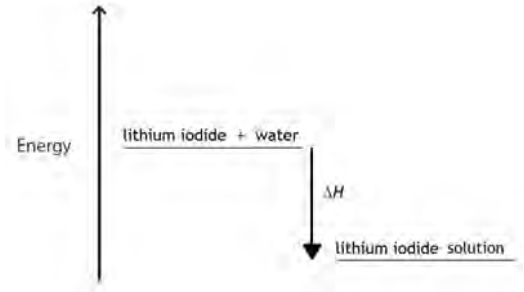
Question number				Answer	Notes	Marks
1	a		**M1** **M2** **M3**	(after) 22.3 (before) 16.7 (change) (+)5.6	All answers must be to 0.1 °C Penalise addition of trailing zero once only Award 1 mark for two correct readings in the wrong order **M3** CQ on temperature readings Ignore units	3
	b	i	**M1** **M2**	100 × 4.2 × 4.9 2058	Accept answer to 2 or 3 sf eg 2060 / 2100 Accept answer in kJ if unit given Ignore signs Allow 1 mark for correct calculation based on incorrect temperature change	2
		ii	**M1** **M2**	$\frac{6.3}{134}$ 0.047	 Accept 1 or more sig figs, eg 0.05 Correct answer with no working scores 2	2

Question number				Answer	Notes	Marks
	c	i	**M1** **M2**	$\frac{2400}{0.048 \times 1000}$ 50	Accept 50.0 and 50.00 Award 1 mark for 50 000 Award 2 marks for 50 000 if units changed to J/mol on answer line Ignore signs Correct answer with no working scores 2	2
	c	ii			Mark M1 and M2 independently **M1** for horizontal line drawn below (labelled or unlabelled) **M2** for (vertical) line connecting the two horizontal lines AND labelled Δ*H* (ignore sign) Ignore all arrow heads Ignore curves for energy profiles including activation energy	2
						Total 11 marks

Question number	Answer	Notes	Marks
2 a	18.7	Give 1 mark for 18.7 and 27.2 wrong way around	1
	27.2		1
	M2−M1 / (+)8.5		1
b i	1450 ÷ 24000		1
	0.0604(16)	Accept minimum of 2 dp Award 1 mark for a correct answer using a volume from either experiment 2 or 3	1
ii	29.2 ÷ M2 from (b)(i) / 29.2 ÷ 0.0604(16)	Accept 29200 ÷ 0.0604	1
	(−)483(.315678)	Final answer in joules scores 1/2	1
iii	200 × 4.2 × 41.2		1
	(−)34608	Accept minimum of 2 sf Award 1 mark for a correct calculation using 1875 for the volume of water.	1
iv	cross in box **B** (not all of the heat energy is transferred to the water)		1

2	c	i	(4 × C-H) + (2 × O=O) 2640	Accept (4 × 412) + (2 × 496) / 1648 + 992 Deduct 1 mark for each mistake Ignore sign	1 1
		ii	(2 × C=O) + (4 × H–O) 3338	Accept (2 × 743) + (4 × 463) / 1486 + 1852 Deduct 1 mark for each mistake Ignore sign	1 1
		iii	– 698 (kJ/mol)	CSQ on answers given to (c)(i) and (c)(ii)	1

(Total for Question 2 = 15 marks)

Question number			Answer	Notes	Marks
3	(a		M1 decrease M2 no effect M3 increase		3
	(b)		M1 amount of pentane = 1.88 ÷ 72 / 0.026 (mol) M2 molar enthalpy change = 51900 ÷ 0.026 / 1996153 J M3 (-)2000 (kJ/mol)	Accept answer in kJ Correct final answer with correct units scores (3) Accept 2 or more significant figures Accept answer in range 1987 - 2000	3
				Total for Question 3	**6**

Question number	Answer	Accept	Reject	Marks
4 (a)	**M1** temperature after: 27.1 **M2** temperature before: 18.8 **M3** temperature change: (+) 8.3 Recorded temperatures correct but in wrong order scores 1 for **M1** and **M2** **M3** csq on **M1** and **M2**	one trailing zero	more than one trailing zero	3
(b)	**M1** heat (energy) /thermal energy lost (to the atmosphere) ignore just energy lost **M2** potassium hydroxide dissolves (very/too) slowly	water evaporates potassium hydroxide does not completely dissolve potassium hydroxide is impure less than 3 g of potassium hydroxide is used more than 50 cm^3 of water is used		2

Total 5 marks