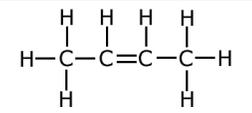
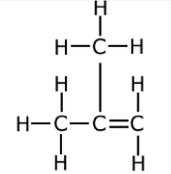
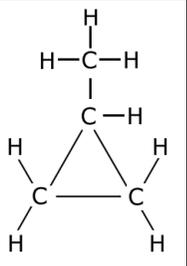


Question number	Answer	Notes	Marks
1 (a) (i)	<p>M1 (compounds/molecules with the) same molecular formula /same number of each type of atom</p> <p>M2 but different displayed formula / structural formula / structures / arrangement of atoms</p>	<p>Ignore references to chemical/general/empirical formula 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)</p> <p>Ignore atoms in different order Ignore references to stereoisomerism</p>	2
(ii)	<div style="display: flex; justify-content: space-around; border: 1px solid black; padding: 5px;"> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> </div> <p>Any one for 1 mark</p>	<p>Accept structure of trans but-2-ene Ignore bond angles</p>	1
(iii)	<p>M1 (Reagent) – bromine (water)</p> <p>M2 (But-1-ene) – goes (from orange) to colourless</p> <p>M3 (cyclobutane) – no change (unless UV light present)</p>	<p>accept decolourised Ignore clear/discolours</p> <p>accept stays orange ignore no reaction</p> <p>If start with bromine (water) in presence of UV light then scores 0/3</p>	3

<p>(b) (i)</p>	$ \begin{array}{cccc} & \text{H} & \text{H} & \text{H} & \text{H} \\ & & & & \\ \text{H} & -\text{C} & -\text{C} & -\text{C} & -\text{C}-\text{H} \\ & & & & \\ & \text{H} & \text{OH} & \text{H} & \text{H} \end{array} $ <p>OR</p> $ \begin{array}{cccc} & \text{H} & \text{H} & \text{H} & \text{H} \\ & & & & \\ \text{H} & -\text{C} & -\text{C} & -\text{C} & -\text{C}-\text{H} \\ & & & & \\ & \text{OH} & \text{H} & \text{H} & \text{H} \end{array} $	<p>Allow -O-H and -OH but not -HO</p>	<p>1</p>
<p>(ii)</p>	$ \left(\begin{array}{cc} \text{H} & \text{H} \\ & \\ -\text{C} & -\text{C}- \\ & \\ \text{C}_2\text{H}_5 & \text{H} \end{array} \right)_n $ <p>M1 correct formula of repeat unit (with carbon to carbon single bond)</p> <p>M2 brackets <u>and</u> continuation bonds <u>and</u> n</p>	<p>Accept displayed C₂H₅</p> <p>Accept C₂H₅ on either C Allow if more than one monomer correctly joined together</p> <p>Accept n anywhere after brackets but not before</p> <p>M2 dep on M1 or near miss</p>	<p>2</p>

Question number	Answer	Notes	Marks
2 a i	C (C ₂ H 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)	<p>Any two from:</p> <p>M1 over/greater supply of long chain hydrocarbons/molecules/ heavy/heavier fractions / OWTTE</p> <p>M2 high(er) demand/more use for short-chain/small hydrocarbons/ light/lighter fractions/ OWTTE</p> <p>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</p>	<p>Accept reverse argument eg not enough short chain hydrocarbons</p> <p>Accept specific alkene and product eg ethene to make poly(ethene)/ethanol/alcohol Accept answers in terms of gasoline/petrol / fuel (for cars)</p>	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	<p>Allow multiples</p> <p>Accept balanced equations containing CO as well as C and/or CO₂ eg $C_8H_{18} + 6.5O_2 \rightarrow 4CO + 4C + 9H_2O$</p>	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 ₄ H ₈	2C ₂ H ₄		1
(ii)	Catalyst - silica / silicon dioxide / silicon(IV) oxide / alumina / aluminium oxide Temperature – 600 – 700(°C) If more than catalyst given, all must be correct	zeolite(s) / aluminosilicates Any temperature or any range within 600-700(°C) Equivalent temperatures in Kelvin		1 1

Question number	Answer	Accept	Reject	Marks
4 (c) (i)	Cracking – any two from: <ul style="list-style-type: none"> • 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)		reusable resource	2
			Total	8