Question Number	Answer	Acceptable answers	Mark
1(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
1(b)(i)	An explanation linking • an advantage • with a linked reason examples include • 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 • bioethanol produces less carbon dioxide (1) • because bioethanol is 'carbon neutral' / ora (1) OR • 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
1(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	***1(c)**	An explanation linking some of the following points properties • 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 uses of petrol fraction • fuels in cars / in motorbikes / transportation uses of bitumen fraction • used for road (surfacing) • used for roofing / flooring	**(6)**
Level	**0**	No rewardable content	
1	**1 – 2**	• 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**	• 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**	• 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	

Question Number	Answer	Acceptable answers	Mark
2(a)	**B** the ease of ignition decreases		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(b)	A description linking either • {carbon monoxide / CO} (1) • is toxic / poisonous (1) or • {carbon / soot / C} (1) • causes respiratory problems /particles blocks jets (1)	 can kill combines with haemoglobin(in place of oxygen) blackens buildings	 **(2)**

Question Number	Answer	Acceptable answers	Mark
2(c)(i)	An explanation linking any two of • greenhouse gas (1) • traps heat (in atmosphere) (1) • may lead to increased (global) temperature / global warming (1)	 (increased) greenhouse effect traps infra-red radiation **reject** references to UV increased of global warming e.g climate change **reject** references to ozone layer	 **(2)**

Question Number	Answer	Acceptable answers	Mark
2(c)(ii)	An explanation linking three from • (sulfur reacts/combusts/burns) with {oxygen/air} (1) • (forms) sulfur dioxide (1) • sulfur dioxide {dissolves/reacts} in {rain/water/clouds} / sulfur dioxide forms acid rain (1) • (acid rain) causes damage to buildings/plants/kills fish in lakes (1)		**(3)**

Question Number	Answer	Acceptable answers	Mark
2(d)	A description including two of the following • biofuels are renewable / fossil fuels are finite/biofuels are sustainable /biofuels will not run out (1) • biofuels are produced from plants (1) • growing plants remove carbon dioxide from the atmosphere (1) • reduces demand for fossil fuels (1) • biofuels do not contain impurities such as sulfur (1)	reject biofuels are reusable ignore carbon neutral alone ignore references to cost	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(a)	remove delivery tube from water <u>before stopping heating</u>	other words which make sequence clear use of (Bunsen) valve	(1)

Question Number	Answer	Acceptable answers	Mark
3(b)	B C_4H_8		(1)

Question Number	Answer	Acceptable answers	Mark
3(c)	contains a {double/multiple} bond	ignore "spare bonds" ignore reference to number of hydrogen atoms attached.	(1)

Question Number	Answer	Acceptable answers	Mark
3(d)	A description to include • bromine water is orange (1) • propane: (remains) orange / no colour change (1) • propene: becomes colourless /decolourises (1)	 red / yellow / brown any combination of these ignore clear /discolours	(3)

Question Number	Answer	Acceptable answers	Mark
3(e)	An explanation linking any **two** of • shorter chain molecules are more useful ORA (1) • demand for shorter chain molecules ORA (1) • meets demand • reduces the excess of longer chain molecules (1) • (cracking) produces alkenes (1) • alkenes used to make polymers (1)	reject long chain molecules are useless named fraction/use/fuel named fraction /use/fuel	(2)

Question Number	Answer	Acceptable answers	Mark
4(a)	A description linking **one** from each of the following pairs: Non-renewable • e.g. fossil fuels (1) • when used, not replaced (in a reasonable time) / finite supply (1) Renewable fuels • produced {from plants / electrolysis (to produce hydrogen)} (1) • (therefore) when used, able to be (quickly) replaced (1)	**ignore** can't be used again **ignore** won't run out / infinite supply / can be used again	**(2)**

Question Number		Indicative Content	Mark
QWC	***4(b)**	**An evaluation including some of the following points** **Advantages of bioethanol** • is renewable / petrol is finite / takes a long time to form crude oil • crops to make bioethanol regrown quickly/takes a long time to form crude oil • use reduces demand on fossil fuels • carbon dioxide is removed from air when growing crops (which are used in ethanol production) • may be sulfur impurities in petrol, none in ethanol / ethanol is less polluting than petrol (does not produce sulphur dioxide) • ethanol burns more completely, petrol does not **Disadvantages of bioethanol** • less readily available than petrol / fewer filling stations than for petrol (in UK but not in some countries) • lots of crops needed to generate sufficient fuel to replace petrol • less farmland available for growing food crops • currently few cars are built to run on bioethanolbioethanol fuel (in cars) runs out faster / over shorter distances / less energy efficient	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. using ethanol conserves oil deposits • 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 description e.g. growing plants gives continuous supply of bioethanol but petrol comes from crude oil which is finite • 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 description e.g. growing plants remove carbon dioxide from the air but lots of crops are needed to make sufficient bioethanol to replace petrol therefore less land to grow food crops • 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
4(c)(i)	$2\ H_2 + O_2 \rightarrow 2\ H_2O$ (3) or left hand side – $H_2 + O_2$ (1) right hand side - H_2O (1) balancing - 2 (H_2) ... 2 (H_2O) (1)	$H_2 + ½\ O_2 \rightarrow H_2O$ (3)	**(3)**

Question Number	Answer	Acceptable answers	Mark
4(c)(ii)	Any **one** from the following points • requires {electricity / energy} for electrolysis (1) • must be stored in {heavy / strong / pressurised} cylinders (1) • gas can escape easily (1) • fewer fuel stations (1)		**(1)**