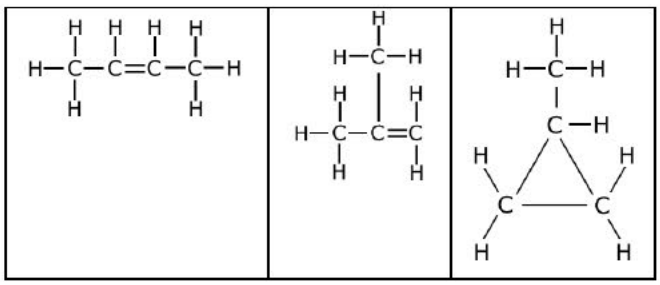
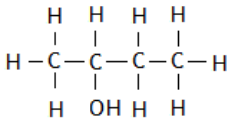
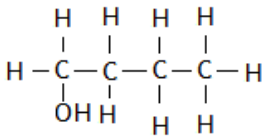
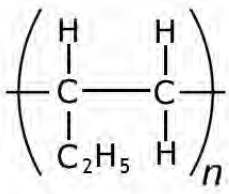
Question number	Answer	Notes	Marks
1 (a) (i)	**M1** (compounds/molecules with the) same molecular formula /same number of each type of atom	Ignore references to chemical/general/empirical formula If use elements/atoms instead of compounds/molecules can score M2 only Allow reference to isomers in question ie have same number of carbon and hydrogen (atoms as each other)	2
	M2 but different displayed formula / structural formula / structures / arrangement of atoms	Ignore atoms in different order Ignore references to stereoisomerism	
(ii)		Accept structure of trans but-2-ene Ignore bond angles	1
	Any one for 1 mark		
(iii)	**M1** (Reagent) – bromine (water)		3
	M2 (But-1-ene) – goes (from orange) to colourless	accept decolourised Ignore clear/discolours	
	M3 (cyclobutane) – no change (unless UV light present)	accept stays orange ignore no reaction If start with bromine (water) in presence of UV light then scores 0/3	

(b)	(i)	 OR 	Allow -O-H and -OH but not -HO	1
	(ii)	 **M1** correct formula of repeat unit (with carbon to carbon single bond) **M2** brackets <u>and</u> continuation bonds <u>and</u> n	Accept displayed C_2H_5 Accept C_2H_5 on either C Allow if more than one monomer correctly joined together Accept n anywhere after brackets but not before M2 dep on M1or near miss	2

Question number	Answer	Notes	Marks
2 a i	C (C_2H_4)		1
ii	B (colourless)		1
iii	A (dehydration)		1
b i	cracking		1
ii	(to act as a) catalyst OR to increase rate / speed up reaction	Accept (to provide an alternative route with) lower activation energy Accept decomposition / cracking in place of reaction	1
iii	cracking produces 2 or more products OR other products are formed OR identified possible product OR not all decane decomposed OR water vapour present (not just water)	Accept molecules / hydrocarbons /alkanes / alkenes in place of products Accept any hydrogen and any hydrocarbon with 8 or fewer carbon atoms (name or formula) Ignore decane decomposes / decane contains impurities Ignore references to air / oxygen / nitrogen / carbon dioxide Accept equation for cracking of decane showing two or more possible products (even if unbalanced)	1
			Total 6 marks

Question number	Answer	Notes	Marks
3 (a)	(refinery) gases		1
(b)	bitumen		1
(c) (i)	$C_{18}H_{38} \rightarrow C_8H_{18} + C_{10}H_{20}$ **OR** $C_{18}H_{38} \rightarrow C_8H_{18} + 2C_5H_{10}$ **OR** $C_{18}H_{38} \rightarrow C_8H_{18} + 5C_2H_4$		1
(ii)	**Any two from:** M1 over/greater supply of long chain hydrocarbons/molecules/ heavy/heavier fractions / OWTTE M2 high(er) demand/more use for short-chain/small hydrocarbons/ light/lighter fractions/ OWTTE M3 reference to a use eg the alkenes produced can be used to make polymers/plastics / eg the short-chain (saturated) hydrocarbons used as fuels	Accept reverse argument eg not enough short chain hydrocarbons Accept specific alkene and product eg ethene to make poly(ethene)/ethanol/alcohol Accept answers in terms of gasoline/petrol / fuel (for cars)	2
(d)	$C_8H_{18} + 8\frac{1}{2}O_2 \rightarrow 8CO + 9H_2O$ **M1** correct formula for CO **M2** correct balanced equation **M2** dep on **M1**	Allow multiples Accept balanced equations containing CO as well as C and/or CO_2 eg $C_8H_{18} + 6.5O_2 \rightarrow 4CO + 4C + 9H_2O$	2

Question number	Answer	Accept	Reject	Marks
4 (a)	it /gasoline is used (as a fuel) for cars ignore references to uses of fuel oil and gasoline burning better	there are more cars than ships	Any other wrong use, eg domestic heating, aeroplanes, ships, etc	1
(b) (i)	C_4H_8	$2C_2H_4$		1
(ii)	Catalyst - silica / silicon dioxide / silicon(IV) oxide / alumina / aluminium oxide	zeolite(s) / aluminosilicates		1
	Temperature – 600 – 700(°C) If more than catalyst given, all must be correct	Any temperature or any range within 600-700(°C) Equivalent temperatures in Kelvin		1

Question number	Answer	Accept	Reject	Marks
4 (c) (i)	Cracking – any two from: • continuous process • pure(r) product • fast(er) process • takes place on large(r) scale • high(er) percentage yield • 100% atom economy ignore references to cost			2
(ii)	Fermentation – any two from: • sugar is a renewable resource / uses a renewable resource • country has suitable climate/ enough land to grow sugar cane / plentiful supply of sugar (cane) • country has no / little crude oil • (ethanol produced) suitable for making alcoholic drinks / vinegar • takes place at lower temperature / uses less energy ignore references to cost		reusable resource	2
			Total	8