Energetics

Mark Scheme

Level	International A Level
Subject	Chemistry
Exam Board	Edexcel
Topic	Chemistry Lab Skills 1
Sub Topic	Energetics
Booklet	Mark Scheme

Time Allowed: **54 minutes**

Score: **/45**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

Question Number	Acceptable Answers	Reject	Mark
1(a)(i)	**A ditional Comment** **For parts (i), (ii),** **correct answers score full marks** **and** **ignore SF (except 1SF)** **and** **penalise incorrect units once only** **and** **penalise incorrect rounding once only** (energy = 50.0 x 4.18 x 4.7 =) 982.3 (J) /982 ALLOW 0.9823 **kJ** IGNORE any sign		1

Question Number	Acceptable Answers	Reject	Mark
1(a)(ii)	(n = 2.54 ÷ 123.5 =) 0.0206/0.0205668 (mol)		1

Question Number	Acceptable Answers	Reject	Mark
1(a)(iii)	ΔH = (0.9823 ÷ 0.0205668 =) 47.76144 (kJ mol^{-1}) **(1)** −47.8 (kJ mol^{-1}) **(1)** Sign and 3 SF required for second mark TE on ans (a)(i) ÷ ans (a)(ii)		2

Question Number	Acceptable Answers	Reject	Mark
1(a)(iv)	To ensure that enthalpy change is per mol of copper(II) carbonate OR So that the limiting factor is the mass of copper(II) carbonate ALLOW To ensure all copper(II) carbonate reacts IGNORE To ensure the reaction goes to completion OR So sulfuric acid is not a limiting factor		1

Question Number	Acceptable Answers	Reject	Mark
1(a)(v)	Heat loss OR Heat capacity of apparatus is not negligible ALLOW Copper(II) carbonate contains copper(II) hydroxide OR Specific heat capacity of solution is not 4.18 IGNORE Non-standard conditions/ Just impurities	Incomplete reaction By-products Side reactions	1

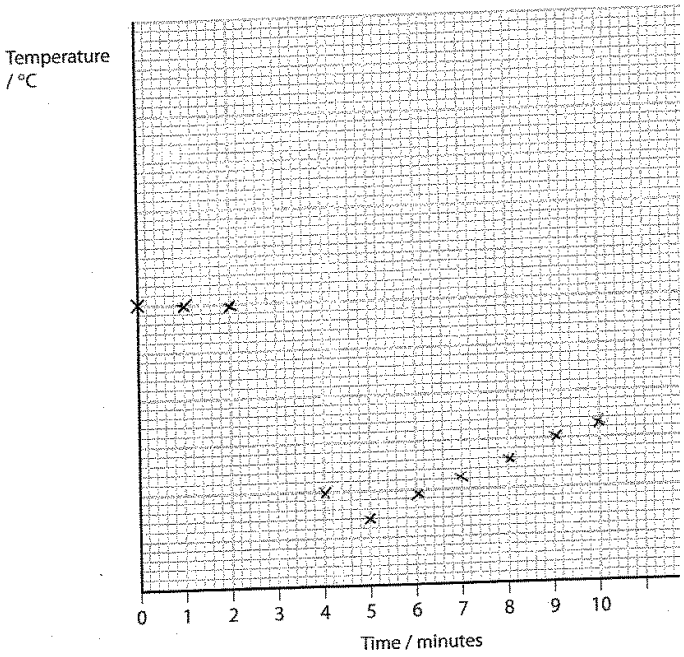
Question Number	Acceptable Answers	Reject	Mark
1(b)	$\Delta H_3 = \Delta H_4 - \Delta H_5$ **(1)** $\Delta H_3 = -47.8 - -56.1 = +8.3$ (kJ mol^{-1}) OR $\Delta H_3 = -47.7 - -56.1 = +8.4$ (kJ mol^{-1}) **(1)** Answer alone scores (2) IGNORE SF TE on 4(a)(iii) No TE on incorrect Hess' Law		2

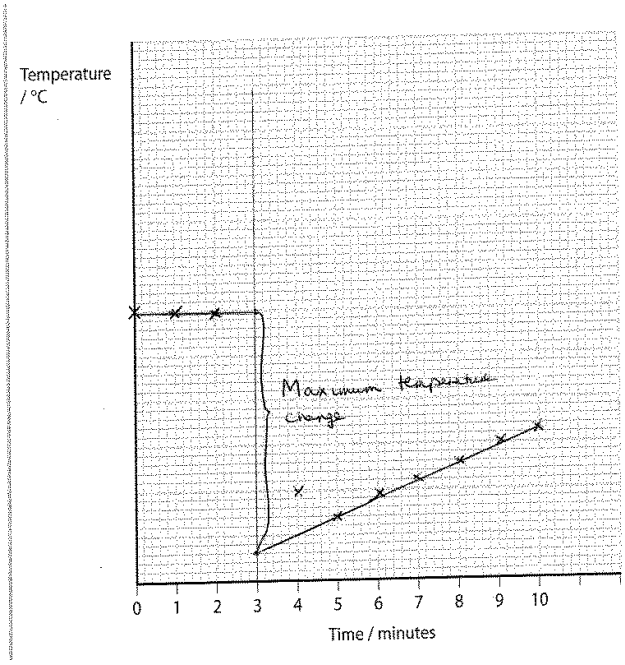
Question Number	Acceptable Answers	Reject	Mark
1(c)	Difficult to measure heat absorbed when heating any substance OR Difficult to measure the temperature (change) of a solid OR Difficult to measure the temperature change when heating	Just 'it's endothermic'	1

(TOTAL FOR QUESTION 1 = 9 MARKS)

Question Number	Acceptable Answers	Reject	Mark
2(a)(i)	**Correct final answer with + sign, 3 sf and units scores 3** (25 x 4.18 x 10.5) = 1097.25 (J) / 1.097 kJ Ignore sign if given (1) Mol NH_4Cl = (5.00/53.5) = 0.09346/ 0.0935 (1) $\Delta H_{solution}$ = (+1.097/0.09346) (= +11.7376 / +11.7406) = **+11.7 kJ mol^{-1}** OR **+11700 J mol^{-1}** Sign, unit and sf must be correct for third mark Use of 2sf earlier may lead to an inaccurate answer (1) ALLOW Final answer = +11.8 kJ mol^{-1} from rounding of MP1 and/or MP2 (3) TE from each step to the next If mass used is 30 g Energy transferred = 1316.7 J $\Delta H_{solution}$ =+14.1 kJ mol^{-1} max (2) If mass used is 5 g Energy transferred = 219.45 J $\Delta H_{solution}$ =+2.35 kJ mol^{-1} max (2)	Answers not to 3 sf No sign or negative sign	3

Question Number	Acceptable Answers	Reject	Mark
2(a)(ii)	First mark is for calculation of error. Second mark is for comparison of temperature error to mass error. Uncertainty in mass = (0.005 x 100 x 2/5.00) = (±)0.2% (1) Uncertainty / error in mass measurement (much) smaller than uncertainty in temperature reading (1) Second mark depends on first being correct, but allow second mark if mass error is 0.1% (as 0.005 not doubled)	Just "0.2% is negligible / very small"	2

Question Number	Acceptable Answers	Reject	Mark
2(b)(i)	Points (close to the) horizontal from starting temperature at 0, 1 and 2 (and 3) minutes (1) Points (on a line) rising from a minimum up to 10 minutes (at least 2 points needed at the warming up stage for extrapolation.) The minimum can be at 4, 5, 6, 7 or 8 minutes. (1)  	Large change of temperature at 3 minutes Cooling curve instead of warming curve	2

Question Number	Acceptable Answers	Reject	Mark
2(b)(ii)	Line through temperature points where warming occurs extrapolated back to 3 minutes. ALLOW Line at minimum temperature shown as staying horizontal and extrapolated back (1) Max temperature change indicated as vertical difference between starting temperature and extrapolated line at 3 minute (1) TE if cooling curve drawn in 3(b)(i) for both marks.  		2

Question Number	Acceptable Answers	Reject	Mark
2(b)(iii)	To check water temperature is steady / constant OR To deduce temperature at 3 mins / at start by extrapolation of line ALLOW to allow water temperature to equilibrate with surroundings/ to reach temperature of surroundings/ to acclimatise IGNORE to get initial temperature accurate	Water temperature may change Minerals in water may affect result	1

Question Number	Acceptable Answers	Reject	Mark
2(c)(i)	Heat must be supplied (and cannot be measured) ALLOW impossible to tell when/if reaction is complete reaction goes to equilibrium/ is reversible IGNORE reference to gases escaping / products are gases / hazards	Just " because it is endothermic" Needs high temperature	1

Question Number	Acceptable Answers	Reject	Mark
2(c)(ii)	$NH_4Cl(s)$ → $\Delta H_{reaction}$ $NH_3(g)$ + $HCl(g)$ ΔH_1 ↓ $\Delta H_2 + \Delta H_3$ ↓ $NH_4Cl(aq)$ ΔH_4 ← $NH_3(aq)$ + HCl (aq) OR 2 separate parallel arrows for $\Delta H_2 + \Delta H_3$ OR ΔH_2 ΔH_3 next to one arrow without being separated by + ALLOW Arrows reversed if signs of enthalpy changes are reversed. IGNORE Any water molecules added/ aq signs / other reactant species Arrow size		1

Question Number	Acceptable Answers	Reject	Mark
2(c)(iii)	$\Delta H_{reaction} = \Delta H_1 - \Delta H_2 - \Delta H_3 - \Delta H_4$ ALLOW any order of terms with correct signs Any correct use of brackets No TE on incorrect cycle		1

Total for Question 2 = 13 marks