

Energetics :

Q1. (2018)

16 A student investigates the energy changes during some chemical reactions.

She measures the temperature at the start and end of each reaction.

Look at her results.

Reaction	Temperature at start (°C)	Temperature at end (°C)	Temperature change (°C)	Type of reaction
A	20	25		Exothermic
B	18	10		
C	21	35		
D	20	20		No reaction

(A)

Question	Answer	Marks	AO element	Guidance																									
16 (a)	<table border="1"> <thead> <tr> <th>Reaction</th><th>Temperature at start in °C</th><th>Temperature at end in °C</th><th>Temperature change in °C</th><th>Type of reaction</th></tr> </thead> <tbody> <tr> <td>A</td><td>20</td><td>25</td><td>(+5)</td><td>exothermic</td></tr> <tr> <td>B</td><td>18</td><td>10</td><td>-8</td><td>endothermic ✓</td></tr> <tr> <td>C</td><td>21</td><td>35</td><td>(+14)</td><td>exothermic ✓</td></tr> <tr> <td>D</td><td>20</td><td>20</td><td>0</td><td></td></tr> </tbody> </table> Temperature change in BOTH reactions A and D ✓	Reaction	Temperature at start in °C	Temperature at end in °C	Temperature change in °C	Type of reaction	A	20	25	(+5)	exothermic	B	18	10	-8	endothermic ✓	C	21	35	(+14)	exothermic ✓	D	20	20	0		3	3 x 2.2	
Reaction	Temperature at start in °C	Temperature at end in °C	Temperature change in °C	Type of reaction																									
A	20	25	(+5)	exothermic																									
B	18	10	-8	endothermic ✓																									
C	21	35	(+14)	exothermic ✓																									
D	20	20	0																										

(B)

(b)	C ✓	1	2.2	ecf on ΔT
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(C)

(c)	(i)	100 (kJ) ✓	1	2.2	ALLOW -100
	(ii)	50 (kJ) ✓	1	2.2	

Q2. (2019)

11	D	1	1.1	
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Q3. (2019)

(A)

Question	Answer	Marks	AO element	Guidance
19 (a) (i)	Exothermic ✓	1	1.1	
(ii)	$\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$ Formulae ✓ Balancing ✓	2	2.1 2.2	ALLOW any correct multiple, including fractions ALLOW = / = instead of → NOT and / & instead of + balancing mark is dependent on the correct formulae but ALLOW 1 mark (M2) for a balanced equation with a minor error in subscripts / formulae eg $\text{MG} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$
(iii)	Aluminium chloride ✓	1	2.2	ALLOW correct formula AlCl_3

(B)

(d)		3		ALLOW ECF if endothermic is given as answer in (a)(i)
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Q4. (2020)

(A)

	(iii)	Activation energy ✓ Energy change ✓ Reactants ✓	3	1.1	ALLOW max 1 mark for correct shape if labels are missing / incorrect
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(B)

	(c)	Any two from: Change the glass beaker for a metal container ✓ Move the spirit burner closer to the container/glass beaker/ metal container ✓ Use a draught shield ✓ Add a lid (to the beaker) ✓	2	3.3b x2	IGNORE put all thermometer (bulb) in water
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Q5. (2021)

4	A ✓	1	2.1	
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Q6. (2021)

(A)

Question	Answer	Marks	AO element	Guidance
16 (a)	Mg ✓ HCl ✓	2	1.1	

(B)

(b)	Aqueous ✓	1	1.1	
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(C)

(c)	(i)	Hydrogen is a gas / a gas is produced ✓ Idea that the gas can escape (from the beaker) ✓	2	1.1 2.2	
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	(ii)	All three points plotted correctly ✓ Line of best fit drawn ✓	2	2.2 1.2	ALLOW ± ½ square
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	(iii)	Answer ±0.02g of the line of best fit ✓	1	2.2	Scores 0 if no line of best fit in 16(c)(ii)
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(D)

(d)	(i)	Experiment 2 / 0.69 ✓	1	3.2b	
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16	(d)	(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.63 (g) award 3 marks 0.60+0.62+0.59 = 1.81 ✓ 1.81 / 3 = 0.603 ✓ 0.60 (g) (2 significant figures) ✓	3	2 x 2.2 1.2	ALLOW ECF from incorrect mean for sig fig mark
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Q7. (2021)

(A)

19	(a)	<table><tr><th>Species</th><th>Cation</th><th>Anion</th></tr><tr><td>NaOH</td><td>Na⁺</td><td>OH⁻ ✓</td></tr><tr><td>H₂SO₄</td><td>H⁺ ✓</td><td>SO₄²⁻</td></tr></table>	Species	Cation	Anion	NaOH	Na ⁺	OH ⁻ ✓	H ₂ SO ₄	H ⁺ ✓	SO ₄ ²⁻	2	2.1
Species	Cation	Anion											
NaOH	Na ⁺	OH ⁻ ✓											
H ₂ SO ₄	H ⁺ ✓	SO ₄ ²⁻											

(B)

(b)	(i)	(No) pH 9 is alkaline / pH 9 is not acidic ✓ Alkaline solutions contain OH ⁻ ions ✓	2	3.1b	Marks are for explanation
	(ii)	pH probe 7 ✓ Universal indicator green ✓	2	1.2	

(C)

(c)		$2\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$ H ₂ O ✓ Balanced equation ✓	2	2.1	Balancing mark is dependent on the correct formula
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(D)

(d)		Z ✓	1	3.2b	
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Q8. (2022)

(A)

Question	Answer	Marks	AO element	Guidance
20 (a)*	Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. Level 3 (5–6 marks) Analyses the information to correctly identify the reaction type in BOTH reaction A AND reaction B AND Uses knowledge and understanding to explain why reaction A is exothermic AND reaction B is endothermic <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Analyses the information to correctly identify the reaction type in BOTH reaction A AND reaction B OR Uses knowledge and understanding to explain why reaction A is exothermic AND reaction B is endothermic OR Analyses the information to correctly identify the reaction type in EITHER reaction A OR reaction B AND uses knowledge and understanding to explain why reaction A is exothermic OR reaction B is endothermic <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) Analyses the information to correctly identify the reaction type in EITHER reaction A OR reaction B OR	6	2 x 1.1 4 x 3.2b	AO1.1 Demonstrates knowledge and understanding of exothermic and endothermic reactions - Exothermic reactions increase the temperature (of the surroundings) - Endothermic reactions decrease the temperature (of the surroundings) - In exothermic reactions energy is given out / exothermic reactions have a negative energy change - In endothermic reactions energy is taken in / endothermic reactions have a positive energy change - In exothermic reactions, the energy of the products is lower than the energy of the reactants - In endothermic reactions, the energy of the products is higher than the energy of the reactants AO3.2b Analyses information and ideas to draw conclusions - Reaction A has a temperature increase - Reaction A has a temperature change of + 6.6°C - Reaction A has a negative energy change - Reaction A is exothermic - Reaction B has a temperature decrease - Reaction B has a temperature change of - 5.1°C
	Uses knowledge and understanding to explain why reaction A is exothermic OR reaction B is endothermic OR Correctly calculates the temperature change of reaction A or reaction B <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks <i>No response or no response worthy of credit.</i>			- Reaction B has a positive energy change - Reaction B is endothermic

(B)

20	(b)	(i)	Thermometer ✓	1	1.2	ALLOW temperature probe
		(ii)	Any two from: Put a lid on the beaker ✓ Use a polystyrene cup / idea of using a container made from a material that is a better insulator than glass ✓ Idea of wrapping insulating material around the beaker ✓	2	2 x 3.3b	IGNORE tin/aluminium foil

(C)

Question	Answer	Marks	AO element	Guidance
20 (c)		3	3 x 1.1	

Q9. (2023)

9	A	1	1.2	
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Q10. (2024)

12	B ✓	1	2.2	
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Q11. (2024)

13	C ✓	1	1.2	
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