# Revision Sheet

A-Level Chemistry · Unit 23 Chemical energetics

6 vocabulary items · 47 marks of exam questions (4 questions)

*Part 1 · Vocabulary review answer key. Section A wants the exact English spelling.*

| Question | Answer | Marks |
|---|---|---|
| 1 | entropy | 1 |
| 2 | enthalpy change of atomisation | 1 |
| 3 | lattice energy | 1 |
| 4 | electron affinity | 1 |
| 5 | enthalpy change of hydration | 1 |
| 6 | enthalpy change of solution | 1 |

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| 7(a)(i) | • enthalpy change / energy change<br>• one mole of electrons<br>• (gained by) **one mole** of **gaseous atoms**<br><br>two for one mark, three for two marks |
| 7(a)(ii) | (energy required to overcome) the repulsion between the electron and anion / negative ion |
| 7(a)(iii) | • less negative / less exothermic down the group<br>• greater the distance between the nucleus and (the shells of the) electrons<br>**OR** atomic radii increases<br>**OR** more shielding by inner shells<br>• the less **attraction** between nucleus<br>and incoming electron (and the less energy released)<br><br>two for one mark, three for two marks |
| 7(b) | **M1** use of correct seven numbers only in calculation / energy cycle<br>**M2** only 2 × used correctly<br>**M3** correct signs and evaluation ecf<br><br>–208 = 131 + 906 + 1733 + 62 + 151 + 2x – 2605<br>2x = –586<br>x = –293 kJ mol$^{-1}$ |
| 7(c) | first box ticked<br>**AND** $Cd^{2+}$ larger / $Cd^{2+}$ lower charge density<br>**AND** less attraction between the ions / weaker ionic bonds |



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| 8(a) | <table><tr><th>energy change</th><th>always positive</th><th>always negative</th><th>can be either negative or positive</th></tr><tr><td>bond energy</td><td>✓</td><td></td><td></td></tr><tr><td>enthalpy change of atomisation</td><td>✓</td><td></td><td></td></tr><tr><td>enthalpy change of formation</td><td></td><td></td><td>✓</td></tr></table> |
| 8(b) | **M1** (enthalpy change) when one mole of gaseous atoms is produced **IGNORE** energy released<br>**M2** from its element(s) in its standard state / standard conditions / 298 K **AND** 1 atm |
| 8(c) | **M1** use of correct six numbers only –31 / 285 / 731 / –141 / 798 / 496<br><br>**M2** 2 × used correctly with Ag (2 × 285 (570) and 2 × 731 (1462)) **AND** 0.5 with O=O (496 (248))<br><br>**M3** correct signs and evaluation<br>–31 = (2 × 285) + (2 × 731) + (–141) + (798) + x + (0.5 × 496)<br><br>x = –2968 kJ mol$^{-1}$ |
| 8(d) | • $Ag_2Se$ $Ag_2S$ $Ag_2O$ **OWTTE**<br>*least exothermic* *most exothermic*<br><br>• charge density of anion decreases down the group **ORA**<br>/ radius/size of anion increases down the group<br>/ $Se^{2-}$ largest radius / $O^{2-}$ smallest radius / O has smallest ionic radius<br><br>• less attraction between the ions / ionic bond gets weaker (with $Ag_2Se$) **ORA**<br><br>Any two [1], all three [2] |
| 8(e)(i) | ($K_{sp}$ = ) $[Ag^+]^2[SO_3^{2-}]$ [1] |

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| 8(e)(ii) | $x = \sqrt[3]{1.5 \times 10^{-14} / 4} = 1.55 \times 10^{-5}$ (mol dm$^{-3}$)<br>$[Ag^+] = 1.55 \times 10^{-5} \times 2 = 3.11 \times 10^{-5}$ (mol dm$^{-3}$) min 2sf ecf (e)(i) |
| 8(f) | • feasibility / it increases as temperature increases **ORA**<br>• $\Delta S$ is positive / $\Delta S$ is >0 / entropy **change** is positive (and $\Delta H$ is positive)<br>**OR** $-T\Delta S$ becomes more negative / $T\Delta S$ becomes more positive<br>• as $\Delta G$ becomes / is negative / $\Delta G < 0$<br>Any two [1], all three [2] |



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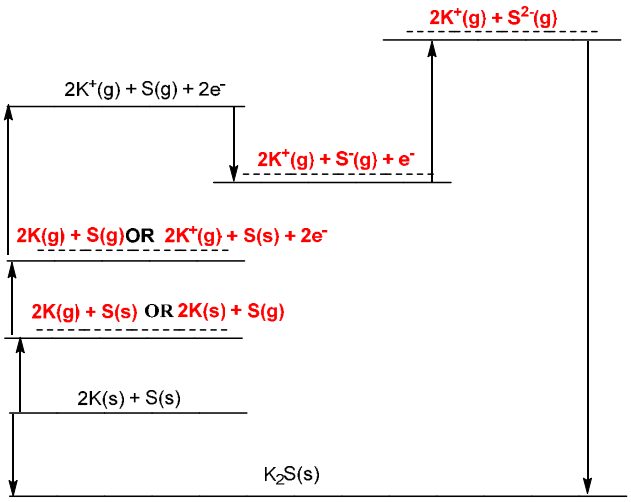
| 9(a) | **M1** magnesium > calcium > strontium<br>**M2** $\Delta H_{latt}$ and $\Delta H_{hyd}$ both become less exothermic / less negative<br>**M3** $\Delta H_{latt}$ changes less **OR** $\Delta H_{hyd}$ is dominant factor<br>**M4** $\Delta H_{sol}$ becomes less exothermic / less negative / more positive / more endothermic |
| 9(b) | **M1** $\Delta H$ / energy change when 1 mole of an ionic solid / compound is formed<br>**M2** from gaseous ions (under standard conditions) |
| 9(c) | **M1** as ionic radii increases **AND** $\Delta H_{latt}$ less exothermic<br>**M2** as ionic charge increases **AND** $\Delta H_{latt}$ increases/more exothermic |
| 9(d)(i) | <br>any two [1] any three [2] all four [3] |
| 9(d)(ii) | **M1** selection of **ONLY** six correct values (–381, 89, 419, 279, –200, 640) **AND** use of × 2 as only multiplier with K<br>**M2** correct evaluation of data used ecf<br><br>$-381 = (89 \times 2) + (419 \times 2) + 279 + (-200) + 640 + \Delta H^{\ominus}_{latt}$<br>$\Delta H^{\ominus}_{latt} = -2116$ (kJ mol$^{-1}$) |

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| 10(a) | • enthalpy / energy change / given out / evolved / released<br>• one mole is formed / made [1]<br><br>• of compound / solid / lattice / crystal<br>• (from) **gas**eous **ions** [1] |
| 10(b)b | $S^-(g) + e^- \rightarrow S^{2-}(g)$ [1] |
| 10(c)c | (555 + 200 – 532 = 223, 223 × 8 = 1784)<br><br>M1 selecting correct data 555, 200, 532 **only**, (ignore signs and multipliers) [1]<br><br>M2 evaluation to give +223 [1]<br><br>M3 multiplying M2 by 8 and evaluation ans (+) 1784 [1] |
| 10(d) | (1619 + 555 – 2612 = –438)<br><br>M1 selecting correct data 1619 555 2612 only, (ignore signs and multipliers) [1]<br><br>M2 evaluation to give –438 [1] |
| 10(e)(i) | ionic radius / size / sum of ionic radii [1]<br><br>ionic charge / product of ionic charges [1] |
| 10(e)(ii) | M1 (size tends to make $\Delta H^{\ominus}_{latt}$ of radium sulfide) less exothermic since the ions are larger [1]<br><br>M2 (charge tends to make $\Delta H^{\ominus}_{latt}$ of radium sulfide) less exothermic since the ions are more highly charged [1] |
| 10(e)(iii) | (ionic) charge (since)<br><br>**AND**<br><br>$\Delta H^{\ominus}_{latt}$ of radium sulfide is more exothermic [1] |