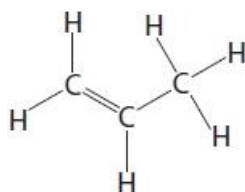


**Questions**

Q1.

Some questions must be answered with a cross in a box (☒). If you change your mind about an answer, put a line through the box (☒) and then mark your new answer with a cross (☒).

The structure of one molecule of a compound is shown in Figure 10.

**Figure 10**

What is the molecular formula of the compound in Figure 10?

(1)

- A CH  
 B CH<sub>2</sub>  
 C 3C<sub>6</sub>H  
 D C<sub>3</sub>H<sub>6</sub>

**(Total for question = 1 mark)**

**Q2.**

Alkenes burn completely to produce carbon dioxide and water.

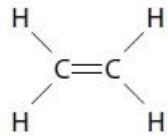
Balance the equation for the complete combustion of butene gas,  $C_4H_8$ .

**(1)****(Total for question = 1 mark)****Q3.**

Figure 14 shows some information about the alkenes, ethene and propene.

Complete the table. The structure of propene must show all covalent bonds.

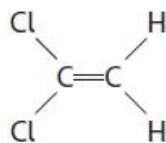
**(2)**

name of alkene	molecular formula	structure
ethene		
propene	$C_3H_6$	

**Figure 14****(Total for question = 2 marks)**

Q4.

Figure 2 shows the structure of a molecule of dichloroethene.

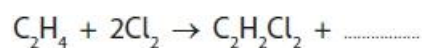


**Figure 2**

Dichloroethene is produced from ethene and chlorine.

In the overall reaction, ethene reacts with chlorine and forms dichloroethene and hydrogen chloride.

Complete the balanced equation for the overall reaction.



(2)

**(Total for question = 2 marks)**

Q5.

The structure of a molecule of ethene is shown in Figure 8.

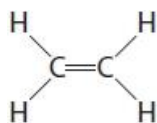


Figure 8

(i) Figure 9 shows the incomplete dot and cross diagram for a molecule of ethene.

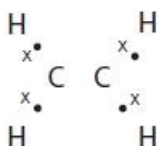


Figure 9

Complete Figure 9 to show the electrons of the  $\text{C}=\text{C}$  double bond.

(1)

(ii) The incomplete combustion of ethene in air produces water as one of the products.

Give the name of another product of the incomplete combustion of ethene.

(1)

.....

**(Total for question = 2 marks)**

**Q6.**

Ethene,  $C_2H_4$ , is an unsaturated hydrocarbon.

A different hydrocarbon has a relative formula mass of 84.  
It has an empirical formula of  $CH_2$ .

Deduce the molecular formula of this hydrocarbon.

You must show your working.

(relative atomic masses : H=1, C=12)

**(3)**

.....

.....

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.....

.....

molecular formula = .....

**(Total for question = 3 marks)**

Q7.

Answer the questions with a cross in the boxes you think are correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

Figure 16 shows the structure of a molecule of dichloroethene.

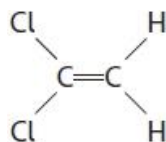


Figure 16

(i) Describe how dichloroethene monomers form a polymer.

(2)

.....

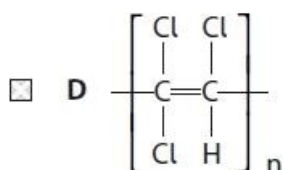
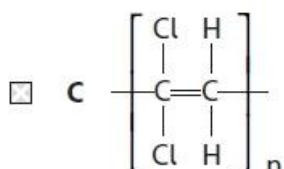
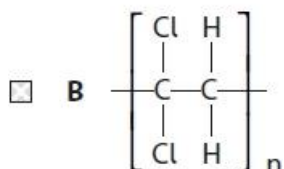
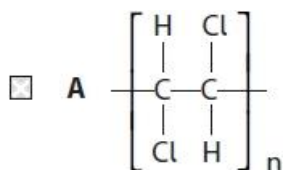
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.....

(ii) Which of these represents the structure of the polymer formed from the monomer in Figure 16?

(1)



(iii) Separate samples of dichloroethene and poly(dichloroethene) are shaken with a few drops of bromine water.

What would be **seen**?

(1)

- A** both mixtures remain orange  
 **B** only the dichloroethene and bromine water goes colourless  
 **C** only the poly(dichloroethene) and bromine water goes colourless  
 **D** both mixtures go colourless

(Total for question = 4 marks)

**Q8.**

Ethene, C<sub>2</sub>H<sub>4</sub>, is an unsaturated hydrocarbon.

Ethene can be polymerised to form poly(ethene).

Describe what you would **see** when a sample of ethene and a sample of poly(ethene) are shaken with separate, small volumes of bromine water.

**(3)**

.....

.....

.....

.....

.....

.....

**(Total for question = 3 marks)**



**Q9.**

Alkanes can be burned in air.

Different products can be formed as the combustion of alkanes can be complete or incomplete.

An investigation was carried out to compare the energy released when the first four alkanes in the homologous series were burned.

Equal amounts of these alkanes were burned to heat 100 cm<sup>3</sup> of water.

The temperature change for each alkane is shown in Figure 12.

alkane	temperature change in °C
methane	9
ethane	16
propane	22
butane	29

**Figure 12**

Discuss the complete and incomplete combustion of these alkanes and the trend in the energy changes they produced.

You should give word equations in your answer.

(6)

**(Total for question = 6 marks)**

## Q10.

Substance X is an unsaturated hydrocarbon.

The structure of a molecule of substance X is shown in Figure 10.

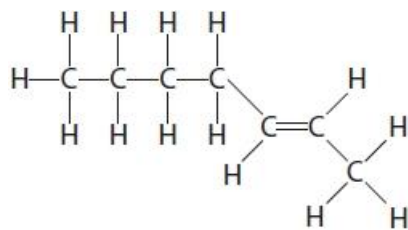


Figure 10

Explain how the structure of substance X shows that it is an **unsaturated hydrocarbon**.

(2)

.....

.....

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.....

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(Total for question = 2 marks)

**Q11.**

Two liquid hydrocarbons, **A** and **B**, were tested with bromine water.

One hydrocarbon was known to be an alkane.

The other hydrocarbon was known to be an alkene.

Each hydrocarbon was shaken with a few drops of bromine water.

The results of the tests were

hydrocarbon A + bromine water: the mixture turned from orange to colourless.

hydrocarbon B + bromine water: the orange colour remained.

Explain these results.

(2)

.....

.....

.....

.....

.....

**(Total for question = 2 marks)**

**Q12.**

Ethene, C<sub>2</sub>H<sub>4</sub>, is an unsaturated hydrocarbon.

Explain why ethene is an **unsaturated hydrocarbon**.

(2)

.....

.....

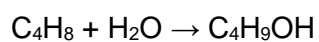
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**(Total for question = 2 marks)**

Q13.

Butene reacts with steam to produce butanol.



What type of reaction takes place between butene and steam?

(1)

- A addition
- B dehydration
- C neutralisation
- D substitution

**(Total for question = 1 mark)**

Q14.

Poly(chloroethene) is a polymer made from chloroethene.  
A molecule of chloroethene is shown in Figure 5.

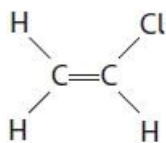


Figure 5

(i) On Figure 5, draw a circle around the functional group in this molecule. (1)

(ii) Draw a section of a poly(chloroethene) molecule containing three repeating units, showing all bonds. (3)

(iii) What type of polymer is poly(chloroethene)? (1)

.....

(iv) Calculate the relative formula mass of a poly(chloroethene) molecule made from 2850 chloroethene molecules,  $C_2H_3Cl$ .

(relative atomic masses: H = 1.00, C = 12.0, Cl = 35.5)

Give your answer to three significant figures.

Show your working. (3)

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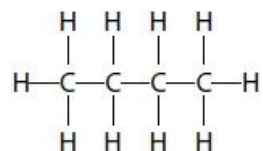
relative formula mass = .....

**(Total for question = 8 marks)**

**Q15.**

Alkanes and alkenes are hydrocarbons.

The structure of a molecule of butane is shown.



Which of the following is the empirical formula for butane?

(1)

- A** CH
- B** CH<sub>2</sub>
- C** C<sub>2</sub>H<sub>5</sub>
- D** C<sub>4</sub>H<sub>10</sub>

(Total for question = 1 mark)

Q16.

Figure 14 shows the structure of a molecule of hydrocarbon **Z**, C<sub>4</sub>H<sub>8</sub>.

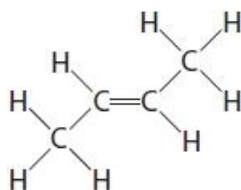


Figure 14

(i) Give the name of hydrocarbon **Z** shown in Figure 14.

(1)

.....

(ii) Complete the balanced equation for the reaction of hydrocarbon **Z**, C<sub>4</sub>H<sub>8</sub>, with bromine.

(2)



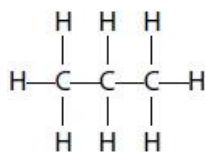
(iii) Draw the repeating unit of the addition polymer formed when hydrocarbon **Z** undergoes polymerisation.

(2)

**(Total for question = 5 marks)**

Q17.

The structure of a molecule of propane is shown as



Give the names of the elements combined together in propane.

(2)

.....

**(Total for question = 2 marks)**



Q18.

The molecules of three organic substances **A**, **B** and **C** are shown in Figure 6.

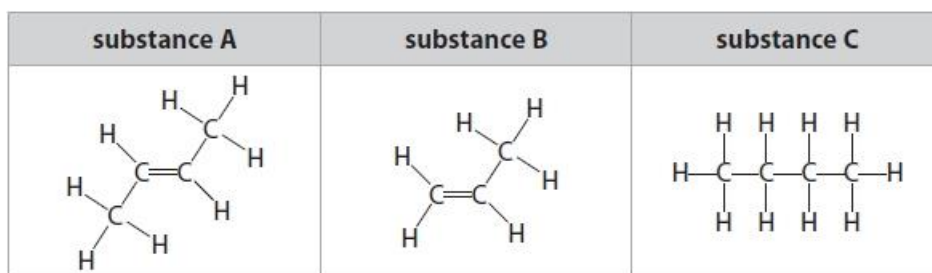


Figure 6

(i) A small volume of bromine water is added to each of the substances **A**, **B** and **C** and the mixtures shaken.

Explain why **A** and **B** decolourise bromine water but **C** does not.

(3)

.....

.....

.....

.....

(ii) Ethane,  $C_2H_6$ , is a hydrocarbon.

Draw a molecule of ethane showing all covalent bonds.

(2)

(iii) State why ethane is described as a **hydrocarbon**.

(2)

.....

.....

(Total for question = 7 marks)

Q19.

Answer the questions with a cross in the boxes you think are correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

Propanol,  $C_3H_7OH$ , can undergo reactions to form compounds Y and Z shown in Figure 14.

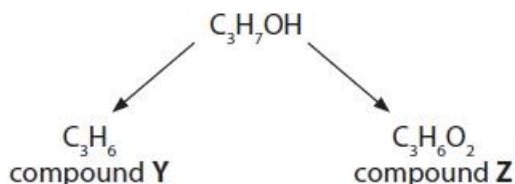


Figure 14

(i) What happens to propanol when it forms compound Y?

(1)

- A propanol undergoes an addition reaction  
 B propanol is dehydrated  
 C propanol is hydrated  
 D propanol is oxidised

(ii) Compound Y can also be formed in the following reaction



Explain how bromine water can be used to distinguish between compound X and compound Y.

(3)

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.....

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.....

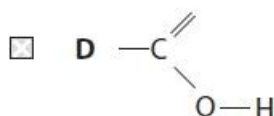
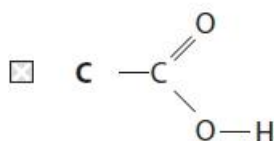
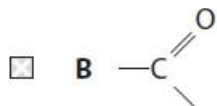
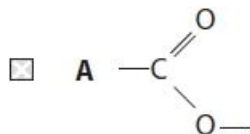
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(iii) Compound **Z** is a carboxylic acid.

Which of the following shows the functional group of a carboxylic acid?

(1)



(iv) Compound **Z** is an acid and turns litmus and universal indicator papers red.  
Compound **Z** also shows other acidic properties.

Devise an experiment that would show another acidic property of compound **Z**.

(2)

.....

.....

.....

.....

(Total for question = 7 marks)

Q20.

The structure of one molecule of a compound is shown in Figure 10.

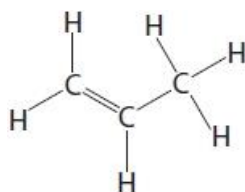


Figure 10

The compound in Figure 10 is an unsaturated hydrocarbon.

State why the compound is described as an **unsaturated hydrocarbon**.

(3)

unsaturated .....

.....

.....

hydrocarbon .....

.....

.....

(Total for question = 3 marks)

**Q21.**

\* A student is provided with unlabelled samples of three liquids.

The three liquids are known to be

hexane,  $C_6H_{14}$ , a liquid alkane

hexene,  $C_6H_{12}$ , a liquid alkene

butanoic acid,  $C_4H_8O_2$ , a carboxylic acid, in aqueous solution

Aqueous solutions of carboxylic acids contain hydrogen ions and undergo reactions typical of acids with indicators and carbonates.

Describe, in detail, using the information given and your knowledge of the reactions of these liquids, tests the student should carry out to identify each of the three liquids.

You should include balanced equations for any chemical reactions described.

**(Total for question = 6 marks)**

**Q22.**

A sample of each of three hydrocarbons, **X**, **Y** and **Z**, was shaken with bromine water. Bromine water is orange coloured.

The results are:

**X** orange mixture becomes colourless

**Y** orange mixture becomes colourless

**Z** mixture remains orange

Using the results, comment on the structures of the hydrocarbons **X**, **Y** and **Z**.

(2)

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.....

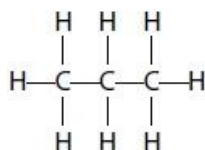
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**(Total for question = 2 marks)**

**Q23.**

The structure of a molecule of propane is shown as



Propane can burn completely in oxygen to form carbon dioxide and water.

(i) Write the word equation for this reaction.

(2)

.....

(ii) Propane is a fuel.

Give the reason why fuels are burned.

(1)

.....

.....

**(Total for question = 3 marks)**

**Q24.**

Ethene, C<sub>2</sub>H<sub>4</sub>, is an unsaturated hydrocarbon.

A sample of ethene is burned completely in oxygen.

Write the balanced equation for this reaction.

(3)

.....

**(Total for question = 3 marks)**

**Mark Scheme**

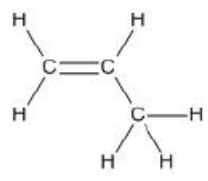
Q1.

Question number	Answer	Mark
	<p><b>D</b> C<sub>3</sub>H<sub>6</sub> is the only correct answer</p> <p>A, B and C are incorrect formula</p>	(1) AO2 1

Q2.

Question number	Answer	Mark
	$C_4H_8 + 6O_2 \rightarrow 4CO_2 + 4H_2O$	(1)

Q3.

Question number	Answer	Mark
	<ul style="list-style-type: none"> <li>Molecular formula - C<sub>2</sub>H<sub>4</sub> (1)</li> <li>Structure (1)</li> </ul> 	(2)

Q4.

Question number	Answer	Mark
	$C_2H_4 + 2Cl_2 \rightarrow C_2H_2Cl_2 + 2HCl$ HCl (1) 2 (1)	(2)



Q5.

Question number	Answer	Additional guidance	Mark
(i)	4 electrons shown between the 2 carbon atoms	electrons may be shown as dots, crosses or as a mixture	(1)
(ii)	carbon monoxide / carbon / soot	allow CO / C ignore carbon dioxide	(1)

Q6.

Question number	Answer	Additional guidance	Mark
	<p><math>C_6H_{12}</math> with or without working gains 3 marks</p> <p>relative mass <math>CH_2 = 12 + (2 \times 1)</math> (1) (=14)</p> <p><math>CH_2</math> units in hydrocarbon = <math>\frac{84}{14}</math> (1) (=6)</p> <p>molecular formula is <math>C_6H_{12}</math> (1)</p>	allow ECF	(3)

Q7.

Question number	Answer	Additional Guidance	Mark
(i)	<p>A description to include any two from</p> <ul style="list-style-type: none"> <li>double bond (in monomer) breaks (1)</li> <li>{monomers/ molecules} link together (1)</li> <li>to form a (long) chain (1)</li> </ul>	<p>diagrams can score MP1, 2 or 3</p> <p>ignore mention of addition or condensation</p>	(2)

Question number	Answer	Mark
(ii)	$\left[ \begin{array}{cc} \text{Cl} & \text{H} \\   &   \\ -\text{C} & - & \text{C}- \\   &   \\ \text{Cl} & \text{H} \end{array} \right]_n$ <p><b>B</b> B is the only correct answer.</p> <p>A is not correct as it is poly(1,2-dichloroethene) C is not correct as it has a double bond D is not correct as it is poly(1,1,2-trichloroethene)</p>	(1)

Question number	Answer	Mark
(iii)	<p><b>B</b> only the dichloroethene and bromine water goes colourless</p> <p>A is incorrect because the alkene decolourises bromine water C is incorrect because the polymer does not decolourise bromine water but the alkene does D is not correct because the polymer does not decolourise bromine water</p>	(1)

## Q8.

Question number	Answer	Additional guidance	Mark
	<p>A description to include</p> <p>bromine water is {yellow / orange / red-brown} (1)</p> <p>ethene: becomes colourless /decolourises (1)</p> <p>poly(ethene): (remains) {yellow / orange / red-brown} / no colour change (1)</p>	<p>allow brown ignore red alone</p> <p>ignore clear /discolours</p> <p>allow no reaction ignore poly(ethene) turns {yellow / orange / red-brown}</p>	(3)

Q9.

Question number	Indicative content	Mark
*	<p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlines in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p><b>A02 (3 marks) A03 (3 marks)</b></p> <p><b>Reactions</b></p> <ul style="list-style-type: none"> <li>• combustion is reaction with oxygen</li> <li>• complete combustion produces carbon dioxide</li> <li>• complete combustion produces water</li> <li>• incomplete combustion with lack of oxygen</li> <li>• incomplete combustion produces carbon/ soot</li> <li>• incomplete combustion produces carbon monoxide</li> </ul> <p><b>Equations</b></p> <ul style="list-style-type: none"> <li>• word equation shows reactants and products for complete combustion</li> <li>• word equation shows reactants and products for incomplete combustion</li> <li>• credit any symbol equations even if incorrectly balanced</li> </ul> <p><b>Energy released</b></p> <ul style="list-style-type: none"> <li>• as you go down table molecules get larger</li> <li>• temperature rise increases as alkane molecule size increases</li> <li>• temperature rise means energy released/ exothermic</li> <li>• least to most is methane, ethane, propane, butane</li> <li>• bigger molecules release more energy</li> </ul>	(6) A02 1 A03 1

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	<ul style="list-style-type: none"> <li>• Interpretation and evaluation of the information attempted but will be limited with a focus on mainly just one variable. Demonstrates limited synthesis of understanding. (A03)</li> <li>• The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (A02)</li> </ul>
Level 2	3–4	<ul style="list-style-type: none"> <li>• Interpretation and evaluation of the information on both variables, synthesising mostly relevant understanding. (A03)</li> <li>• The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (A02)</li> </ul>
Level 3	5–6	<ul style="list-style-type: none"> <li>• Interpretation and evaluation of the information, demonstrating throughout the skills of synthesising relevant understanding. (A03)</li> <li>• The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (A02)</li> </ul>

Level	Mark	Descriptor	Additional Guidance
	0	No rewardable material.	Ignore any material about properties of CO or CO <sub>2</sub> Read whole answer and ignore all incorrect material/ discard any contradictory material then:
Level 1	1-2	<u>Additional Guidance</u> The pattern in the table is described OR Correct products in complete OR incomplete combustion given <i>Products can be written or given in full or partial equations</i>	<u>Possible candidate response</u> Incomplete combustion is with a lack of oxygen (1) Methane has the lowest temperature change (1) Methane has lowest temperature change and butane highest (1) Incomplete combustion is with a lack of oxygen and forms CO (2) As you go down the table, the temperature change is higher/ more energy is released (2)
Level 2	3-4	<u>Additional Guidance</u> The pattern in the table is described and correct products in complete OR incomplete combustion given <i>Products can be written or given in full or partial equations</i>	<u>Possible candidate response</u> As you go down table, molecules get larger and the larger the molecule is the more energy is released (3) As you go down the table, the temperature change increases, alkane + oxygen → carbon dioxide (3) Complete combustion produces carbon dioxide and water and incomplete combustion gives carbon monoxide (3) The larger the molecule the higher the temperature change, and when an alkane completely burns it produces carbon dioxide and water (4)
Level 3	5-6	<u>Additional Guidance</u> The pattern in the table MUST be described and correct products in complete AND incomplete combustion given <i>Products can be written or given in full or partial equations</i>	<u>Possible candidate response</u> As you burn bigger molecules down the table more energy is released. If the alkanes burn completely, carbon dioxide and water are released, but if with a lack of oxygen, carbon monoxide is formed (6)

## Q10.

Question number	Answer	Additional guidance	Mark
	An explanation linking <ul style="list-style-type: none"> <li>• (molecules of X) contain double bonds / C=C (1)</li> <li>• <b>only</b> contain carbon and hydrogen atoms (1)</li> </ul>	allow multiple bond	(2)

Q11.

Question number	Answer	Additional guidance	Mark
	<p>An explanation linking any two of the following</p> <ul style="list-style-type: none"> <li>• <b>A</b> reacts with bromine (water) (1)</li> <li>• (therefore) <b>A</b> is unsaturated (1)</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>• <b>B</b> does not react with bromine (water) (1)</li> <li>• (therefore) <b>B</b> is saturated (1)</li> </ul>	<p>allow <b>A</b> is alkene / <b>B</b> is alkane (1) allow alkane does not decolourise / alkene does decolourise (1)</p> <p>allow <b>A</b> is saturated and <b>B</b> is unsaturated (2) allow <b>A</b> reacts and <b>B</b> does not react (2) ignore bromine water turns clear / is discoloured</p>	(2)

Q12.

Question number	Answer	Additional guidance	Mark
	<p>an explanation linking</p> <p>contains hydrogen and carbon <b>only</b> (1)</p> <p>contains a (double / multiple) bond (between two carbon atoms) (1)</p>	<p>reject is a mixture of carbon and hydrogen</p> <p>reject contains hydrogen and carbon molecules</p> <p>ignore bonds that haven't been used</p>	(2)

Q13.

Question number	Answer	Mark
	A	(1)

Q14.

Question number	Answer	Additional guidance	Mark
(i)	circle around C=C	or circle around C-Cl	(1) AO1

Question number	Answer	Additional guidance	Mark
(ii)	$  \begin{array}{cccccc}  \text{H} & \text{Cl} & \text{H} & \text{Cl} & \text{H} & \text{Cl} \\    &   &   &   &   &   \\  -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C}- \\    &   &   &   &   &   \\  \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H}  \end{array}  $ (3)	chain containing 6 C atoms (1) single bonds between C atoms (1) rest of structure complete (1) allow alternative arrangements  allow max 2 for $  \left[ \begin{array}{cc}  \text{H} & \text{Cl} \\    &   \\  -\text{C} & -\text{C}- \\    &   \\  \text{H} & \text{H}  \end{array} \right]_3  $	(3) AO2

Question number	Answer	Additional guidance	Mark
(iii)	addition (polymer)		(1) AO1

Question number	Answer	Additional guidance	Mark
(iv)	relative formula mass $\text{C}_2\text{H}_3\text{Cl} = 62.5$ (1) $2850 \times 62.5$ (1) (=178125)  $178000$ (to 3 sig figs) (1)	without working $178000$ (3) $178125 / 178127$ (2) allow TE on incorrect relative formula mass  answer to 3 sig fig from calculation (1) (stand alone mark)	(3) AO2

Q15.

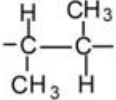

Question number	Answer	Mark
	C	(1)



## Q16.

Question number	Answer	Additional guidance	Mark
(i)	but-2-ene	allow 2-butene	(1) AO1 1

Question number	Answer	Additional guidance	Mark
(ii)	$C_4H_8 + Br_2 \rightarrow C_4H_8Br_2$ fully correct equation (2) if equation not fully correct, then correct formula of product $C_4H_8Br_2$ (1)	reject charges on formulae reject superscript numbers  allow incorrect lower and upper case letters	(2) AO2 2

Question number	Answer	Additional guidance	Mark
(iii)	 <p>2 neighbouring carbon atoms with single bond and continuation bonds shown (1)</p> <p>rest of repeating unit correct (1)</p>	allow $CH_3$ or  ignore brackets and n MP2 depends on MP1	(2) AO2 1

## Q17.

Question number	Answer	Mark
	<ul style="list-style-type: none"> <li>carbon (1)</li> <li>hydrogen (1)</li> </ul>	(2)

Q18.

Question Number	Answer	Additional guidance	Mark
(i)	An explanation that includes <ul style="list-style-type: none"> <li>A is {an alkene/ unsaturated/ has C=C/ has double bond} (1)</li> <li>B is {an alkene/ unsaturated/ has C=C/ has double bond} (1)</li> <li>C {is alkane/ is saturated/ no C=C/ has no double bond/ has <b>only</b> single bonds} (1)</li> </ul>	Do not accept alkynes for alkenes	(3) AO 3 2a AO 3 2b

Question Number	Answer	Additional guidance	Mark
(ii)	$\begin{array}{c} \text{H} \quad \text{H} \\   \quad   \\ \text{H}-\text{C}-\text{C}-\text{H} \\   \quad   \\ \text{H} \quad \text{H} \end{array}$ Fully correct with all capital letters (2)	Allow 1 if fully correct but any small letters  allow 1 for any molecule containing 2 carbon atoms and one single C-C bond  Reject ethene (=0)  Allow Dot-and-cross diagrams	(2) AO 1 1

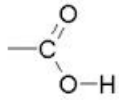
Question Number	Answer	Additional guidance	Mark
(iii)	contains carbon and hydrogen (atoms) (1) only (1)  MP2 dependent on MP1	Allow 1: contains carbon and hydrogen molecules <b>only</b> Allow 1: Element containing carbon and hydrogen <b>only</b>	(2) AO 1 1

Q19.

Question number	Answer	Mark
(i)	<b>B</b> propanol is dehydrated is the only answer  Reaction <b>B</b> involves loss of water, <b>A</b> , <b>C</b> and <b>D</b> do not involve loss of water	(1)  AO1



Question number	Answer	Mark
(ii)	<p>An explanation linking</p> <ul style="list-style-type: none"> <li>• bromine water is yellow (1)</li> <li>• with compound <b>X</b>, yellow colour remains / no change of colour (1)</li> <li>• with compound <b>Y</b>, bromine water turns colourless (1)</li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>• bromine water and compound <b>X</b> – no change in colour of bromine water (1)</li> <li>• bromine water and compound <b>Y</b> – bromine water changes from yellow (1) to colourless (1)</li> </ul>	(3) A02

Question number	Answer	Mark
(iii)	<p><b>C</b>  is the only answer.</p> <p><b>A, B</b> and <b>D</b> are not correct</p>	(1) A01

Question number	Answer	Additional guidance	Mark
(iv)	<p>Any suitable reaction and result such as</p> <ul style="list-style-type: none"> <li>• add a piece of magnesium ribbon (1)</li> <li>• bubbles of gas form (1)</li> <li>• add a (metal) carbonate (1)</li> <li>• bubbles of gas form (1)</li> <li>• add a metal oxide and warm (1)</li> <li>• metal oxide reacts to form a solution (1)</li> <li>• measure pH (1)</li> <li>• pH less than 7 (1)</li> <li>• add an alkali (1)</li> <li>• a neutral solution produced (1)</li> </ul>	<p>ignore add any metal but allow MP2</p> <p>ignore using other indicators</p>	(2) A03

Q20.

Question number	Answer	Additional guidance	Mark
	<p>(unsaturated)</p> <ul style="list-style-type: none"><li>it has a double bond/ C=C (1)</li></ul> <p>(hydrocarbon)</p> <ul style="list-style-type: none"><li>it contains carbon and hydrogen (1)</li><li>(carbon and hydrogen) (atoms) only (1)</li></ul>	<p>read whole answer then award marks from either section</p> <p>allow 'double carbon bond'</p> <p>MP3 allow alternatives such as 'just carbon and hydrogen'</p> <p>mixture of carbon and hydrogen/ contains molecules of carbon and hydrogen gets MP2 but not MP3</p>	<p><b>(3)</b> <b>AO1 1</b></p>

Q21.

Question Number	Indicative content	Mark
*	<p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlines in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <ul style="list-style-type: none"> <li>• (add) sodium carbonate (or any suitable carbonate) / test with blue litmus</li> <li>• carboxylic acid sample effervesces / blue litmus turns red</li> <li>• alkane and alkene sample give no effervescence / does not affect litmus</li> <li>• therefore liquid is butanoic acid</li> <li>• butanoic acid + sodium carbonate → sodium butanoate + carbon dioxide + water</li> <li>• (balanced equation)  <math>2 \text{C}_3\text{H}_7\text{COOH} + \text{Na}_2\text{CO}_3 \rightarrow 2 \text{C}_3\text{H}_7\text{COONa} + \text{CO}_2 + \text{H}_2\text{O}</math></li> <li>• (add) bromine water (to separate samples of each liquid)</li> <li>• (bromine water) orange colour</li> <li>• shake</li> <li>• alkene sample changes from orange to colourless</li> <li>• alkane (and carboxylic acid) stay orange</li> <li>• therefore liquid changing is hexene</li> <li>• hexene + bromine → 1,2-dibromohexane (allow any suitable isomer product / ignore numbers)</li> <li>• structural formula of product, <i>e.g.</i></li> <li>• (balanced equation / addition reaction)  <math>\text{C}_6\text{H}_{12} + \text{Br}_2 \rightarrow \text{C}_6\text{H}_{12}\text{Br}_2</math></li> </ul> <p>credit any appropriate test for an acid, <i>e.g.</i> specific indicator with correct colour change(s)</p> <ul style="list-style-type: none"> <li>• liquid giving negative results with both the test for acids and the bromine water is the alkane/hexane</li> </ul> <p>credit any appropriate test which would distinguish between the substances</p>	(6) AO 1 1

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	<ul style="list-style-type: none"> <li>• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1)</li> <li>• Presents an explanation with some structure and coherence. (AO1)</li> </ul>
Level 2	3-4	<ul style="list-style-type: none"> <li>• Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1)</li> <li>• Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)</li> </ul>
Level 3	5-6	<ul style="list-style-type: none"> <li>• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1)</li> <li>• Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)</li> </ul>

Q22.

Question number	Answer	Mark
	<ul style="list-style-type: none"> <li>X and Y are both unsaturated/contain {multiple/double} bonds/alkenes (1)</li> <li>Z is saturated/contains no {multiple/double} bonds/alkane (1)</li> </ul>	(2)

Q23.

Question number	Answer	Mark
(i)	propane + oxygen → carbon dioxide + water <ul style="list-style-type: none"> <li>LHS (1)</li> <li>RHS (1)</li> </ul>	(2)

Question number	Answer	Mark
(ii)	to {release/produce} {heat/energy}	(1)

Q24.

Question number	Answer	Additional guidance	Mark
	$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$ (3)  $C_2H_4 + O_2 \rightarrow$ (1) $\rightarrow CO_2 + 2H_2O$ (1) balancing of correct formulae (1)	allow correct multiples  allow = for —  penalise incorrect subscripts once only	(3)