

Exothermic and endothermic reactions

Q1. (2019)

02.6	Level 3: The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO3 AO2
	Level 2: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4	5.5.1.1
	Level 1: The design/plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content Steps <ul style="list-style-type: none"> • use a suitable container eg test tube • use insulation • add water • measure the initial water temperature (with a thermometer) • add stated mass eg 1g or 1 spatula • stir (to dissolve the solid) • measure the final (allow lowest or highest) temperature of the solution • calculate the temperature difference or determine graphically • repeat with different masses • repeat with the same volume of water <p>to access level 3 there must be an indication of how the temperature change is determined using different masses dissolved in the same quantity of water</p>		

Q2. (2020)

05.1	temperature (change)		1	AO2 5.4.1.2 5.5.1.1 RPA 10
------	----------------------	--	---	-------------------------------------

Q3. (2020)

A)

05.2	to reach a constant temperature	allow to reach room temperature	1	AO3 5.4.1.2 5.5.1.1 RPA 10
------	---------------------------------	---------------------------------	---	-------------------------------------

B)

05.3

line of best fit after 7 minutes

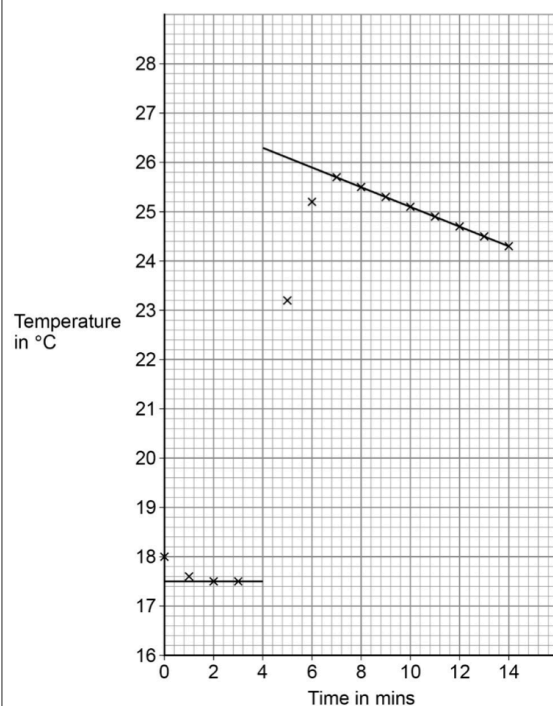
extends line back to 4 minutes

ignore extension of line beyond
4 minutes

1

AO2
5.4.1.2
5.5.1.1
RPA 10

the diagram below scores 2 marks



C)

05.4

(maximum **and** minimum values
at 4 minutes)
26.3 (°C) **and** 17.5 (°C)(temperature change at
4 minutes)
= 8.8 (°C)

allow ecf from 05.3

1

AO3
5.4.1.2
5.5.1.1
RPA 10

1

D)

05.5

the reaction finished / stopped

(so) energy is lost to
surroundings / atmosphere
or
(so the) solution cools (back to
room temperature)allow maximum temperature has
been reached

allow heat for energy

1

1

AO3
5.4.1.2
5.5.1.1
RPA 10

E)

05.6	aluminium / zinc / iron / beryllium	allow Al / Zn / Fe / Be do not accept copper, silver MP2 dependent on a correct answer to MP1	1	AO3
	metal Q is less reactive (than magnesium) or metal Q is lower in reactivity series	allow converse	1	AO2 5.4.1.2 5.5.1.1 RPA 10

Q4. (2021)

A)

03.1	temperature (of solution)	allow temperature change	1	AO1 5.5.1.1
------	---------------------------	--------------------------	---	----------------

B)

03.2	any three from: • insulate the beaker or use polystyrene cup • add a lid • stir more (times) • repeat the experiment and calculate the mean (ignoring anomalous results) • use smaller volume (of water) • use larger mass of ammonium nitrate • more accurate balance • use digital thermometer or use a more accurate thermometer		3	AO3 5.5.1.1
------	---	--	---	----------------

Q5. (2021)

03.3	(from 0 to 1.5 minutes the) temperature decreases	allow the temperature decreases (from 21.4 °C to 15.4 °C)	1	AO3 5.5.1.1
	(because) ammonium nitrate dissolving is endothermic		1	
	(then) after 1.5 minutes the temperature increases	(then) after 15.4 °C the temperature increases	1	
	(because) energy transfers to the solution from the surroundings		1	

Q6. (2021)

07.1	particles collide		1	AO3 5.5.1.2
	(but at room temperature) particles have insufficient energy or (but) have energy less than the activation energy (so collisions are not successful)		1	

Q7. (2021)

07.2	2120 (kJ/mol)		1	AO3 5.5.1.2 5.5.1.3
------	---------------	--	---	---------------------------

Q8. (2021)

07.3		allow C—C for X		AO2 5.5.1.3
	(bonds broken = $(8 \times 410) + 2 \text{ X} + (5 \times 500)$ $= 5780 + 2 \text{ X}$	allow (bonds broken = $(8 \times 410) + (5 \times 500)$ $= 5780$	1	
	(bonds formed = $(6 \times 740) + (8 \times 460)$ $= 8120$		1	
	(bonds broken – bonds formed = energy released) $(5780 + 2 \text{ X}) - 8120 = -1640$	allow correct use of incorrect values from step 1 and/or step 2	1	
	$(2 \text{ X} =) 700$	allow correct use of incorrect value from step 3	1	
	$(\text{X} =) 350 \text{ (kJ/mol)}$		1	

Q9. (2024)

04.7	(for each mass of magnesium carbonate) repeat the experiment (discard anomalous results) and calculate the mean		1	AO3 5.5.1.1 RPA10
	measure the highest temperature		1	