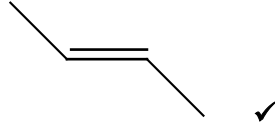


Question		Expected Answers	Marks	Additional Guidance
1	(a)	Respiration ✓	1	IGNORE anaerobic
	(b) (i)	$100 \times 4.18 \times 17.3$ ✓ 7.23 (kJ) ✓	2	ALLOW 7231 J ✓ ALLOW 7.23 with no working out ALLOW from 7.2 up to calculator value of 7.2314 ALLOW from 0.060 up to calculator value for 1 mark (i.e. ECF from use of $m = 0.831$ in first stage) IGNORE sign
	(ii)	$M_r = 180$ ✓ amount = 4.62×10^{-3} (mol) ✓	2	ALLOW 4.6×10^{-3} OR 4.62×10^{-3} OR 4.617×10^{-3} up to calculator value DO NOT ALLOW 0.005 ALLOW ECF from wrong M_r
	(iii)	$\Delta H_c = 1560$ (kJ) OR 1570 (kJ) but answer must be to 3 sig fig ✓ minus sign ✓	2	ALLOW ECF from 'answer to (i) ÷ answer to (ii)' but answer must be to 3 sig fig minus mark is an independent mark

Question		Expected Answers	Marks	Additional Guidance
	(c)	+1250 ✓ +(-394 × 6) + (-286 × 6) OR -4080 ✓ -2830 ✓	3	ALLOW full marks for -2830 with no working out ✓✓✓ ALLOW for 2 marks: +2830 cycle wrong way around OR 1400 OR 860 one value not × 6 OR -5330 OR +5330 wrong sign for 1250 or 4080 OR +570 ✓✓ correct cycle but not × 6 ALLOW for 1 mark: -1400 OR -860 cycle wrong way around and one value not × 6 OR -570 cycle wrong way around and not × 6 OR -1930 OR +1930 ✓ wrong sign and not × 6 Note: There may be other possibilities.
	(d)	Any two from the following: Heat released to the surroundings ✓ Incomplete combustion OR incomplete reaction OR not everything burns ✓ Non-standard conditions ✓	2	ALLOW heat loss IGNORE reference to evaporation
		Total	12	

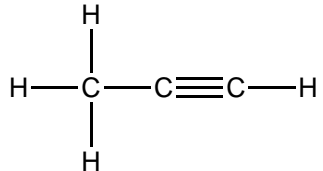
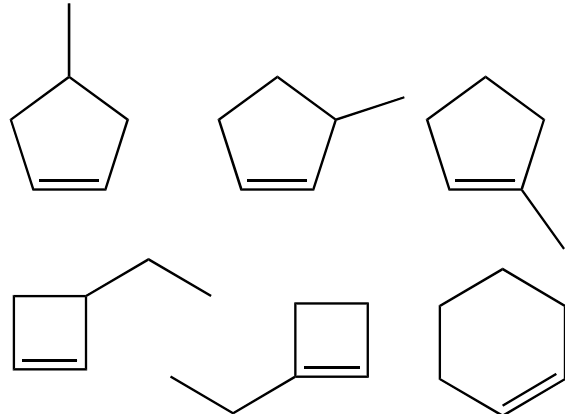
Question		Answer	Marks	Guidance
2	(a)	alkene ✓ ester ✓	2	ALLOW carbon-carbon double bond OR a C-C <u>double</u> bond A double bonded carbon is not sufficient C=C is not sufficient Carbon-carbon multiple bond is not sufficient Ketone / carbonyl / aldehyde / carboxylic acid contradicts the ester mark
	(b)	contains a C=C bond ✓	1	Contains a double bond is not sufficient Carbon-carbon multiple bond is not sufficient DO NOT ALLOW contains a C=O bond
	(c)	(from) orange (to) colourless ✓	1	ALLOW shades of orange OR yellow OR brown ALLOW orange to decolourised DO NOT ALLOW red alone DO NOT ALLOW any response that includes precipitate OR solid, irrespective of colour DO NOT ALLOW clear for colourless
	(d)	(i)		Same structural formula AND different arrangement (of atoms) in space OR different spatial arrangement ✓
			1	ALLOW have the same structure/displayed formula/skeletal formula DO NOT ALLOW same empirical formula OR same general formula Stereoisomers have the same formula or molecular formula is not sufficient Different three dimensional arrangement is not sufficient Reference to <i>E/Z</i> isomerism or optical isomerism is not sufficient

Question		Answer	Marks	Guidance
(d)	(ii)		1	<p>Any writing must not contradict the diagram</p> <p>IGNORE any other feature of the structure drawn</p> <p>ALLOW the J will be the <i>E</i> isomer and I is the <i>Z</i> isomer</p> <p>ALLOW the J will be the <i>trans</i> isomer and I is the <i>cis</i> isomer</p> <p>ALLOW a description, eg the other isomer will have (carbon) chains diagonally arranged across the C=C or the other isomer will have hydrogen atoms diagonally arranged across the C=C bond</p> <p>DO NOT ALLOW draw <i>trans</i> but label as <i>cis</i></p>
(e)	(i)	<p>(Enthalpy change that occurs) when one mole of a substance ✓</p> <p>completely combusts OR reacts fully with oxygen ✓</p>	2	<p>ALLOW energy required OR energy released</p> <p>ALLOW (energy change) when one mole of an element / compound / molecule / reactant</p> <p>DO NOT ALLOW one mole of reactants / product / substances / fuel / atoms</p> <p>ALLOW combusts in excess oxygen</p> <p>ALLOW burns in excess oxygen</p> <p>DO NOT ALLOW combust in excess air</p> <p>IGNORE fully oxidised</p> <p>IGNORE any conditions stated</p>

Question		Answer	Marks	Guidance
(e)	(ii)	<p>FIRST, CHECK THE ANSWER ON ANSWER LINE IF answer = 7.06(42), award 2 marks. IF answer = 7.1, award 1 mark.</p> <p>$q = 50.0 \times 4.18 \times 33.8$ OR 7064.2 (J) ✓ = 7.06(42) (kJ) ✓</p>	2	<p>ALLOW 7.06 up to calculator value of 7.0642 correctly rounded</p> <p>DO NOT ALLOW ECF from marking point 1 IGNORE negative sign in answer</p>
	(iii)	<p>FIRST, CHECK THE ANSWER ON ANSWER LINE IF answer = 0.005(00), award 2 marks.</p> <p>$M_r = 268.0$ ✓ amount used = 0.005(00) (mol) ✓</p>	2	<p>IF there is an alternative answer, check to see if there is any ECF credit possible using working below</p> <p>ALLOW 268</p> <p>ALLOW 5×10^{-3} ALLOW ECF from incorrect M_r IGNORE trailing zeros</p>
	(iv)	<p>FIRST, CHECK THE ANSWER ON ANSWER LINE IF answer = -1413, award 3 marks. IF answer = 1413, award 2 marks.</p> <p>$\Delta H = \frac{\text{answer to (ii)}}{\text{answer to (iii)}}$ OR $\frac{7.0642}{0.005}$ ✓ 1413 ✓ minus sign (this is an independent mark) ✓</p>	3	<p>IF there is an alternative answer, check to see if there is any ECF credit possible using working below</p> <p>ALLOW ECF from (ii) and (iii)</p> <p>ALLOW 1410 up to calculator value of 1412.84 correctly rounded ALLOW answers in standard form 1.41×10^3 up to calculator value of 1.41284×10^3 correctly rounded</p> <p>Answer must be at least three significant figures</p> <p>ALLOW 1412 if answer to (ii) is 7.06 ALLOW 1420 if answer to (ii) is 7.1</p>

Question		Answer	Marks	Guidance
	(e) (v)	incomplete combustion OR not sufficient oxygen available AND carbon is formed ✓	1	IGNORE soot is formed, carbon monoxide is formed or carbon dioxide is formed
	(f)	$C_6H_{12}O_6 \rightarrow 2CO_2 + 2C_2H_5OH$ ✓ use of yeast OR zymase ✓ anaerobic OR absence of oxygen OR any temperature between 20 and 45 °C OR water OR aqueous ✓	3	ALLOW correct molecular OR structural OR displayed OR skeletal formula OR mixture of the above (as long as unambiguous) IGNORE state symbols Enzyme is not sufficient DO NOT ALLOW acid catalyst If there is a contradiction or an incorrect answer in any condition given then do not award this mark. ALLOW room temperature Temperature quoted must include unit ALLOW conditions shown in the equation IGNORE warm temperature IGNORE heat / warm Body temperature is not sufficient A limited supply of oxygen is not sufficient IGNORE low pressure OR atmospheric pressure DO NOT ALLOW high pressure OR a pressure above 2 atmospheres
Total			19	

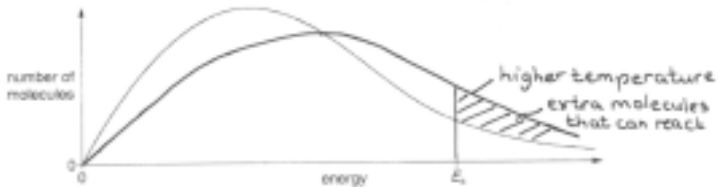
Question			Expected Answers	Marks	Additional Guidance
3	a	i	Series having same functional group and a general formula ✓	1	ALLOW same functional group and members vary by CH ₂ ALLOW organic compounds with the same functional group that differ in length of their hydrocarbon chain
		ii	More surface contact OR bigger molecules ✓ More van der Waals' forces ✓	2	BOTH answers need to be comparisons ALLOW higher relative formula mass OR has more electrons OR longer chain length OR more carbon atoms IGNORE surface area / bigger compounds ALLOW stronger van der Waals' forces / stronger induced dipoles VDW forces is not sufficient More intermolecular forces is not sufficient DO NOT ALLOW breaking bonds within the chain / breaking covalent bonds IGNORE reference to bonds if not linked to covalent bonds
	b	i	Pent-1-yne OR pent-2-yne ✓	1	ALLOW pentyne Look for answer in the table if not on answer line but answer line takes precedence
		ii	C _n H _{2n-2} ✓	1	ALLOW C _n H _{2(n-1)}

Question		Expected Answers	Marks	Additional Guidance
b	iii	Correct displayed formula ✓	1	
	iv	Correct skeletal formula of cyclic hydrocarbon with formula C_6H_{10} ✓	1	<p>Examples of correct skeletal formulae include</p> 
c		<p>Energy required to break bonds = (+) 2912 ✓</p> <p>Energy released to make bonds = (-)4148 ✓</p> <p>Enthalpy of combustion = -1236 ✓</p>	3	<p>ALLOW full marks for correct answer with no working out</p> <p>ALLOW $(2 \times 415) + (837) + (2.5 \times 498)$</p> <p>ALLOW $(4 \times -805) + (2 \times -464)$</p> <p>OR $(4 \times 805) + (2 \times 464)$</p> <p>ALLOW ECF for calculation of enthalpy of combustion</p> <p>ALLOW 2 marks for +1236 with no working out</p>

Question		Expected Answers	Marks	Additional Guidance
d	i	(Enthalpy change) when one mole of a compound ✓ is made from its elements (in their standard states) ✓ (Standard conditions are) 298 K and 100 kPa ✓	3	IGNORE energy required / energy released ALLOW (energy change) when one mole of a substance DO NOT ALLOW enthalpy change for one mole of products ALLOW 1 atmosphere pressure / 101 kPa / 10^5 Pa / $1.01 \times 10^5 \text{ Nm}^{-2}$ / 1000 millibars / 25 °C / any stated temperature in words IGNORE 1 mol dm^{-3} for solutions
	ii	From energy cycle Enthalpy change to get elements = $-(-60) - (2 \times -286) / (+) 632$ ✓ Enthalpy change from elements = $-987 + (+227) / (-)760$ ✓ Enthalpy change = -128 ✓	3	ALLOW full marks for -128 with no working out ALLOW ECF from errors in calculation ALLOW two marks for answer of $-414 / +128 / -1392 / +1392$ ALLOW one mark for answer of $+414$
e	i	$\frac{26.0}{100.1} \times 100$ 100.1 ✓ 26.0% ✓	2	First mark for 100.1 OR $(64.1 + 36.0)$ OR $(74.1 + 26.0)$ at bottom of fraction with or without $\times 100$ ALLOW full marks for 26.0 or 26% with no working out ALLOW from two significant figures up to calculator value ALLOW 25.97 / 26% NO ECF for this part from incorrect numbers in first expression

Question		Expected Answers	Marks	Additional Guidance
e	ii	1.56×10^4 OR 15600 OR 15601 ✓	1	ALLOW calculator value of 15600.62402 and any rounded value to a minimum of three significant figures
	iii	1.5×10^4 OR 15000 ✓	1	ALLOW 1.50×10^4 etc.
	iv	96.2 ✓	1	ALLOW ECF from (iii) ÷ (ii) ALLOW calculator value 96.1538461 and any rounded value to a minimum of two significant figures ALLOW 96.14768284 if 15601 is used ALLOW any value between 88 to 89 if answer to (iii) was calculated by dividing by 26
	v	Any two from: Low atom economy gives a poor sustainability OR low atom economy means lots of waste ✓ A use for the aqueous calcium hydroxide needs to be developed to increase atom economy ✓ Alternative process needs to be developed with high atom economy ✓	2	ANNOTATE WITH TICKS AND CROSSES IGNORE comments about percentage yield ALLOW ECF from (i) e.g. high atom economy will have good sustainability ALLOW find a use for the waste to increase atom economy
Total			23	

Question			Expected Answers	Marks	Additional Guidance
4	(a)	(i)	$2\text{H}_2\text{O}_2 \longrightarrow 2\text{H}_2\text{O} + \text{O}_2$ ✓	1	ALLOW any correct multiple including fractions IGNORE state symbols
		(ii)	More crowded particles OR more particles per (unit) volume ✓ more collisions per second OR more frequent collisions ✓	2	ALLOW particles are closer together DO NOT ALLOW 'area' instead of 'volume' IGNORE 'more concentrated particles' ALLOW collisions more often OR increased rate of collision OR collisions are more likely OR there is a greater chance of collisions 'More collisions' is not sufficient
		(iii)	Any two from the following: Reaction takes alternative route ✓ Activation energy is lowered ✓ More molecules have energy above activation energy OR more molecules have enough energy to react ✓	2	ALLOW catalyst changes reaction mechanism ALLOW an alternative approach using adsorption particles adsorbed onto surface ✓ so bonds weakened as a result of the adsorption ✓

Question		Expected Answers	Marks	Additional Guidance
	(iv)	<p>Correct curve for higher temperature ✓</p> <p>Activation energy does not change OR clearly labelled on diagram, e.g. E_a OR E ✓</p> <p>More molecules have energy above activation energy OR more molecules have enough energy to react ✓</p>	3	<p>maximum of curve to right AND lower than maximum of original curve AND above dotted line at higher energy as shown in diagram below</p> <p>IGNORE minor point of inflexion of curve</p>  <p>Note that the diagram above would score all 3 marks</p> <p>More successful collisions is not sufficient</p>
(b)	(i)	<p>$\frac{34.0}{267.4} \times 100$ ✓</p> <p>12.7% ✓</p>	2	<p>First mark for 267.4 OR (34.0 + 233.4) OR (169.3 + 98.1) at bottom of fraction with or without $\times 100$</p> <p>ALLOW from 2 sig figs up to calculator value ALLOW full marks for 13 OR 12.7 OR 12.72 OR 12.715 up to calculator value with no working out 12.71 scores one mark only NO ECF for this part from incorrect numbers in first expression</p>

Question		Expected Answers	Marks	Additional Guidance
	(ii)	<p>Any three from the following:</p> <p>Oxygen comes from air ✓</p> <p>No poisonous materials formed OR no poisonous materials involved ✓</p> <p>No waste products formed OR atom economy is 100% ✓</p> <p>Anthraquinone is regenerated OR recycled OR used again OR Anthraquinone acts as a catalyst ✓</p>	3	<p>IGNORE hydrogen comes from the air</p> <p>IGNORE harmful</p> <p>ALLOW higher atom economy</p>
	(c)	<p>Bond breaking absorbs energy AND bond making releases energy ✓</p> <p>More energy released than absorbed ✓</p>	2	<p>ALLOW bond breaking is endothermic AND bond making is exothermic</p> <p>ALLOW exothermic change transfers more energy than endothermic change OR bond making transfers more energy than bond breaking OR '(the sum of the) bond enthalpies in the products is greater than the (sum of the) bond enthalpies in the reactants' OR '(the sum of the) bond enthalpies of the bonds made is greater than (the sum of) the bond enthalpies of the bonds broken'</p> <p>IGNORE reference to strong and weak bonds</p> <p>IGNORE enthalpy of products is less than enthalpy of reactants</p>
		Total	15	