

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.

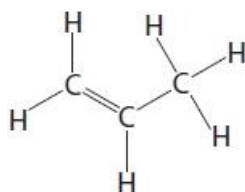


Figure 10

Many molecules of the compound in Figure 10 combine to form substance Y. Figure 11 shows part of a molecule of substance Y.

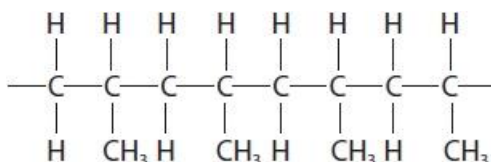


Figure 11

(i) What type of substance is Y?

- ☒ **A** a composite
 ☒ **B** a nanoparticle
 ☒ **C** a polymer
 ☒ **D** a protein

(1)

(ii) One molecule of the compound in Figure 10 has a mass of 6.98×10^{-23} g.

64 800 of these molecules combine to form one molecule of Y.

Calculate the mass of this molecule of Y in g.

(2)

.....

mass of one molecule of Y - g

(Total for question = 3 marks)

Q2.

Figure 1 shows toothbrushes in a container.

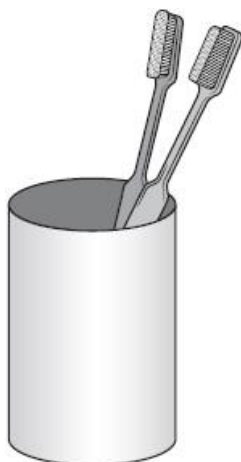


Figure 1

The toothbrush handles are made of plastic (polymer).

(i) Give a reason why plastic is a suitable material to make a toothbrush handle.

(1)

.....
.....

(ii) Some toothbrush handles are made of wood, not plastic.

Explain a disadvantage of using plastics.

(2)

.....
.....

(Total for question = 3 marks)

Q3.

Some alcohols can react with some carboxylic acids to form polyesters, which are condensation polymers.

Figure 17 shows the repeating unit of the polyester molecule formed in a reaction between a carboxylic acid and an alcohol.

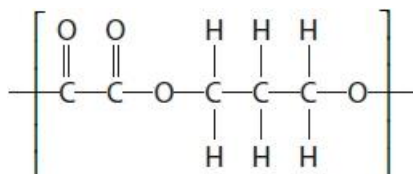


Figure 17

(i) Give the formula of the other product formed in this reaction.

(1)

.....

(ii) Draw the structure of one molecule of the alcohol used to produce the polyester shown in Figure 17, showing all covalent bonds.

(2)

(Total for question = 3 marks)

Q4.

Figure 14 shows the structure of a molecule of hydrocarbon **Z**, C₄H₈.

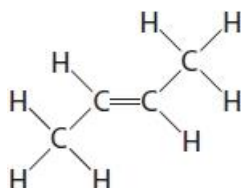


Figure 14

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

(1)

.....

(ii) Complete the balanced equation for the reaction of hydrocarbon **Z**, C₄H₈, with bromine.

(2)



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

(2)

(Total for question = 5 marks)

Q5.

Polymer molecules can be made by joining together large numbers of small molecules called monomers.

Calculate the relative formula mass of the poly(propene) molecule made from joining together 24 600 molecules of propene, C_3H_6 .
(relative formula mass: $C_3H_6 = 42.0$)

Give your answer to three significant figures.

(2)

.....
.....
.....

relative formula mass =

(Total for question = 2 marks)

Q6.

Polymer molecules can be made by joining together large numbers of small molecules called monomers.

Figure 5 shows the names and structures of some polymers and the monomers used to make them.

Complete the table using the information given.

(3)

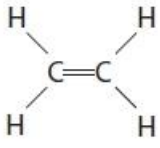
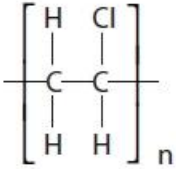
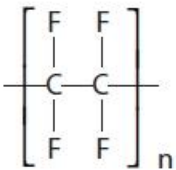
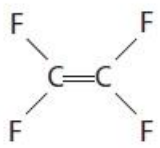
name of polymer	structure of polymer molecule	name of monomer	structure of monomer molecule
poly(ethene)		ethene	
poly(chloroethene)		chloroethene	
		tetrafluoroethene	

Figure 5

(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.

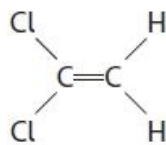


Figure 16

(i) Describe how dichloroethene monomers form a polymer.

(2)

.....

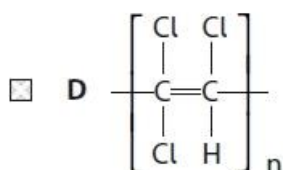
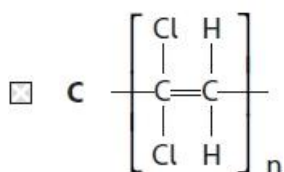
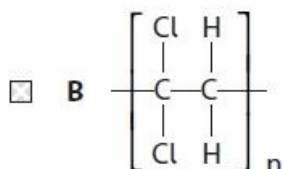
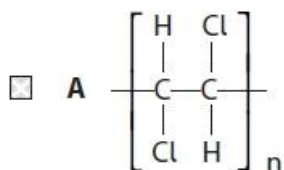
.....

.....

.....

(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.

*Polymers have many uses.

However, the disposal of polymers after use can be a problem.

The uses of polymers are related to their properties.

Some uses of three common polymers are given in Figure 13.

polymer	uses
poly(ethene)	plastic bags, plastic bottles
poly(chloroethene) (PVC)	window frames, water pipes, insulation for electrical wires
poly(tetrafluoroethene) (PTFE, Teflon™)	coating for frying pans, stain-proofing for clothing

Figure 13

Discuss the reasons for using these polymers in the ways shown in Figure 13 and the problems in disposing of these polymers.

(6)

(Total for question = 6 marks)

Q9.

Poly(chloroethene) is a polymer made from chloroethene.
A molecule of chloroethene is shown in Figure 20.

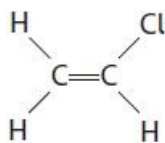


Figure 20

(i) On Figure 20, 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)

Q10.

Figure 16 shows the structure of a molecule of dichloroethene.

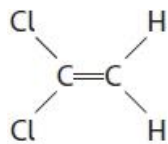


Figure 16

Poly(dichloroethene) was used to wrap food to keep it fresh.

Explain **one** property that a plastic food wrapping must have.

(2)

.....

.....

.....

(Total for question = 2 marks)

Q11.

* Polymers are addition or condensation polymers.

Polymers can be formed by using the monomers shown in Figure 12.

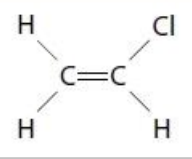
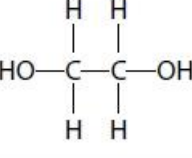
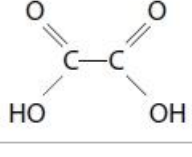
monomer	structure
chloroethene	
ethane-1,2-diol	
ethanedioic acid	

Figure 12

Explain, using appropriate monomers from Figure 12, how different polymers can be formed.

(6)

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(Total for question = 6 marks)

Q12.

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

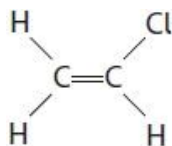


Figure 5

(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)

.....
.....
.....
.....
.....

relative formula mass =

(Total for question = 8 marks)

Q13.

Polymer molecules can be made by joining together large numbers of small molecules called monomers.

A molecule of propene has the structure shown in Figure 6.

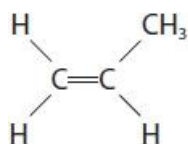
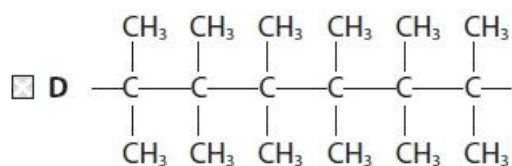
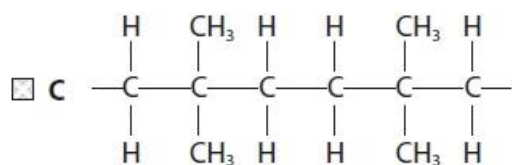
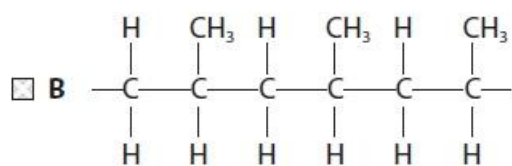
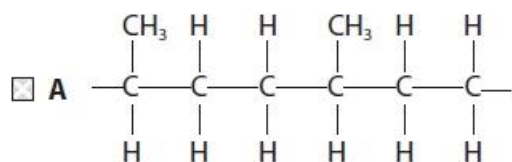


Figure 6

Which of the following shows the structure of part of a poly(propene) molecule?

(1)



(Total for question = 1 mark)

Q14.

The repeating unit in a polyester molecule is shown in Figure 6.

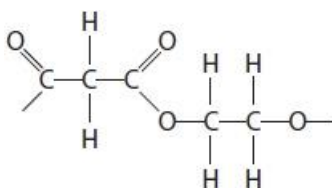


Figure 6

(i) This polymer is made from two different monomers.

Draw a molecule of each monomer showing all covalent bonds.

(2)

(ii) Give the name or formula of the small molecule formed when the monomer molecules react to form an ester link.

(1)

.....

(Total for question = 3 marks)

Q15.

Figure 3 shows the structure of two monomers.

monomer A	monomer B
$\text{HO}-\text{CH}_2-\text{CH}_2-\text{OH}$	$\text{HOOC}-\text{CH}_2-\text{CH}_2-\text{COOH}$

Figure 3

(i) Monomer **B** contains a carboxylic acid group.

Describe what you would **see** when a small amount of solid sodium carbonate is added to a solution of monomer **B**.

(2)

.....

.....

.....

(ii) When monomer **A** and monomer **B** react together they polymerise to form a polymer and one other product.

Name the type of polymerisation that takes place and name the other product.

(2)

type of polymerisation

.....

name of other product

.....

(iii) A naturally occurring polymer is made by combining monomers called nucleotides.

Give the name of this natural polymer.

(1)

.....

(Total for question = 5 marks)

Q16.

(i) The structure of a molecule of a polymer is shown in Figure 12.

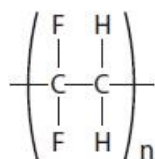
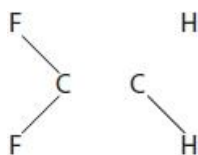


Figure 12

Complete the structure of a molecule of the monomer used to make this polymer by adding the missing covalent bonds.

(2)



* (ii) Poly(ethene) has many uses in everyday life.

Large amounts of poly(ethene) are manufactured from ethene produced by cracking fractions obtained from crude oil.

Poly(ethene) is used to make many objects.

After use it is necessary to dispose of the large amounts of poly(ethene) in these objects.

Explain some of the problems associated with the manufacture and disposal of poly(ethene).

(Total for question = 8 marks)

Q17.

This question is about polymers.

(i) State a problem with **recycling** polymers.

(1)

.....
.....

(ii) Describe a problem associated with the **disposal** of polymers.

(2)

.....
.....
.....
.....

(Total for question = 3 marks)

Q18.

Polymer molecules can be made by joining together large numbers of small molecules called monomers.

Plastics are polymers.

State **two** problems caused by the disposal of polymers.

(2)

1

.....

2

.....

(Total for question = 2 marks)

Q19.

Poly(propene) is an example of a polymer.

The structure of a poly(propene) molecule is shown in Figure 5.

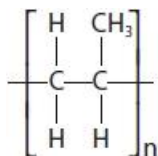


Figure 5

This polymer is made from a monomer.

Draw the structure of the monomer molecule showing all covalent bonds.

(2)

(Total for question = 2 marks)

Q20.

A layer of poly(chloroethene) (PVC) is used to surround the copper in electrical cables.

Explain why poly(chloroethene) is a suitable material for this purpose.

(2)

.....

.....

.....

(Total for question = 2 marks)

Q21.

Some polymers are polyesters.

What type of reaction takes place when polyesters are formed?

(1)

- A** addition
- B** condensation
- C** neutralisation
- D** precipitation

(Total for question = 1 mark)

Mark Scheme

Q1.

Question number	Answer	Mark	
(i)	C polymer is the only correct answer A is incorrect because there is only one substance B is incorrect because this is a long chain D is incorrect because the molecule is not made from proteins	(1) AO2 1	
Question number	Answer	Additional guidance	Mark
(ii)	4.52304 x 10 ⁻¹⁸ with or without working scores 2 <ul style="list-style-type: none"> • 6.98 x 10⁻²³ x 64800 (1) • = 4.52(304) x 10⁻¹⁸ (g) (1) 	do not award 4.52304 x 10 ¹⁸ (but could score MP1 if this is correctly shown) Allow 2-6 sig fig. MP2 scores for correct evaluation of a division including the two pieces of data ONLY: 1.07716 x 10 ⁻²⁷ (1) 9.2836... x 10 ²⁶ (1)	(2) AO2 1

Q2.

Question number	Answer	Additional guidance	Mark
(i)	strong / unreactive (with water/air) / non-toxic / can be moulded	allow: flexible; ignore: hard, tough, durable, won't break allow: waterproof, insoluble ignore: Doesn't corrode/ rust ignore: easy to make, cheap ignore lightweight and any other properties/ descriptions	(1) AO1 1

Question number	Answer	Additional guidance	Mark
(ii)	<p>an explanation linking</p> <ul style="list-style-type: none"> plastics made from (crude) oil (1) which is {finite/ non-sustainable} (1) <p>OR</p> <ul style="list-style-type: none"> the plastic is non-biodegradable (1) plastic ends up in landfill (1) 	<p>MP2: allow non-renewable</p> <p>MP3: allow: {takes a long time/hard} to {decompose/ break down}</p> <p>MP4: allow: {hard to/ cannot be} recycled / may give toxic fumes if incinerated ignore any reference to effect on wildlife ignore general answers such as 'harmful to environment' mark independently</p>	(2) AO2 1

Q3.

Question number	Answer	Mark
(i)	H ₂ O	(1) AO1 1

Question number	Answer	Additional guidance	Mark
(ii)	$ \begin{array}{ccccccc} & & \text{H} & \text{H} & \text{H} & & \\ & & & & & & \\ \text{H} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{O} & - & \text{H} \\ & & & & & & \\ & & \text{H} & \text{H} & \text{H} & & \end{array} $ <p>fully correct diagram scores (2) if not scores (1) for 3 single bonded carbon atoms / 2 OH groups</p>	<p>allow OH or O-H</p> <p>reject any double bonds</p>	(2) AO2 1

Q4.

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

Q5.

Question number	Answer	Additional guidance	Mark
	MP1 : calculation $24\,600 \times 42$ (1) (=1 033 200) MP2 : answer to 3 sig figs $= 1\,030\,000 / 1.03 \times 10^5$ (1) (to 3 sig figs)	without working: $1\,030\,000$ – 2 marks $1\,033\,200$ – 1 mark allow $24600/42 = 586$ (1)	(2)

Q6.

Question number	Answer	Additional guidance	Mark
	$\left[\begin{array}{cc} \text{H} & \text{H} \\ & \\ -\text{C} & -\text{C}- \\ & \\ \text{H} & \text{H} \end{array} \right]_n$ (1) $\begin{array}{c} \text{H} & & \text{Cl} \\ & \backslash & / \\ & \text{C} = \text{C} \\ & / & \backslash \\ \text{H} & & \text{H} \end{array}$ (1) poly(tetrafluoroethene) (1)	 note n must be present on the repeating unit allow polytetrafluoroethene ignore ptfе / Teflon	(3)

Q7.

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

Question number	Answer	Mark
(ii)	$\left[\begin{array}{cc} \text{Cl} & \text{H} \\ & \\ -\text{C} & -\text{C}- \\ & \\ \text{Cl} & \text{H} \end{array} \right]_n$ B B is the only correct answer. 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)	(1)

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

Q8.

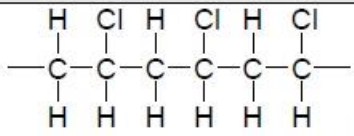
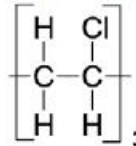
Question number	Indicative content	Mark
	<p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant.</p> <p>Additional content included in the response must be scientific and relevant.</p>	(6)

	<p>A description to include some of the following points</p> <p>(reasons for the uses) poly(ethene) :</p> <ul style="list-style-type: none">• plastic bags / plastic bottles - flexible/bendable, inert/unreactive, waterproof/weatherproof, light <p>poly(chloroethene) :</p> <ul style="list-style-type: none">• window frames / gutters / waterpipes - tough/hard, long-lasting, durable/good insulator, waterproof/weatherproof, inert/unreactive• insulation for electrical wires - flexible /bendable, good insulator,waterproof/weather proof, inert/unreactive <p>poly(tetrafluoroethene):</p> <ul style="list-style-type: none">• coating for frying pans - slippery, non-stick, tough, high melting point/heat resistant, inert/unreactive• stain-proofing clothing and carpets - slippery <p>(problems of disposal) landfill</p> <ul style="list-style-type: none">• non-biodegradable• persist in landfill/very long time to degrade• fill up land/new landfill sites needed• harmful to animal habitats <p>recycling</p> <ul style="list-style-type: none">• plastics need to be sorted/time consuming• transport to collection area/recycling point uses fuel• collection point may cause litter problem/eyesore etc <p>burning</p> <ul style="list-style-type: none">• toxic substances released• hydrogen chloride/acid gas produced from burning PVC• carbon dioxide released contributing to global warming• carbon monoxide released• toxic ash/solids formed	
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Level	Mark	Additional Guidance	General additional guidance – the decision within levels Eg - At each level, as well as content, the scientific coherency of what is stated backed up by planning detail will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	<u>Additional guidance</u> <ul style="list-style-type: none"> gives simple statements about problems in disposal of polymers OR link a use of one polymer to its properties 	<u>Possible candidate responses</u> <ul style="list-style-type: none"> polymers are not biodegradable not all polymers can be recycled polythene is used in plastic bags because it is flexible PTFE is used in frying pans because it is non-stick Statement with detail scores upper mark of level
Level 2	3–4	<u>Additional guidance</u> <ul style="list-style-type: none"> links uses of at least two polymers to their properties OR describes at least two problems associated with disposing of polymers OR links a use of at least one polymer to its properties AND describes at least one problem associated with disposing of polymers 	<u>Possible candidate responses</u> <ul style="list-style-type: none"> PVC is used as insulation in electrical wires because it does not conduct electricity. PTFE is used in frying pans because it is non-stick. Polymers will be present in landfill for a long time. Incineration of polymers releases toxic gases. Poly(ethene) is used in plastic bags because it is flexible, but it is not biodegradable. All statements with detail scores upper mark of level
Level 3	5–6	<u>Additional guidance</u> <ul style="list-style-type: none"> links uses of at least two polymers to their properties AND explains at least one problem associated with disposing of polymers OR links uses of at least one polymer to its properties AND explains at least two problems associated with disposing of polymers 	<u>Possible candidate responses</u> <ul style="list-style-type: none"> PTFE is used in stainproof clothing and carpets because it is non-stick so stains are easily removed. PVC is used in window frames because it is waterproof. Polymers last for a long time in landfill sites. Poly(ethene) is used in plastic bottles because it is inert so will not react with food. However, it is not biodegradable and releases carbon dioxide when burnt, which contributes to global warming All statements with detail scores upper mark of level

Q9.

Question number	Answer	Additional guidance	Mark
(i)	circle around C=C	or circle around C-Cl	(1)
			A02

Question number	Answer	Additional guidance	Mark
(ii)	 (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  ₃	(3) AO1

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

Question number	Answer	Additional guidance	Mark
(iv)	relative formula mass $C_2H_3Cl = 62.5$ (1) 2850×62.5 (1) (=178125) 178000 (to 3 sig figs) (1)	without working 178000 (3) $178125 / 178127$ (2) allow ECF on incorrect relative formula mass	(3) AO2

Q10.

Question number	Answer	Additional Guidance	Mark
	An explanation to a property with a linked reason non-toxic (1) so stops food being poisonous (1) OR unreactive (1) so it does not react with the food (1) OR flexible (1) so it can wrap all around the food (1)	<u>MP2 depends on MP1</u> allow impermeable to air (1) stops food {oxidation / reaction with air} (1) ignore 'stops food going off' impermeable to water (1) stops dampening of food (1) high melting point (1) so can wrap hot food (without melting) (1) ignore: strong/ tough/ transparent/ cheap/ can seal	(2)

Q11.

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 outlined 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>Candidates choose appropriate monomers to illustrate the formation of different polymers.</p> <ul style="list-style-type: none"> polymer molecules are long chains made up of simple repeating units use chloroethene (only) to form poly(chloroethene) which is addition polymerisation use ethane-1,2-diol and ethanedioic acid to form a polyester which is condensation polymerisation one of the bonds in the double bond in chloroethene molecule breaks and chloroethene molecules join together to form a long chain molecule equation $n \begin{array}{c} \text{H} & & \text{Cl} \\ & \diagdown & / \\ & \text{C} = \text{C} \\ & / & \diagdown \\ \text{H} & & \text{H} \end{array} \longrightarrow \left[\begin{array}{c} \text{H} & \text{Cl} \\ & \\ -\text{C} & - & \text{C}- \\ & \\ \text{H} & \text{H} \end{array} \right]_n$ <ul style="list-style-type: none"> identification of repeat unit alcohol group combines with a carboxylic acid group and an ester (link) formed with a water (molecule) eliminated equation $\begin{array}{c} \text{O} & \text{O} \\ & \\ \text{C} & - & \text{C} \\ / & \backslash \\ \text{HO} & \text{OH} \end{array} + \begin{array}{c} \text{H} & \text{H} \\ & \\ \text{HO}-\text{C} & - & \text{C}-\text{OH} \\ & \\ \text{H} & \text{H} \end{array} \longrightarrow \begin{array}{c} \text{O} & \text{O} & \text{H} & \text{H} \\ & & & \\ -\text{C} & - & \text{C} & - & \text{O} & - & \text{C} & - & \text{C} & - & \text{O}- \\ & & & \\ & & \text{H} & \text{H} \end{array} + \text{H}_2\text{O}$ <ul style="list-style-type: none"> ester link shown identification of repeat unit 	(6)

Level	Mark	Descriptor
	0	No awardable content.
Level 1	1–2	<ul style="list-style-type: none"> 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. (AO2) Lines of reasoning are unsupported or unclear. (AO2)
Level 2	3–4	<ul style="list-style-type: none"> 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. (AO2) Lines of reasoning mostly supported through the application of relevant evidence. (AO2)
Level 3	5–6	<ul style="list-style-type: none"> 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. (AO2) Lines of reasoning are supported by sustained application of relevant evidence. (AO2)

Q12.

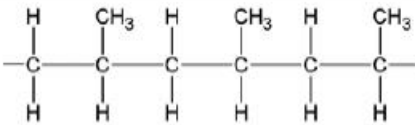
Question number	Answer	Additional guidance	Mark
(i)	circle around C=C	or circle around C-Cl	(1) AO1

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

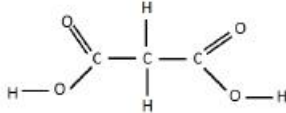
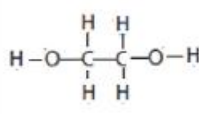
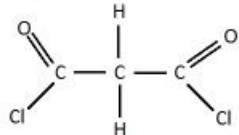
Question number	Answer	Additional guidance	Mark
(iii)	addition (polymer)		(1) AO1

Question number	Answer	Additional guidance	Mark
(iv)	relative formula mass $C_2H_3Cl = 62.5$ (1) 2850×62.5 (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

Q13.

Question number	Answer	Mark
	<p>B</p>  <p>is the only correct answer</p> <p>A is not correct because there are insufficient CH_3 groups attached to the carbon chain C is not correct because only one CH_3 group can be attached to a carbon atom D is not correct because there are no H atoms attached to the carbon chain</p>	(1)

Q14.

Question Number	Answer	Additional guidance	Mark
(i)	 (1)  (1)	either order allow  accept -OH in place of -O-H on both structures.	(2) AO 3 2a AO 3 2b

Question Number	Answer	Additional guidance	Mark
(ii)	water/ H_2O	or hydrogen chloride/HCl if diacid chloride shown as monomer	(1) AO 1 1

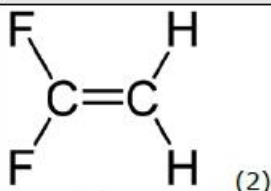
Q15.

Question number	Answer	Additional guidance	Mark
(i)	A description including any 2 of <ul style="list-style-type: none"> • effervescence / fizzing (1) • solid disappears (1) • colourless solution forms (1) 	allow bubbles	(2)

Question number	Answer	Additional guidance	Mark
(ii)	type of polymerisation condensation (1) name of other product water / H ₂ O (1)	reject addition	(2)

Question number	Answer	Additional guidance	Mark
(iii)	DNA (1)	allow RNA / deoxyribonucleic acid	(1)

Q16.

Question Number	Answer	Mark
(i)	 <p>(2)</p> <p>1 mark for each correct bond -1 for each <u>additional</u> bond</p>	(2) AO 2 1

Question Number	Indicative content	Mark
* (ii)	<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>Aspect 1: MANUFACTURE</p> <ul style="list-style-type: none"> • crude oil is a raw material • crude oil is finite • cracking requires a lot of energy • generation of energy for fractional distillation and cracking may cause release of carbon dioxide • carbon dioxide is a greenhouse gas and may lead to global warming <p>Aspect 2: DISPOSAL</p> <ul style="list-style-type: none"> • some polymers disposed of in landfill sites • non-biodegradable • persists in landfill • landfill space runs out • some plastic ends up as litter/ in oceans • this may be hazardous to wildlife • some polymers are recycled • polymers must be sorted into different types • public must make effort to sort/ recycle • some polymers are burnt • produces carbon dioxide • carbon dioxide is a greenhouse gas • greenhouse gases may cause global warming • toxic gases may be produced <p>Ignore all irrelevant material Ignore general statements such as 'disposal of polymers is harmful to the environment' If carbon dioxide/ greenhouse effect etc. mentioned in both aspects, only credit once</p>	<p>(6)</p> <p>AO 1 1</p>

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

Q17.

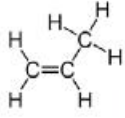
Question number	Answer	Mark
(i)	Any one from <ul style="list-style-type: none"> • need to sort polymers into different types • polymers often need to be separated from other polymers • takes time to sort by hand • containers may need to be washed before recycling • difficult to break down into their monomers • some not recyclable • requires a lot of energy 	(1) AO1

Question number	Answer	Additional guidance	Mark
(ii)	A description to include <ul style="list-style-type: none"> • polymers persist in landfill / landfill site fills up too quickly • polymers degrade very slowly or <ul style="list-style-type: none"> • combustion produces gases • which may be toxic 	accept polymers persist in the environment / harmful to wildlife not biodegradable / hard to decompose	(2) AO1

Q18.

Question number	Answer	Additional guidance	Mark
	any two from <ul style="list-style-type: none"> • polymers degrade very slowly / last very long time in landfill (1) • not biodegradable (1) • landfill sites fill up quickly (1) • (toxic) gases produced during disposal by combustion (1) • harmful to wildlife / habitats / ecosystems(1) 	allow decompose/ breakdown / disintegrates allow named gases allow carbon dioxide	(2)

Q19.

Question Number	Answer	Additional guidance	Mark
	 <p>(2)</p> <p>one C=C bond in a three consecutive carbon atom molecule (1)</p> <p>all other atoms and bonds correct (1) MP2 is dependent on MP1</p>	<p>ignore bond angles</p> <p>reject CH₃ for MP2</p>	(2) AO 2 1

Q20.

Question Number	Answer	Additional guidance	Mark
	<p>An explanation linking</p> <ul style="list-style-type: none"> low ability to conduct electricity / does not conduct electricity/ insulator (1) separates user from {current / electricity} / prevents shock electric / prevents electrocution (1) 	<p>allow</p> <ul style="list-style-type: none"> high flexibility/bendable (1) less likely to break easily (than other materials) (1) <p>OR</p> <ul style="list-style-type: none"> inert/unreactive/waterproof/weatherproof (1) separates the wire from surrounding water (1) 	(2) AO 1 1

Q21.

Question Number	Answer	Mark
	<p>B condensation</p> <p>The only correct answer is B</p> <p><i>A is not correct because this is not an addition reaction</i></p> <p><i>C is not correct because this is not a neutralisation reaction</i></p> <p><i>D is not correct because this is not a precipitation reaction</i></p>	(1) AO 1 1