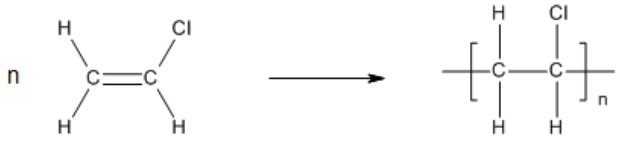
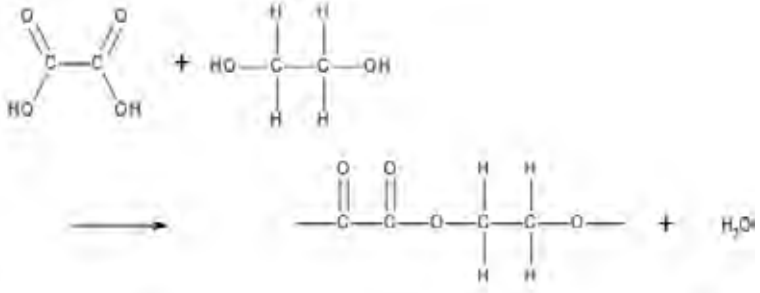
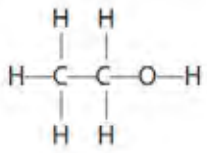
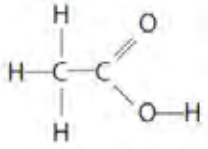
Question number	Answer	Mark
1(a)	An explanation that combines identification – improvement of the experimental procedure (1 mark) and justification/reasoning which must be linked to the improvement (1 mark): • reverse the boiling tubes/pass gas through the tube in ice water first (1) • so that if any liquid condenses in the tube it must have come from the burning wax (and not from the limewater) (1)	**(2)**

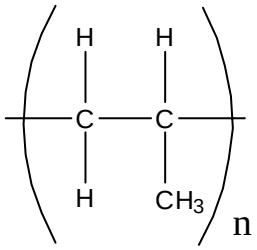
Question number	Indicative content	Mark
*1(b)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Candidates choose appropriate monomers to illustrate the formation of different polymers. • 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  • identification of repeat unit • alcohol group combines with a carboxylic acid group • and an ester (link) formed • with a water (molecule) eliminated • equation  • ester link shown • identification of repeat unit	(6)

Level	Mark	Descriptor
	0	No awardable content.
Level 1	1–2	• 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	• 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	• 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)

Question number	Answer	Marks
1(c)(i)	carboxylic acids	**(1)**

Question number	Answer	Marks
1(c)(ii)	A is  (1) B is  (1)	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(a)	C alkenes are unsaturated hydrocarbons		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(b)	poly(ethene) (1)  (1)	polythene/polyethylene continuation bonds need not go through brackets Allow bond pointing to any part of CH_3	**(2)**

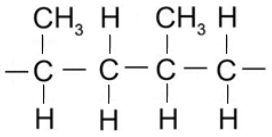
Question Number	Answer	Acceptable answers	Mark
2(c)	An explanation linking two of non biodegradable (1) persist in landfill sites (1) OR produce gases/fumes when **burnt** (1) M1 gases may be toxic/harmful (1) M2 OR cannot be recycled (1) new {raw material/crude oil} needed (1)	 {do not/take (very) long time to} decompose/rot/disintegrate/degrade stays for long time take up a lot of space (in landfill sites) a named gas linked to the environmental problem it causes e.g. carbon dioxide is a greenhouse gas Ignore pollutants (need to use) finite resources	**(2)**

Question Number		Indicative Content	Mark
QWC	***2(d)**	An explanation including some of the following points A good fuel should **Burning considerations** • ignite easily • burn easily • release a lot of /sufficient heat energy when it is burnt **Usage considerations** • be safe to use • be safe/easy to transport • be {safe/easy/convenient} to store • be reasonably cheap **Supply considerations** • readily available/good supply • be renewable/sustainable/not finite **Products considerations** • not produce (much) solid/ash when burnt • not produce much/any smoke • contain little/no sulfur • not produce {toxic/harmful} gases/fumes • carbon neutral • not produce too much carbon dioxide or other named gas such as sulfur dioxide or greenhouse gases	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description covering two aspects: e.g. burn easily and safe to use **OR** one aspect covered in more detail e.g. is cheap and easy to transport the answer communicates ideas using simple language and uses limited scientific terminology, spelling, punctuation and grammar are used with limited accuracy	

Question Number	Answer	Acceptable answers	Mark
3(a)(i)	An explanation linking (a compound containing) • hydrogen and carbon (1) • (hydrogen and carbon) only (1) • contains double / multiple bond (between carbon atoms) (1)	 ignore H and C reject {ions/molecule} of carbon and hydrogen reject mixture reject oxygen ignore 'spare bonds' allow carbon atoms not joined to the maximum number of other atoms	**(3)**

Question Number	Answer	Acceptable answers	Mark
3(a)(ii)	**B** cracking		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(a)(iii)	A description to include • (bromine water is) orange (1) • decolourises / turns colourless (1)	 allow brown / yellow or combinations eg orange-yellow ignore red (alone) ignore clear / changes colour / discolour	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(b)(i)	**D** 		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(b)(ii)	waterproof / rot-proof / strong / flexible / does not react with oxygen / water resistant / weather proof	allow durable / tough ignore ductile / stretchy	**(1)**

Question Number	Answer	Acceptable answers	Mark
3(b)(iii)	not biodegradable / persist in landfill sites / does not decompose	ignore answers in terms of burning / allow takes a long time to rot / decompose / takes up space in landfill	**(1)**

Question Number	Answer	Acceptable answers	Mark
4(a)	the liquid oil is changed into a solid		**(1)**

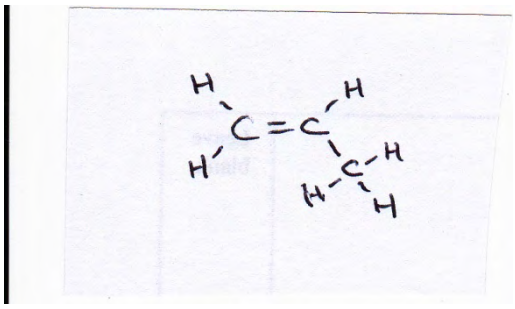
Question Number	Answer	Acceptable answers	Mark
4(b)(i)	**B** sodium hydroxide		**(1)**

Question Number	Answer	Acceptable answers	Mark
4(b)(ii)	An explanation linking any two of • tail / {hydrophobic / hydrocarbon } end into grease (1) • head / {anion / hydrophilic} end into water (1) • allows grease to mix with water when surrounded by soap (anions) / grease is surrounded by soap (1) • surface tension lowered (1)	allow correctly labelled diagram (2) head is soluble in water (1)	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(c)(i)	propanoic (acid)		**(1)**

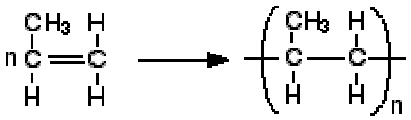
Question Number	Answer	Acceptable answers	Mark
4(c)(ii)	$CH_3COOH + C_2H_5OH \rightarrow CH_3COOC_2H_5$ (1) + H_2O (1) award one mark if incorrectly balanced	correct products but no / incorrect reactants shown (1) allow correct molecular formulae allow correct multiples ignore state symbols	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(d)	(making) fibres/fleece/clothing/ fabrics/bedding/computer mouse mats/yarns/ropes/safety belts/filters/insulating tape/wood finishes/(plastic) carrier bags	allow any named item of clothing	**(1)**

Question Number	Answer	Acceptable answers	Mark
5(a)(i)	 **one** C=C in a three consecutive carbon atom molecule (1) rest of structure correct, ignore bond angles, conditional on first marking point(1)	allow methyl group written as CH_3	**(2)**

Question Number	Answer	Acceptable answers	Mark
5(a)(ii)	C_7H_{16}		**(1)**

Question Number	Answer	Acceptable answers	Mark
5(b)	A description including add bromine (water) / aqueous bromine (and shake the tube)(1) stays orange / no change / does not go colourless in {propane/alkane} (1) turns colourless / decolorises in {propene/alkene} (1) Maximum 1 mark for 2 correct observations with an incorrect reagent or no reagent specified	**Allow** recognisable spelling for bromine **Allow** yellow / brown or combinations of these for orange **Ignore** just 'red' **Ignore** clear / discoloured one correct test with statement or clear implication that the other must be the other gas for full marks eg add bromine water to both gases, the one that turns it colourless is propene, scores 3 marks as it is clearly implied that the other gas does not turn it colourless	**(3)**

Question Number		Indicative Content	Mark
QWC	***5(c)**	An explanation including some of the following points **Making the polymer** many propene molecules join/react together form a long chain polymerisation reaction propene is the monomer propene is unsaturated / has a double bond poly(propene) has single bonds propene is a gas and forms poly(propene) which is a solid the C=C bond breaks / opens up  **Properties of poly(propene) with related uses** e. property – flexible, low density (lightweight), shatterproof, high softening point, non-toxic, strong, tough, good insulator, water proof, resistant to corrosion, long lasting, can be moulded into shape, can be made into fibres Uses of poly(propene) use – to make plastic bags, packaging, buckets, bowls, food containers, ropes, carpets, thermal underwear, Thinsulate items, toys, bottles, bottle caps, laboratory equipment, medical equipment, pipes, car bumpers, crates, furniture, tubing	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	a limited explanation of how to make the polymer or properties or uses e.g. propene molecules join together to form the polymer / polypropene can be used to make carpets the answer communicates ideas using simple language and uses limited scientific terminology spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	a simple explanation of how to make the polymer and/or properties and/or uses e.g. propene molecules are monomers and join together to make poly(propene)/ poly(propene) is used to make buckets because it can be moulded into shape the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	a detailed explanation including reference to how to make the polymer, its uses and properties e.g. propene molecules have a double bond and poly(propene) can be used to make washing up bowls because it is strong. / propene molecules have a double bond and many of them join together to make polypropene which is used to make ropes. the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately spelling, punctuation and grammar are used with few errors	