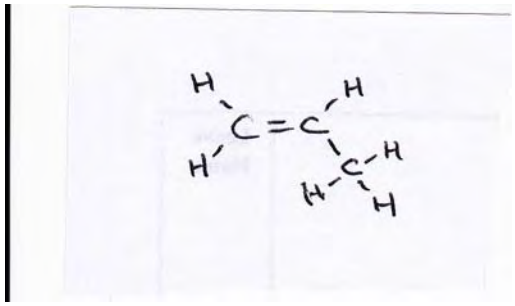
Question Number	Answer	Acceptable answers	Mark
1(a)(i)	D C_4H_{10}		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(a)(ii)	 **one** C=C in a molecule with three consecutive carbon atoms (1) rest of structure correct, ignore bond angles, conditional on first marking point(1)	allow -CH_3 do not allow two C=C in a molecule allow (1) for completely correct dot and cross diagram	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(b)	C oxidised		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(c)(i)	A description including two from • effervescence / fizzing / bubbles of gas (1) • solid {disappears/clears} /(colourless)solution formed (1)	ignore {cloudy/white ppt} /'gas formed'/colour change /name of gas / changes to a liquid (solid/sodium carbonate/it) dissolves (1)	**(2)**

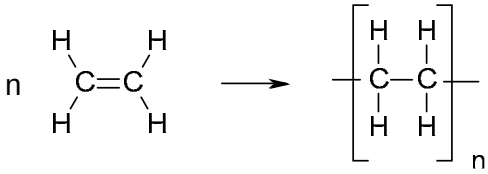
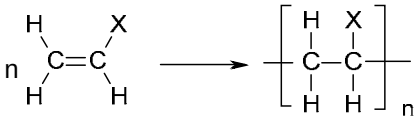
Question Number	Answer	Acceptable answers	Mark
1(c)(ii)	$CH_3COOC_2H_5$/$CH_3COOCH_2CH_3$ / $CH_3CO_2C_2H_5$ / $CH_3CO_2CH_2CH_3$ / $C_2H_5O_2CCH_3$ / $CH_3CH_2OOCCH_3$ (1) H_2O (1)	allow displayed formulae/ $C_4H_8O_2$ do not allow formulae ending in –COOH/-COO or any formula that does not show an ester do not allow H2O / H^2O /lower case h/HOH maximum (1) if additional incorrect balancing ignore state symbols	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(a)(i)	LPG, petrol and diesel		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(a)(ii)	An explanation linking **two** of the following points • use of {fractions / large molecules / long chain hydrocarbons} of {less demand / less useful / lower value} / ORA (1) • to meet demand / small molecules needed (1)	**reject** useless use up excess kerosene / fuel oil and bitumen to make more petrol / LPG / alkenes	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(b)	**B** the boiling point of the hydrocarbon increases		**(1)**

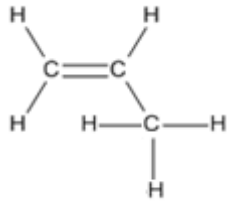
Question Number	Answer	Acceptable answers	Mark
2(c)(i)	C_2H_4		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(c)(ii)	 (2) ignore n missing on polymer structure LHS (1) RHS (1) Allow:  (1) (where X could be CH_3 or similar)	n $C_2H_4 \rightarrow (C_2H_4)_n$ (2) Note: Displayed formulae alkene with **C=C** polymer – single bonds between atoms with continuation bonds Allow any number of C_2H_4 on LHS **drawn out** with corresponding structure of polymer on RHS	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(d)(i)	An explanation linking the following points • greenhouse gas / traps heat in atmosphere (1) • may lead to increasing global temperature / global warming (1)	traps infra-red radiation / **increases** greenhouse effect **reject** reference to UV melting {ice caps / glaciers} / climate change / sea-level rising / loss of habitats **reject** reference to ozone layer	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(d)(ii)	An explanation linking **two** of the following points • sulfur dioxide formed (during combustion of fuel) (1) • sulfur dioxide {dissolves in rain / forms acid (rain)} (1) • an effect of acid rain e.g. harms {fish / plants / statues / buildings} / lowers pH of lakes (1)	SO_2 possible harm to human respiration	**(2)**

Question number	Answer	Mark
3(a)	C	(1)

Question number	Answer	Additional guidance	Mark
3(b)	• molecular formula – C_5H_{10} (1) • structure (1) 		(2)

Question number	Answer	Additional guidance	Mark
3(c)(i)	• calculates relative molecular mass of C_4H_9OH (1) • calculates mass of C_4H_9OH produced (1) • final answer = 1.9 (kg) (1)	Example of calculation Relative molecular mass of C_4H_9OH = (4 × 12) + (9 × 1) + 16 + 1 = 74 Mass of C_4H_9OH produced = (74 ÷ 56) × 1.4 Accept 1.85 (kg) Award full marks for use of moles/correct numerical answer without working	(3)

Question number	Answer	Mark
3(c)(ii)	A	(1)

Question number	Answer	Mark
3(d)	• X and Y are both unsaturated/contain {multiple/double} bonds/alkenes (1) • Z is saturated/contains no {multiple/double} bonds/alkane (1)	(2)

Question Number	Answer	Acceptable answers	Mark
4(a)	C		**(1)**

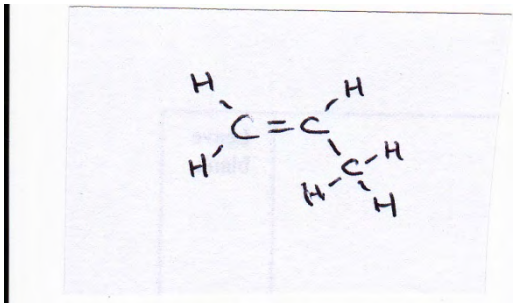
Question Number	Answer	Acceptable answers	Mark
4(b)	• correct repeating unit(1) • two correct units shown with continuation bonds (1)	any answer with double bonds = 0 **Allow** if correct and more than two units shown	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(c)	A description including **two** of the following points • bromine (water) (1) • (bromine water) turns (from orange) to colourless/or is decolourised (1)	**Ignore** clear/discoloured	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(d)(i)	17 (g)	seventeen (g)	**(1)**

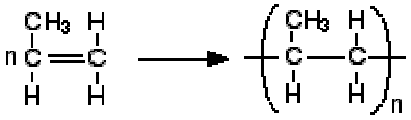
Question Number	Answer	Acceptable answers	Mark
4(d)(ii)	An explanation linking **two** of the following • break down of hydrocarbons / large molecules / alkanes (1) • into small(er) molecules (1) • into alkanes and alkenes (1)	**Reject** 'chains of molecules' /polymers **Ignore** chains	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(d)(iii)	An explanation linking **two** of the following: • less demand for (fractions containing) large molecules ORA (1) • large molecules are less useful ORA (1) • specific use of product fractions e.g. petrol / fuel for cars(1) • to make alkenes (1) • specific use of alkenes produced e.g. as monomers / to make polymers / to make plastics (1)	**Reject** are useless named alkenes	**(2)**

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	