

Question number	Answer	Additional guidance	Mark															
2(d)	<ul style="list-style-type: none"> divides mass by relative atomic mass (1) calculates simplest ratio (1) expresses ratio correctly as empirical formula (1) 	<p>Example of calculation</p> <table style="margin-left: 20px;"> <tr> <td>Ca</td> <td>:</td> <td>Br</td> </tr> <tr> <td>0.2</td> <td>:</td> <td>0.8</td> </tr> <tr> <td>40</td> <td>:</td> <td>80</td> </tr> <tr> <td>0.005</td> <td>:</td> <td>0.01</td> </tr> <tr> <td>1</td> <td>:</td> <td>2</td> </tr> </table> <p>empirical formula CaBr₂</p> <p>Formula alone scores max 1</p>	Ca	:	Br	0.2	:	0.8	40	:	80	0.005	:	0.01	1	:	2	(3)
Ca	:	Br																
0.2	:	0.8																
40	:	80																
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Question number	Answer	Mark
3(a)	C	(1)

Question number	Answer	Mark
3(b)(i)	(oil well) C	(1)

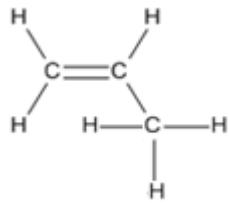
Question number	Answer	Mark
3(b)(ii)	(oil well) A	(1)

Question number	Answer	Additional guidance	Mark
3(c)(i)	<p>An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (2 marks):</p> <ul style="list-style-type: none"> when the decane is heated it vaporises/turns to a gas (1) decane vapour/gas breaks down as it comes in contact with hot porous pot (1) large molecules of decane produce smaller molecules, including ethene (1) 	Do not allow this point if ethane passes over hot porous pot	(3)

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

Question number	Answer	Mark
3(c)(iii)	$2C_{10}H_{22} + 31O_2 \rightarrow 20CO_2 + 22H_2O$ <ul style="list-style-type: none"> LHS (1) RHS both numbers correct (1) 	(2)

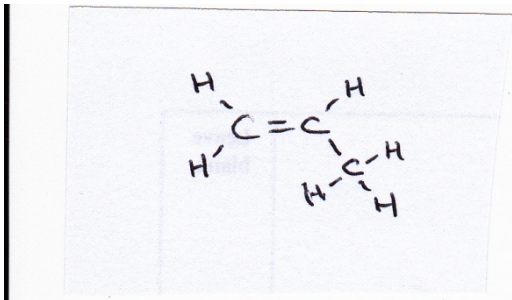
Question number	Answer	Mark
4(a)	C	(1)

Question number	Answer	Additional guidance	Mark
4(b)	<ul style="list-style-type: none"> molecular formula – C₅H₁₀ (1) structure (1) 		(2)

Question number	Answer	Additional guidance	Mark
4(c)(i)	<ul style="list-style-type: none"> calculates relative molecular mass of C₄H₉OH (1) calculates mass of C₄H₉OH produced (1) final answer = 1.9 (kg) (1) 	<p><u>Example of calculation</u></p> <p>Relative molecular mass of C₄H₉OH = (4 × 12) + (9 × 1) + 16 + 1 = 74</p> <p>Mass of C₄H₉OH produced = (74 ÷ 56) × 1.4</p> <p>Accept 1.85 (kg)</p> <p>Award full marks for use of moles/correct numerical answer without working</p>	(3)

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

Question number	Answer	Mark
4(d)	<ul style="list-style-type: none"> 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
6(a)(i)	 <p>one C=C in a three consecutive carbon atom molecule (1)</p> <p>rest of structure correct, ignore bond angles, conditional on first marking point(1)</p>	allow methyl group written as CH ₃	(2)

Question Number	Answer	Acceptable answers	Mark
6(a)(ii)	B C ₇ H ₁₆		(1)

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

Question Number	Indicative Content	Mark
QWC	<p>*6(c)</p> <p>An explanation including some of the following points</p> <p>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</p> $n \begin{array}{c} \text{CH}_3 \quad \text{H} \\ \quad \\ \text{C} = \text{C} \\ \quad \\ \text{H} \quad \text{H} \end{array} \longrightarrow \left(\begin{array}{c} \text{CH}_3 \quad \text{H} \\ \quad \\ -\text{C} - \text{C}- \\ \quad \\ \text{H} \quad \text{H} \end{array} \right)_n$ <p>Properties of poly(propene) with related uses e.g. 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</p>	(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

Question Number	Answer	Acceptable answers	Mark
2(a)(i)	An explanation linking (a compound containing) <ul style="list-style-type: none"> 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
2(a)(ii)	B cracking		(1)

Question Number	Answer	Acceptable answers	Mark
2(a)(iii)	A description to include <ul style="list-style-type: none"> (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
2(b)(i)	D $ \begin{array}{cccc} \text{CH}_3 & \text{H} & \text{CH}_3 & \text{H} \\ & & & \\ -\text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - \\ & & & \\ \text{H} & \text{H} & \text{H} & \text{H} \end{array} $		(1)

Question Number	Answer	Acceptable answers	Mark
2(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
2(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)

Total for Question 2 = 9 marks

Question Number	Answer	Acceptable answers	Mark
5(a)	<u>burns</u> easily / <u>produces</u> little ash / <u>produces</u> little smoke / <u>produces</u> high heat energy (per unit mass) / <u>easy</u> to {store / transport}	'renewable' / few pollutants / few emissions / easy to ignite / burns cleanly Ignore references to cost	(1)

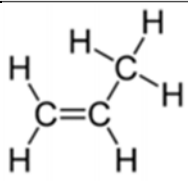
Question Number	Answer	Acceptable answers	Mark
5(b)(i)	An explanation linking <ul style="list-style-type: none"> • an advantage • with a linked reason examples include <ul style="list-style-type: none"> • bioethanol is always available / crude oil is finite (1) • because more sugar beet can be grown / crude oil takes a long time to form / bioethanol conserves crude oil (1) OR <ul style="list-style-type: none"> • bioethanol produces less carbon dioxide (1) • because bioethanol is 'carbon neutral' / ora (1) OR <ul style="list-style-type: none"> • bioethanol uses less energy in production (1) • because fermentation does not require energy / crude oil must be heated to obtain petrol (1) 	allow crops (= sugar beet) allow renewable bioethanol is less polluting	(2)

Question Number	Answer	Acceptable answers	Mark
5(b)(ii)	$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$ (3) lhs (1) rhs (1) balancing correct formulae (1)	allow multiples ignore state symbols even if incorrect.	(3)

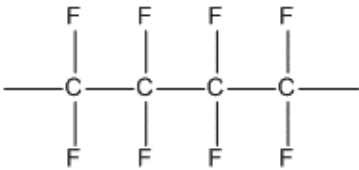
Question Number		Indicative Content	Mark
QWC	*5(c)	<p>An explanation linking some of the following points</p> <p>properties</p> <ul style="list-style-type: none"> • petrol has shorter (carbon) chains /ORA • petrol has lower {melting point / boiling point} / ORA • petrol has lower viscosity / ORA • petrol {ignites / burns} more easily / ORA • bitumen does not combust completely (due to high number of carbon atoms per molecule) • burning bitumen produces lots of carbon monoxide/soot <p>uses of petrol fraction</p> <ul style="list-style-type: none"> • fuels in cars / in motorbikes / transportation <p>uses of bitumen fraction</p> <ul style="list-style-type: none"> • used for road (surfacing) • used for roofing / flooring 	(6)
Level	0	No rewardable content	
1	1 – 2	<ul style="list-style-type: none"> • a limited explanation of petrol or bitumen eg petrol easily ignites • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy 	
2	3 – 4	<ul style="list-style-type: none"> • a simple explanation of at least two properties or uses of petrol or bitumen or a combination of uses and properties eg petrol from the top ignites easily, has a low boiling point and is used as a fuel. • 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	<ul style="list-style-type: none"> • a detailed explanation of at least two different properties of petrol or bitumen and at least one use of petrol and at least one use of bitumen eg petrol has a lower boiling point and is used as a fuel in cars, bitumen is more viscous and is used to surface roads. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors 	

Total for Question 5 = 12 marks

Question Number	Answer	Acceptable answers	Mark
4(a)	D unsaturated hydrocarbons		(1)

Question Number	Answer	Acceptable answers	Mark
4(b)(i)	 <p>one C=C in a three consecutive carbon atom molecule (1)</p> <p>rest of the structure correct (1) conditional on first mark correct</p>	<p>Allow methyl group written as CH₃</p> <p>Ignore bond angles</p> <p>Penalise h/c instead of H/C for M2</p>	(2)

Question Number	Answer	Acceptable answers	Mark
4(b)(ii)	<p>A description including</p> <p>add bromine (water/solution) (1)</p> <p>In propene/alkene: turns colourless/decolourises (1)</p> <p>In propane/alkane: orange/yellow/brown / no change/does not go colourless (1)</p> <p>For incorrect reagent, score 0 (except bromide where M2 and M3 possible)</p>	<p>Ignore bromide for M1 but mark on assuming they meant bromine for M2, M3</p> <p>Ignore clear/ transparent/ discolours</p> <p>Reject incorrect bromine colour for M3 only</p> <p>Ignore red</p> <p>Ignore no reaction</p> <p>Allow 'turns orange'</p> <p>Ignore attempted descriptions (e.g. linking to saturated/unsaturated) even if wrong</p>	(3)

Question Number	Answer	Acceptable answers	Mark
4(c)(i)	 <p>correct repeating unit (any multiple of 2; with or without brackets, continuation bonds or n) (1)</p> <p>two correct units shown with continuation bonds and no "n" (1)</p>	<p>Any answer with one or more double bonds scores (0)</p> <p>Ignore any outside brackets</p>	(2)

Question Number	Answer	Acceptable answers	Mark
4(c)(ii)	<p>(Making) any <u>named object</u> from:</p> <p>pans/kitchen utensils /skis/ bearings /burette taps/ carpets/clothing</p> <p>or</p> <p>as a lubricant</p>	Allow sensible alternatives	(1)

Question Number	Answer	Acceptable answers	Mark
4(d)	<p>Any one from</p> <p>recycle/incinerate/burn/combust</p>	<p>reuse the items made from polymers</p> <p>Allow descriptions e.g. melt AND remould</p>	(1)

Total for Question 4 = 10 marks

Question Number	Answer	Acceptable answers	Mark
6(a)	B boiling point lower than Y, ease of ignition easier than Y, viscosity lower than Y.		(1)

Question Number	Answer	Acceptable answers	Mark
6(b)	$C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$ LHS formulae (1) RHS formulae (1) balancing correct formulae (1)	ignore state symbols Reject incorrect subscripts and cases e.g. CO ² , CO ₂ , Co ₂ Allow multiples, =	(3)

Question Number	Answer	Acceptable answers	Mark
6(c)	An explanation linking any two of the following <u>sulfur dioxide/SO₂</u> (1) (gas) {dissolves in/ reacts with} rain /forms {acid rain/an acid/sulfuric acid} (1) an effect of acid rain eg: harms/kills {fish/plants}/ damages/corrodes metals/ damages/erodes/weathering {statues/ buildings}/ causes {lung damage/ breathing problems} (1)	Ignore sulfur/ sulfur oxide for M1 but mark on Ignore 'pollutes water'/ 'acidifies water/lakes' / damages habitats etc	(2)

Question Number	Indicative Content	Mark
QWC	<p>*6(d) A description/explanation including some of the following points</p> <p>Description of experiment</p> <ul style="list-style-type: none"> •! heat liquid paraffin/ alkane •! (pass paraffin vapour) over hot porcelain/porous pot/catalyst •! collect gas over water <p>Some of these points could be made on a labelled diagram</p> <p>Need for cracking: supply and demand</p> <ul style="list-style-type: none"> •! too little gases / petrol fraction •! high demand for petrol •! there is more of the kerosene fraction than is needed from crude oil to match demand / ORA •! stops over-production / makes better use of kerosene •! produces smaller/ more in demand alkanes / more useful alkanes <p>Need for cracking: properties</p> <ul style="list-style-type: none"> •! shorter molecule easier to ignite etc •! produces alkenes (to make plastics)/ polymers <p>Credit correct diagrams or equations Ignore fractional distillation</p>	(6)
Level	0	No rewardable content
1	1 - 2	<ul style="list-style-type: none"> •! a limited description of the need for cracking or cracking in the laboratory e.g. heat liquid paraffin and pass over catalyst •! the answer communicates ideas using simple language and uses limited scientific terminology •! spelling, punctuation and grammar are used with limited accuracy
2	3 - 4	<ul style="list-style-type: none"> •! a simple description of the need for cracking or cracking in the laboratory e.g explains two advantages/reasons for undertaking cracking •! 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	<ul style="list-style-type: none"> •! a detailed account to include advantages/reasons for cracking and details of the cracking process in the laboratory. •! the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately •! spelling, punctuation and grammar are used with few errors
Total for Question 6 = 12 marks		