

# A Level AQA Chemistry

## Chapter 6 – answers

Question	Answers	Extra information	Mark	AO Spec reference
01.1	The energy/enthalpy change when <b>1 mole gaseous</b> atoms Gains <b>1 mole of electrons</b> Under standard conditions		1 1 1	3.1.8.1 AO1
01.2	<p>2nd <math>E_a</math> O = 602 + 148 + 738 + 1450 + 249 – 141 – 3890</p> <p>= 844 kJ mol<sup>-1</sup></p>	<b>1</b> mark for each correct step of the Born-Haber cycle.	6	3.1.8.1 AO2
01.3	Electrons are attracted to the nucleus Energy released when they enter the lowest possible energy level		1 1	3.1.8.1 AO3

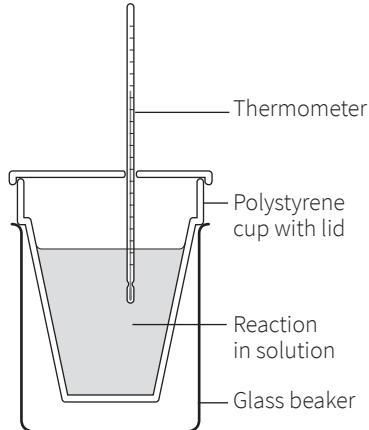
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02.1	The enthalpy/energy change when <b>1 mole</b> Of <b>gaseous atoms</b> Is formed under standard conditions		1 1 1	3.1.8.1 AO1
02.2	$\Delta H = 164 + 549 + 1064 + (2 \times 243) - (2 \times 349) - 2150$ $= -585 \text{ kJ mol}^{-1}$	Allow correct Born-Haber cycle Mark <b>2</b> for correct doubling of chlorine values	1 1	3.1.8.1 AO2
02.3	Removing an electron from a positive ion More energy required to overcome attraction	Allow reference to smaller radius/size	1 1	3.1.8.1 AO3
02.4	Bond enthalpy results in 2 moles of Cl atoms being formed So double the atomisation by definition	Allow both correct definitions	1 1	3.1.8.1 AO3
03.1	The enthalpy/energy change when one mole of <b>solid ionic</b> compound is <b>formed</b> From its constituent ions at an infinite distance Under standard conditions	Allow 'far apart'	1 1 1	3.1.8.1 AO1
03.2		Must have state symbols Do not accept multiples	4	3.1.8.1 AO1

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03.3	616 + 159 + 520 + 79 – 328 = 1046 –1046	Must have - sign for second mark	1 1	3.1.8.1 AO2 MS2.4
03.4	Very little/low/no degree of covalency Because the values are very close So no distortion of electron cloud/polarity	Mark in accordance with <b>03.3</b> answer.	1 1 1	3.1.8.1 AO3
04.1	The enthalpy/energy change when <b>1 mole</b> of <b>gaseous ions</b> Are completed surrounded by water To create an infinitely dilute solution	Allow reference to ions “no longer interacting/influencing each other” or WTTE	1 1 1	3.1.8.1 AO1
04.2	Impossible to add exactly the right amount of water/ Some crystals will dissolve		1 1	3.1.8.1 AO3
04.3			2	3.1.4.2 AO3

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04.4	This question is marked using Levels of Response. Examiners should apply a ‘best-fit’ approach to the marking.	<b>Indicative content</b>	6	3.1.8.1 AO3
	<b>Level 3 (5–6 marks)</b> All stages are covered, and the explanation of each stage is generally correct and virtually complete. Answer is communicated coherently and shows a logical progression from stage 1 to stage 2, stage 3 and then stage 4.	<b>Stage 1: Measuring out the copper sulfate and water</b> 1a uses suitable equipment (scales balance) 1b uses named suitable mass (between 2–8 g) of both salts 1c evidence of weigh-reweigh technique to determine mass of salt delivered		
	<b>Level 2 (3–4 marks)</b> Coherent communication where each stage is outlined All stages are covered but the explanation of each stage may be incomplete or may contain inaccuracies OR two stages are covered, and the explanations are generally correct and virtually complete. Answer is mainly coherent and shows some progression from stage 1 to stage 2, stage 3 and then stage 4.	1d Known volume of water measured using suitable equipment (measuring cylinder/pipette)		
	<b>Level 1 (1–2 marks)</b> Two stages are covered but the explanation of each stage may be incomplete or may contain inaccuracies OR only one stage is covered but the explanation is generally correct and virtually complete. Answer shows some progression between two stages	<b>Stage 2: Determining both enthalpies</b> 2a simple calorimeter set up (polystyrene cup and lid) 2b basic method of measuring starting temperature (with thermometer) over time (min 3 mins) then adding and recording the temperature for a time after (min 4 mins) 2c acknowledgement that when salt is added temperature should not be recorded		

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	<p><b>Level 1 (1–2 marks)</b> Two stages are covered but the explanation of each stage may be incomplete or may contain inaccuracies OR only one stage is covered but the explanation is generally correct and virtually complete.</p> <p>Answer shows some progression between two stages</p>	<p>2d Graphical determination of instantaneous temperature rise by extrapolation</p> <p><b>Stage 3: Calculating <math>\Delta H</math></b></p> <p>3a use of <math>q = mc\theta</math> or equivalent</p> <p>3b: use of <math>M_r</math> to find moles and hence <math>\Delta H_1</math> and <math>\Delta H_2</math></p> <p>3c Use of Hess cycle or <math>\Delta H_1 - \Delta H_2</math></p> <p>Partially complete means <math>\frac{3}{4}</math> of stage met</p>		
04.5	$(2099) + (1080) - (67) = 3112 \text{ kJ mol}^{-1}$	Allow correct cycle or diagram –3112 scores <b>1</b> mark	2	3.1.4.3 AO2 MS2.4
05.1	The measure of disorder of a system	Allow ‘chaos’	1	3.1.8.2 AO1
05.2	<p>Enthalpy change = <math>\sum \text{Products} - \sum \text{Reactants}</math>  <math>= (-709 + -394 + -286) - (-483 + -951) = 45 \text{ kJ mol}^{-1}</math></p> <p>Entropy change = <math>\sum \text{Products} - \sum \text{Reactants}</math>  <math>= 175 + 215 + 70 - 158 - 102 = 200 \text{ J mol}^{-1}</math></p> <p><math>\Delta G = \Delta H - T\Delta S</math></p> <p><math>0 = 45 - 0.2T</math></p> <p><math>T = 45/0.2</math>  <math>= 225 \text{ K}</math></p>	<p>Allow correct cycle</p> <p>Can be awarded through working</p> <p>Mark for conversion entropy</p> <p>Answer of <math>225^\circ\text{C}</math> scores only <b>7</b></p>	1 1 1 1 1 1	3.1.8.2 3.1.4.3 AO2 MS2.2, 2.3, 2.4

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05.3	Temperature way below freezing. Ethanoic acid will be solid.	Ignore references to water being ice unless specifically referenced in terms of solution	1	3.1.8.2 AO3
06.1	<p>1st mark is for overall shape 2nd mark is for correct equations 3rd mark is for doubling K equations</p> $\Delta_{L_f}H = -392 + (2 \times 90) + (2 \times 418) + 248 + (-142) + 844$ $= -2328 \text{ kJ mol}^{-1}$	<p>2358 scores all <b>6</b> marks only if accompanied by a correct cycle. Without cycle, max score is <b>3</b>. Do not penalise scale of lines on any Born-Haber cycle constructed</p> <p>An answer of 1850 with cycle scores <b>3</b> marks</p>	6	3.1.8.1 MS2.4 AO2
06.2	Oxygen is a gas, so more disordered		1 1	3.1.8.2 AO3

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06.3	$\Delta G = \Delta H - T\Delta S$ $\Delta S = 94 - (2 \times 67) - (205/2) = -142.5 \text{ J mol}^{-1}$ $T = 573$ $\Delta G = -392 - (573 \times -0.1425)$ $= -310 \text{ kJ mol}^{-1}$ Reaction is feasible as $\Delta G$ is less than 0	Accept -473.65	1 1 1 1 1	3.1.8.2 AO2 MS2.1, 2.2, 2.3, 2.4
07.1	Correct axis labelled Suitable scale (plotted points should take up over half the paper) Points plotted accurately Read off temperature from line temperature = 1112 K	Allow 1 point plotted outside 1mm Allow 1110 – 1120 K	1 1 1 1	3.1.8.2 MS3.3
07.2	$PV = nRT$ $n = PV/RT$ $n = \frac{100000 \times 0.5}{8.31 \times 298} = 20.2 \text{ moles}$ $\text{mass} = 100.1 \times 20.2 = 2022 \text{ g}$	Accept 2.022 kg	1 1 1 1	3.1.2.3 AO2 MS2.2, 2.3, 2.4
07.3	$\text{CaO(s)} + \text{H}_2\text{O(l)} \rightarrow \text{Ca(OH)}_2\text{(s)}$		1	3.1.2.5 AO1

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<b>07.4</b>	$M_r \text{ Ca(OH)}_2 = 40.1 + (2 \times 17) = 74.1$		1	3.1.2.5
	$2.28/74.1 = 0.308$ moles		1	AO1
	Moles $\text{H}_2\text{SO}_4 = 0.308$ as 1:1		1	MS0.2
	concentration = $0.0308/0.5 = 0.0616 \text{ mol dm}^{-3}$		1	
<b>07.5</b>	$\text{pH} = -\log(0.0616 \times 2) = 0.91$	Must be 2 d.p.	1	3.1.12.2 MS0.4, 2.5 AO2
<b>08.1</b>	Because it is an element		1	3.1.4.1 AO1
<b>08.2</b>	$\Delta H = -111 - (-75 + -242)$ $206 \text{ (kJ mol}^{-1}\text{)}$		1	3.1.8.2
	$\Delta S = 3 \times 131 + 198 - (186 + 189) = 216 \text{ J K}^{-1} \text{ mol}^{-1}$		1	MS3.3
	$\Delta G = \Delta H - T\Delta S / = 206 \times 10^3 - (973 \times 216)$ $-4168 \text{ J mol}^{-1}$		1	
	Reaction is feasible as $\Delta G \leq 0$		1	
			1	
<b>08.3</b>	Any change made to a system under equilibrium will cause a response		1	3.1.6.1
	Which will oppose the change		1	AO1



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08.4	Moles steam = 2.70 Moles CO = 1.30 Moles H <sub>2</sub> = 3.90		1	3.1.10 AO2 MS1.1, 2.2, 2.3
	Mole fractions CH <sub>4</sub> = 0.7 / 8.6 = 0.0814 H <sub>2</sub> O = 2.7 / 8.6 = 0.314 CO = 1.3 / 8.6 = 0.151 H <sub>2</sub> = 3.9 / 8.6 = 0.453		1	
	Partial pressures CH <sub>4</sub> = 0.0814 × 300 = 24.4 H <sub>2</sub> O = 0.314 × 300 = 94.2 CO = 0.151 × 300 = 45.3 H <sub>2</sub> = 0.453 × 300 = 136		1	
	$K_p = \frac{p_{\text{CO}} \times p^3_{\text{H}_2}}{p_{\text{CH}_4} \times p_{\text{H}_2\text{O}}}$		1	
	$= \frac{45.3 \times 136^3}{24.4 \times 94.2} = 4.96 \times 10^4$ kPa <sup>2</sup>		1	

### Skills box answers:

- Units of  $k = \text{dm}^3 \text{mol}^{-1} \text{s}^{-1}$
- Units of  $K_c = \text{mol dm}^{-3}$
- Units of  $K_p = \text{Pa}$
- Units of  $k = \text{dm}^6 \text{mol}^{-2} \text{s}^{-1}$
- Units of  $K_c = \text{mol}^3 \text{dm}^{-9}$
- Units of  $K_p = \text{Pa}^3$