based on Organic Chemistry and Chemistry of the Atmosphere. In this series they seemed less equipped to deal with Chemical Analysis, Rate of Reaction and some aspects of Using Resources.

There were a number of instances of key reagents, techniques and colour changes still not being well known.

Answer 62 · Examiner comments



**Mark Ranges and Award of Grades**

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

4.7.2.2 Reactions of alkenes

Answer 63 · Examiner comments

June 2022 | 8462/2H | Original Q1

**Question 1 (Standard demand)**

**01.1** This was well answered by many students. The most common errors were to omit the double bond, or to add additional bonds to the carbon atoms. Brackets and/or the inclusion of the letter n were ignored. Around two-thirds of the students scored both marks.

**01.2** The majority of responses correctly referred to the insulation being burned or melted or the lack of purity or 'contamination' of the copper produced. Around 60% of students scored this mark.

**01.3** This was generally well answered as the copper melting and being reformed/moulded into new pipes were commonly seen. Responses referring to 'heating the wire' were insufficient to gain credit. Around 70% of the students scored both marks.

**01.4** The most common correct responses referred to the conservation of copper and the use of less energy in this process. Relatively few answers identified specified environmental impacts.

Weaker responses referred to 'pollution' alone which was insufficient to gain credit. Only around 30% of the students were able to identify two advantages of recycling.

Answer 63 · Examiner comments

June 2022 | 8462/2H | Original Q1

**01.5** The specific correct reagent used and correct result, were not well known.

A variety of tests were chosen, with the most common incorrect response being the use of flame tests.

Acceptable results included shades of blue precipitate, e.g. pale/light blue, but answers giving two colours such as green/blue were not credited. Around a third of students scored both the marks.

**01.6** The use of barium chloride or barium nitrate as the reagent for the test was generally followed by the correct result. Again, around a third of the students scored both the marks.

The most common incorrect responses were the use of a flame test or the use of an incorrect reagent.

The mark for the result of the test was dependent upon a mark being being awarded for a correct test.

Answer 64 · Examiner comments



**Question 4 (standard and standard/high demand)**

**04.1** The great majority of students gave the correct answer, with most of the rest split evenly between the first option (adding the three bond energies together) and the third (subtracting only one H—Cl bond).

**04.2** This question discriminated well and there were some excellent answers that described the energy released in making new bonds being greater than the energy required to break old bonds. However, some implied that energy is required in both steps, and others only referred to the bond making process, omitting a consideration of the bond breaking process. There were misconceptions with some students referring to gases being lost and taking energy with them, and others responding that an exothermic reaction is one that loses matter, rather than energy.

**04.3** This question discriminated well; half of the students were awarded all three marks, while nearly all scored one mark. Most students drew an exothermic profile, but fewer labelled the products. Those who drew an endothermic profile could still access the second and third marking points. A few did not complete the profile so were only able to access the mark for the activation energy. There were some arrows for the activation energy and overall energy change that were untidily drawn which made it impossible to judge whether they started and finished at the correct place. This is one example where using a ruler really does help the student. A few labelled the top of the curve as the activation energy, rather than the gap between the energy of the reactants and the top of the curve.

**04.4** Nearly three quarters of students scored both marks. Many fully correct diagrams were seen. The majority of students chose to use the format with a ring around each atom, but answer without rings were equally acceptable. A few students drew an extra electron on either hydrogen or carbon, and some drew ions instead of a molecule.

**04.5** This question proved to be difficult, with few students giving fully correct answers to gain all 4 marks and with a third of students gaining no credit.

To answer the question, students needed to compare the size of the molecules, hence the strength of the intermolecular forces, hence the energy required to break those forces and hence the boiling/melting points. However, many students did not mention molecules at all, seeming to believe that the polymer is a giant structure. There was much confusion between bonds and intermolecular forces. Students sometimes think that by including both intermolecular forces and covalent bonds they will cover all eventualities, but this often results in contradictions which lose marks. Students often thought intermolecular forces had to be broken in methane but bonds had to be broken in poly(ethene). Many did not refer to the energy requirement or to the melting or boiling point.

4.7.2.2 Reactions of alkenes

Answer 65 · Examiner comments

June 2023 | 8462/2H | Original Q2

**Question 2 (standard demand)**

**02.1** This simple calculation was answered correctly by more than three-quarters of the students. Occasionally errors were seen using 38.9 kJ/g rather than 39.8 kJ/g. In these cases, it was impossible to tell whether this was a transcription error or use of the value for hexanol. Either way, we cannot award credit for transcription errors.

**02.2** Nearly 9 in 10 students were able to plot the data within tolerance on all points. However, nearly all drew a line of best fit, which for a discrete variable in this context was not appropriate. These lines of best fit were ignored.

**02.3** Around two-thirds of students gained this mark. The answer, within the tolerances stated in the mark scheme, was estimated from the plotted points alone, and was as stated in the mark scheme unless misplotted points (usually for hexanol and/or heptanol) suggested otherwise.

**02.4** Fewer than half of students knew that lime water is aqueous calcium hydroxide.

**02.5** Around 90% of students could describe the result of this test adequately to gain credit.

**02.6** More than half of the students gave a correct response. ‘An alkali metal’ was a strong distractor.

**02.7** This was not well known, with only around 30% scoring the mark. Many students completed a square of bonds around the four atoms provided.

**02.8** More than half of the students gained both marks. There was no discernible pattern amongst those who scored one mark.

4.7.2.2 Reactions of alkenes

Answer 66 · Examiner comments

June 2023 | 8462/2H | Original Q8

**Question 8 (standard, standard / high and high demand)**

**08.1** The majority of students correctly circled the C=C group. A common mistake for those who didn't gain the mark was identifying the C-Cl bond or to circle the double bond alone without including the carbon atoms. More than half of students gained this mark.

**08.2** There was a wide range of responses to this question. In the majority of answers MP2 was achieved with 3x C-H and 1x C-Cl bonds drawn correctly. Incorrect answers often lacked extended bonds or failed to extend them far enough or failed to replace the C=C bond by C-C.

**08.3** A wide range of responses were seen to this question. Common incorrect responses included alloys, polymers, formulations, mixtures and ceramics. Around one-third of students gained this mark.

**08.4** A wide range of responses were seen to this question. Common incorrect answers included alkene, hydrogen, named alkanes and alkenes, protein and nitrogen. Around one-half of students gained this mark.

**08.5** Many students got this question correct. Those achieving one mark often got this for calculating the $M_r$ of $NH_2$ and COOH and adding them for MP1. For those who didn't gain any marks a common mistake was subtracting the $M_r$ of $NH_2$ and COOH from each other. Around three-quarters of students gained both marks

**08.6** A wide variety of answers were seen. Incorrect responses included students circling individual side groups such as -OH or $-CH_2OH$ or some including both bridging oxygen atoms or neither. Correct answers varied in which repeating unit they circled – there are six valid alternatives. Nearly half of the students gained the mark.

**08.7** The most common correct answers seen were starch, cellulose or glycogen. Polysaccharide was less commonly seen. Incorrect responses included alcohol, amino acids, proteins and a whole range of polymer names including polyester. Fewer than one-third of students gained this mark.

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Answer 66 · Examiner comments

June 2023 | 8462/2H | Original Q8

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**08.8** Many students gave the answer 'bases' or gave the names of DNA bases. Fewer than one-third responded 'nucleotides'.

**08.9** The majority of students (9/10) knew the shape of DNA. A common incorrect response was 'DNA'.

Answer 67 · Examiner comments



**Question 8 (standard, standard / high and high demand)**

08.1 Around 60% of students correctly identified the C=C bond. For students who were not awarded the mark common mistakes were incorporating the 3 Hs and 1 O atom attached to the C=C group in their circle or also circling the C=O group. Others circled only the double bond and not the carbon atoms on either side.

08.2 Those students who were awarded marking point 1 used a range of the colours allowed in the mark scheme to describe the starting colour of bromine water. The most common colours were orange or brown. A small number of students described the bromine water as turning clear rather than colourless. For students who were awarded one mark there seemed to be an even split between those awarded marking point 1 and those awarded marking point 2. Just over half scored both.

08.3 A variety of areas in the molecule were circled in an attempt to answer this question. A mistake some students made who were not awarded this mark was incorporating one of the C atoms either side of the ester bond in their circle. Around 40% of students gained credit.

08.4 Those students awarded 3 marks for this question often balanced the equation using half the values of those in the mark scheme and gained credit. A common error was use of inaccurate formulae, particularly a small O on $H_2O$ or $CO_2$. Just over one-third of students gained all three marks.

08.5 For those students awarded one mark there was an even split between those achieving marking point 1 and marking point 2. A minority of students added atoms or groups to the extension bonds, which contradicted marking point 1. Around 40% gained both marks.

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### 4.7.2.2 Reactions of alkenes

**Answer 67 · Examiner comments** June 2024 | 8462/2H | Original Q8

08.6 This multiple-choice question was well answered, with three quarters of students gaining the mark.

08.7 An array of answers were given for this question. Common incorrect responses included condensation, meltable, polyester, hydrocarbon and alkene. 'Thermoforming' was regarded as a process and not a description of the polymer used in that process. Nearly half of students gained a mark here.

08.8 Only around 10% of students achieved two marks for this question.

Common mistakes for marking point 1 were referencing crosslinks but saying they were between the polymers or molecules rather than the polymer chains, or mentioning bonds between polymer chains but not stating they were covalent. A number of students also referred to crosslinks between monomers in the polymer or crosslinks between bonds in the polymer.

For marking point 2 many students were not awarded the mark as they gave generalised answers about a lot of energy, or high amounts of energy being needed to break the strong bonds but did not make it clear that **too much** energy was needed to break the bonds between polymer chains.

Answer 68 · Examiner comments

June 2025 | 8462/1H | Original Q2

## Question 2 (standard demand)

**02.1** Fewer than half of students could count the ions and realise that the ratio was 1:1 so the formula is CaS. Some tried to do it from the formulae of the ions but often wrote $CaSO_4$. $Ca_9S_9$ was a common incorrect answer, as was 9CaS. A formula was required, not an equation; equations did not gain credit.

**02.2** More than three fifths of students gave fully correct answers, and nearly all scored at least 3 marks. The main omission was not saying what ions were formed. Students sometimes contradicted themselves by describing the atoms sharing electrons as well as those electrons being transferred. Any mention of sharing electrons negated the first three marking points. The correct formula of the sulfide ion was sometimes contradicted by an incorrect name such as 'sulfur ion' or 'sulfate ion'.

**02.3** This was well answered by the majority of students, with two thirds reaching level 2. The question discriminated well. Many referred to the giant structure, the layers, the covalent bonds and the delocalised electrons. Fewer referred to the hexagonal rings of carbon atoms, with some incorrectly referring to the layers themselves as hexagonal. Many tried to refer to each carbon atom having three bonds, but some could not express themselves clearly, for example by leaving out the word atom or by implying that the whole structure contained only 3 bonds or 3 atoms. Fewer referred to the strength of the covalent bonds, with some incorrectly saying that covalent bonds are weak. Many also referred to the lack of covalent bonds between layers or the presence of weak intermolecular forces between the layers, but some referred to intermolecular forces without specifying their location. Very few referred to covalent bonds being shared pairs of electrons or to the fact that there is one delocalised electron per carbon atom. Many students introduced properties of graphite, which were not asked for and did not gain credit.

**02.4** Very few gave the expected answer, which is the syllabus statement that small molecules do not have an overall electric charge. Some did try to refer to this but were not clear enough; 'they do not have an overall charge' does not necessarily refer to the small molecules since the subject of the sentence was 'substances. More than half did score the mark, but this was usually due to a reference to the lack of delocalised electrons. Some stated that there was no space for delocalised electrons, which is not the same thing and did not gain credit. Some stated that there are no mobile ions, which is ambiguous as it could mean that there are ions, but they are not mobile; this would not be correct.

**02.5** Just over a half of students gave the correct reason, with 'poly(ethene) has more covalent bonds to break than methane' being the most popular distractor. Some ticked 2 boxes – usually the first and last; this automatically scores zero when the instruction is to tick **one** box.

### 4.7.2.2 Reactions of alkenes

**Answer 69 · Examiner comments** June 2025 | 8462/2H | Original Q7

07.1 Although these compounds are clearly identified in the specification, very few had learnt them. Common attempts to give the names included di-ethanol and di-butanoic acid.

07.2 Around 15% of students correctly identified a polyester. The most common incorrect response was for an ester.

07.3 Just over two thirds of students correctly identified water as the small molecule produced during this condensation polymerisation reaction.

07.4 1 in 5 students gained the mark for this item by correctly identifying a polypeptide. Polyglycine was the most common incorrect response, but protein was also seen. The definition of a polypeptide is given in the specification, but many students could not apply the definition to the context given.

07.5 The structural formula of glycine is given in the specification, but only 15% of students were able to recognise that the displayed structure of the carboxylic acid functional group was required. It was expected that all bonds were shown, so -OH was insufficient, when -O-H was required. Many students added bonds to the amine, as well as adding amines to the carbon atom where the carboxylic acid group was required.

07.6 Three quarters of students correctly identified the definition of a protein that is given in the specification.

07.7 Two thirds of students gained all three marks on this familiar application for an unfamiliar polymer. Far fewer students than previously left the double bond between the two carbon atoms. The most common mistake was adding the trailing bonds incorrectly, often not breaking the line of the brackets.

07.8 The description of the structure of a thermosetting polymer was not well known by students with only 1 in 5 gaining any marks on this item. More students knew the idea of cross links between chains than the idea of the structure consisting of long chain molecules. A lot of the incorrect responses were definitions of thermosetting polymers in terms of heating and melting.