

Heat Energy Past Paper Answers IGCSE Edexcel

1.

Question number	Answer	Notes	Marks
(a) (i)		curve from reactant level to product level with peak below that of original (1)	1
(ii)		M1 for approximately vertical line/arrow between reactant level and product level labelled ΔH /enthalpy change/ -9 kJ/mol M2 for approximately vertical line/arrow between reactant level and peak of <u>candidate</u> curve labelled E_{act} /activation energy M1 and M2 CQ candidate curve	2
(b) (i)	rate decreases / OWTTE	Allow (reaction is) slower Allow reaction takes longer Ignore references to yield / position of equilibrium	1
(ii)	M1 (at lower temperature equilibrium position shifts to right so yield of hydrogen iodide) increases M2 because (forward) reaction is exothermic	Ignore ΔH is negative Accept backward reaction is endothermic Ignore because reaction moves in exothermic direction Ignore references to Le Chatelier's principle e.g. decrease in temperature favours exothermic reaction M2 DEP M1	2

Question number	Answer	Notes	Marks
(c) (i)	(rate) decreases / OWTTE	Allow (reaction is) slower Allow reaction takes longer (to reach equilibrium) Ignore references to yield / position of equilibrium	1
(ii)	M1 (decrease in pressure has) no effect (on yield of hydrogen iodide) M2 because equal numbers of (gas) moles/molecules on both sides	Allow no change Ignore has no effect on other factors e.g. equilibrium (position) Ignore references to rate Allow (gas) particles for moles/molecules M2 DEP M1	2

2.

<p>M1 $\Sigma(\text{bonds broken}) = 436 + 193$</p> <p>OR 629 (kJ/mol)</p> <p>M2 $\Sigma(\text{bonds made}) = 2 \times 366$</p> <p>OR 732 (kJ/mol)</p> <p>M3 $\Delta H = -103$ (kJ/mol) OR</p> <p>M1 – M2 evaluated correctly with the correct sign</p>	<p>IGNORE any signs in M1 and M2</p> <p>negative sign required</p> <p>–103 with or without working scores 3</p> <p>(+)103 with or without working scores 2</p>	3
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3.

Question number	Answer	Notes	Marks
6 (a) (i)	<p>M1 volume of water</p> <p>M2 temperature of water before and after burning</p>	<p>ALLOW mass of water</p> <p>ALLOW temperature change</p>	2
(ii)	<p>M1 $n[\text{heptanol}] = 0.75 \div \text{Mr}$ OR evaluated correctly and quoted to at least two significant figures</p> <p>M2 $19 \div \text{M1}$</p> <p>M3 evaluated correctly and quoted to at least two significant figures</p> <p>OR</p> <p>M1 (0.75g produces 19kJ) so 1g produces $19 \div 0.75 = 25.33\dots$ (kJ)</p> <p>M2 so 114g produces $114 \times 25.33\dots$</p> <p>M3 evaluated correctly and quoted to at least two significant figures</p>	<p>calculator answer from 114 is 0.0065789473684 (mol) calculator answer from 116 is 0.0064655172</p> <p>calculator answer from 114 is 2888 (kJ/mol) = 2900 (kJ/mol) to 2 sig fig calculator answer from 116 is 2938.66 (kJ/mol) = 2900 (kJ/mol) to 2 sig fig</p> <p>IGNORE sign in final answer</p> <p>from 114 calculator the answer is 2888 (kJ/mol) = 2900 (kJ/mol) to 2 sig fig</p> <p>IGNORE sign in final answer</p> <p>correct answer with no working scores 3</p>	3

Question number	Answer	Notes	Marks
(b) (i)	<p>M1 $\Sigma(\text{bonds broken}) = [(2 \times 436) + 498]$ OR 1370 (kJ)</p> <p>M2 $\Sigma(\text{bonds formed}) = 4 \times 464$ OR 1856 (kJ)</p> <p>M3 $\Delta H = - 486$ (kJ)</p> <p>OR</p> <p>if M1 and/or M2 incorrect:</p> <p>M3 numerical difference between M1 and M2</p> <p>If M2 greater than M1 answer must be negative</p> <p>If M2 less than M1 answer must be positive</p>	<p>IGNORE sign</p> <p>IGNORE sign</p> <p>negative sign is required</p> <p>-486 with or without working scores 3</p> <p>(+)486 with or without working scores 2</p> <p>unless a clear statement is made that reaction is exothermic then sign can be negative</p>	3

Question number	Answer	Notes	Marks
(b) (ii)	M1 for $2\text{H}_2 + \text{O}_2$ and $2\text{H}_2\text{O}$ in correct positions M2 ΔH correctly placed and labelled	ALLOW hydrogen and oxygen and water ALLOW reactants and products Mark CQ on sign in (i) ACCEPT ΔH label on vertical line/double arrow/arrow pointing from reactants level to product level REJECT arrow pointing from products level to reactants level IGNORE activation energy	2

4.

Question number	Answer	Notes	Mar						
(a)	<table border="1"> <tr> <td>Temperature after in °C</td> <td>32.5</td> </tr> <tr> <td>Temperature before in °C</td> <td>(27.0)</td> </tr> <tr> <td>Change in temperature in °C</td> <td>(+)5.5</td> </tr> </table>	Temperature after in °C	32.5	Temperature before in °C	(27.0)	Change in temperature in °C	(+)5.5	<p>M1 32.5</p> <p>M2 5.5</p> <p>ALLOW M2 ECF from M1</p>	2
Temperature after in °C	32.5								
Temperature before in °C	(27.0)								
Change in temperature in °C	(+)5.5								
(b) (i)	<p>M1 EITHER</p> <p>size/surface area (of metal)</p> <p>OR</p> <p>amount / number of moles (of metal)</p> <p>AND Any TWO from</p> <p>M2 concentration of acid</p> <p>M3 volume of acid</p> <p>M4 rate/time of stirring</p>	<p>IGNORE volume of metal</p> <p>IGNORE mass of metal</p> <p>ALLOW amount of acid</p> <p>ALLOW starting temperature</p>	3						
(ii)	<p>M5 external/room temperature the more reactive the metal the greater the temperature rise</p>	<p>ACCEPT reverse argument</p> <p>IGNORE reactivity is proportional to temperature rise</p>	1						
(iii)	<p>no reaction (takes place)/ gold does not react (with hydrochloric acid)</p>	<p>IGNORE gold is (too) unreactive/not reactive enough</p>	1						

5.

Question number	Answer	Notes	Marks
(a)	<p>M1 use the <u>burette</u> to add the (sulfuric) acid (to the sodium hydroxide)</p> <p>M2 until there is a change in colour (of the indicator/methyl orange/solution)</p> <p>M3 take initial and final readings of acid (and subtract to calculate the volume added)</p> <p>Plus any one from:</p> <p>M4 add acid dropwise (when near to the end point)</p> <p>M5 swirl the solution (when near to the end point)</p> <p>M6 repeat to obtain concordant results</p>	<p>If both initial and final colours are given both must be correct</p> <p>ACCEPT orange/pink/red as the final colour</p> <p>ACCEPT correct colours of any alternative indicator chosen e.g. (pink) to colourless for phenolphthalein</p> <p>(blue) to purple/red/pink for litmus</p> <p>REJECT Universal Indicator</p> <p>ALLOW repeat to obtain accurate/reliable results</p>	4

Question number	Answer	Notes	Marks
(b) (i)	20(.0) °C		1
(ii)	17.5 cm ³		1
(iii)	10 (cm ³) AND 25 (cm ³)		1
		Total	7

6.

number	Answer	Notes	Marks
(a) (i)	$\text{CH}_3\text{OH} + \text{O}_2 \rightarrow \text{CO} + 2\text{H}_2\text{O}$ M1 all formulae correct M2 correctly balanced	ACCEPT multiples and fractions M2 DEP on M1	2
(ii)	thermal energy/heat (energy) lost to the surroundings/environment	ACCEPT lost to atmosphere/beaker/thermometer ACCEPT evaporation of water/methanol	1

Question number	Answer	Notes	Marks
5 (b) (i)	M1 (Q =) $125 \times 4.2 \times 36$ M2 = 18 900 (J) /19 000 (J)	ACCEPT answer in kJ if unit included Correct final answer with no working scores 2 ALLOW one mark for $1.5 \times 4.2 \times 36 = 226.8$ ALLOW one mark for $126.5 \times 4.2 \times 36 = 19\,126.8$	2
(ii)	M1 $\text{mass}[\text{CH}_3\text{OH}] = 84.7 - 83.2$ OR 1.5 (g) M2 $n[\text{CH}_3\text{OH}] = 1.5 \div 32$ OR 0.046875 (mol) OR M1 $\div 32$ M3 $\Delta H = 18\,900 \div \text{M2}$ OR 403 200 (J/mol) M4 $\Delta H = -400$ (kJ/mol)	ACCEPT any number of sig fig except 1, eg 0.047 ACCEPT M2 from (b)(i) \div M2 from (b)(ii) ACCEPT any number of sig fig ACCEPT any number of sig fig, eg 403, 403.2 Negative sign must be included (+) 400/403/403.2 etc scores 3 Mark CSQ throughout Correct final answer with no working scores 4	4

Question number	Answer	Notes	Ma
5 (b) (ii)	<p>M1 $\text{mass}[\text{CH}_3\text{OH}] = 84.7 - 83.2$ OR 1.5 (g)</p> <p>M2 $18900 \div 1.5$ OR 12600 OR $18900 \div$ M1</p> <p>M3 $\Delta H = 12600 \times 32$ OR 403200 (J)</p> <p>M4 $\Delta H = -400$ (kJ/mol)</p>	<p>ACCEPT any number of sig fig except 1, eg 0.047</p> <p>ACCEPT M2 from (b)(i) \div M2 from (b)(ii)</p> <p>ACCEPT any number of sig fig</p> <p>ACCEPT any number of sig fig, eg 403, 403.2</p> <p>Negative sign must be included</p> <p>(+) 400/403/403.2 etc scores 3</p> <p>Mark CSQ throughout</p> <p>Correct final answer with no working scores 4</p>	4

Question number	Answer	Notes	Marks
5 (b) (iii)	<p>M1 oxygen/other reactant missing from methanol</p> <p>M2 product level / carbon dioxide and water above reactant level</p>	<p>ACCEPT product level should be below reactant level</p> <p>ACCEPT answers shown on diagram</p> <p>IGNORE references to activation energy</p> <p>IGNORE references to missing x-axis</p>	2

Question number	Answer	Notes	Marks
(c)	<p>Route 1:</p> <p>M1 $\Sigma(\text{bonds broken}) = (412 \times 3) + 360 + 463 + (496 \times 1.5)$ OR 2803 (kJ/mol)</p> <p>M2 $\Sigma(\text{bonds made}) = (743 \times 2) + (463 \times 4)$ OR 3338 (kJ/mol)</p> <p>Route 2:</p> <p>M1 $\Sigma(\text{bonds broken}) = (412 \times 3) + 360 + (496 \times 1.5)$ OR 2340 (kJ/mol)</p> <p>M2 $\Sigma(\text{bonds made}) = (743 \times 2) + (463 \times 3)$ OR 2875 (kJ/mol)</p> <p>M3 Correct calculation of difference between M1 and M2</p> <p>M4 If M2 > M1 final answer must be negative If M2 < M1 final answer must be positive</p>	<p>IGNORE negative sign</p> <p>IGNORE negative sign</p> <p>IGNORE sign</p> <p>Expected final answer is -535</p> <p>Positive sign not required If a clear statement is made that the reaction is exothermic, then sign can be negative Correct final answer with no working scores 4</p>	4
Total			15

7.

Question number	Answer	Notes	Marks
7 (a)	M1 polystyrene is a better insulator M2 so less heat (energy)/thermal energy is transferred/lost to the surroundings/atmosphere/air	ALLOW polystyrene is an insulator REJECT no heat loss to the surroundings	2
(b)	M1 (before) 18.6 (°C) M2 (after) 22.8 (°C)	one mark for correct answers in the wrong order Ignore trailing zeros e.g. accept 18.60	2

Question	Answer	Notes	Marks
(c) (i)	<p>Highest temperature of mixture in °C</p> <p>volume of aqueous sodium hydroxide in cm³</p> <p>M1 and M2 all points plotted correctly to the nearest gridline</p> <p>M3 best fit straight line through first 3 points drawn with the aid of a ruler</p> <p>M4 best fit straight line through last 3 points drawn with the aid of a ruler</p>	deduct one mark for each incorrectly plotted point ALLOW M3 and M4 even if lines do not intersect Penalise lack of use of a ruler once only	4

Question	Answer	Notes	Marks
(c) (ii)	M1 (sodium hydroxide) expected value 37-38 cm ³ M2 (hydrochloric acid) (100 - M1) expected value 63-62 cm ³	mark CSQ on candidate's graph read to nearest gridline	2
(ii)	sodium hydroxide (has the greater concentration because) M1 sodium hydroxide and hydrochloric acid react in a 1:1 (molar) ratio M2 the volume of sodium hydroxide required is less (than the volume of hydrochloric acid required)	ALLOW hydrochloric acid has the lower concentration because the volume of hydrochloric acid required is more (than the volume of sodium hydroxide)	2
Total			12

8.

Question number	Answer	Notes	Marks
(a) (i)	(to provide the) zymase/enzyme (that acts as a catalyst)	ALLOW (to act as a) catalyst ALLOW to increase the rate of reaction IGNORE to lower the activation energy IGNORE to start the reaction REJECT to provide (activation) energy	1
(ii)	(turns) milky / cloudy / turbid (then clear) OR <u>white</u> precipitate / <u>white</u> suspension / <u>white</u> solid (forms then disappears)		1
(iii)	30 °C	ACCEPT any temperature, or range of temperatures, between 25 and 40 °C	1

Question number	Answer	Notes	Mark
(b)	<p>Route 1:</p> <p>M1 $\Sigma(\text{bonds broken}) =$ $348 + (5 \times 412) + 360 + 463 + (3 \times 496)$ OR 4719 (kJ/mol)</p> <p>M2 $\Sigma(\text{bonds made}) = (4 \times 743) + (6 \times 463)$ OR 5750 (kJ/mol)</p> <p>Route 2:</p> <p>M1 $\Sigma(\text{bonds broken}) =$ $348 + (5 \times 412) + 360 + (3 \times 496)$ OR 4256 (kJ/mol)</p> <p>M2 $\Sigma(\text{bonds made}) = (4 \times 743) + (5 \times 463)$ OR 5287 (kJ/mol)</p> <p>M3 $4719 - 5750 \text{ (kJ/mol) / M1 - M2}$</p> <p>M4 $- 1031 \text{ (kJ/mol)}$ OR correct evaluation of M3</p>	<p>IGNORE negative sign</p> <p>IGNORE negative sign</p> <p>Sign required ACCEPT answers given to three significant figures</p> <p>Correct answer with no working scores 4 + 1031 (kJ/mol) scores 3</p>	4

Question number	Answer	Notes	Marks
(c) (i)	<p>M1 32</p> <p>M2 $(32 \times 15.6) = 500$ (kJ)</p> <p>OR</p> <p>M1 $\times 15.6$ correctly evaluated</p>	<p>ACCEPT 499 / 499.2</p> <p>Correct answer with no working scores 2</p>	2
(ii)	<p>M1 & M2 Any two from:</p> <ul style="list-style-type: none"> • mass of water / volume of water / amount of water • distance of flame from the can • length of wick 	<p>IGNORE temperature of water (at start)</p> <p>ALLOW distance of burner from can</p>	2
(iii)	<p>Any two from:</p> <p>M1 heat (energy)/thermal energy is lost (to /surroundings)</p> <p>M2 incomplete combustion (of the fuel)</p> <p>M3 evaporation of water/fuel</p>	<p>IGNORE just energy lost</p> <p>IGNORE not all of the ethanol is burned</p>	2
Total			13