A-Level Chemistry

Paper 4

Unsolved Topical

Past Papers with Marking Schemes

All Variants

2014-2021

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PREFACE

Excellence in learning cannot be claimed without application of concepts in a dexterous way. In this regard one of the logical approach is to start in chunks; like chapter wise learning and applying the concept on exam based questions.

This booklet provides an opportunity to candidates to practice topic wise questions from previous years to the latest. Extensive working of Team MS Books has tried to take this booklet to perfection by collaborating with top of the line teachers.

We have added answer key / marks scheme at the end of each topic for the candidate to compare the his/her answer to the best.

MS Books strives to maintain actual spacing between consecutive questions and within options as per CAIE format which gives students a more realistic feel of attempting question.

Review, feedback and contribution in this booklet by various competent teachers of a subject belonging to renowned school chains make it most valuable resource and tool for both teachers and students.
With all belief in strength of this resource material I can confidently claim that it is worth in achieving brilliance.

Our sincere thanks and gratification to Mr. Waqar Ahmad who took out special time to help compile and manage this booklet. We would also like to appreciate chemistry faculty for reviewing and indorsing it.

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CHEMISTRY PAPER 4

TABLE OF CONTENTS

AS QUESTIONS IN PAPER 4

Enthalpy and Born-Haber Cycles

Q2(d)/42/M/J/14

1 (d) (i) Write an equation to represent the lattice energy of $PbCl_2$. Show state symbols.

....

(ii) Use the following data, together with appropriate data from the *Data Booklet*, to calculate a value for the lattice energy of $PbCl_2$.

electron affinity of chlorine = –349 kJ mol^{-1}
enthalpy change of atomisation of lead = +195 kJ mol^{-1}
enthalpy change of formation of $PbCl_2$(s) = –359 kJ mol^{-1}

lattice energy = ... kJ mol^{-1}

(iii) How might the lattice energy of $PbCl_2$ compare to that of $PbBr_2$? Explain your answer.

....

....

....

[6]

Q2(c)/43/M/J/14

2 **(c)** Copper(I) oxide and copper(II) oxide can both be used in the ceramic industry to give blue, green or red tints to glasses, glazes and enamels.

The table lists the $\Delta H_f^\ominus$ values for some compounds.

compound	$\Delta H_f^\ominus$ / kJ mol^{-1}
$Cu_2O(s)$	–168.6
$CuO(s)$	–157.3
$Cu(NO_3)_2(s)$	–302.9
$NO_2(g)$	+33.2

(i) Copper(II) oxide can be produced in a pure form by heating copper(II) nitrate. Use suitable $\Delta H_f^\ominus$ values from the table to calculate the $\Delta H^\ominus$ for this reaction.

$$Cu(NO_3)_2(s) \rightarrow CuO(s) + 2NO_2(g) + \tfrac{1}{2}O_2(g)$$

$\Delta H^\ominus$ = ... kJ mol^{-1}

(ii) Copper(I) oxide can be produced from copper(II) oxide.

- Use suitable $\Delta H_f^\ominus$ values from the table to calculate $\Delta H^\ominus$ for the reaction.

$$2CuO(s) \rightleftharpoons Cu_2O(s) + \tfrac{1}{2}O_2(g)$$

$\Delta H^\ominus$ = ... kJ mol^{-1}

- Hence suggest whether a low or a high temperature of oxidation would favour the production of copper(I) oxide. Explain your reasoning.

....

....

[4]

Q3(e)/42/O/N/14

3 (e) (i) What is meant by the term *lattice energy*?

....

....

(ii) Explain why the lattice energy of calcium phosphate is **less** exothermic than that of magnesium phosphate.

....

....

[3]

Q1(b(ii)/43/O/N/14

4 (b) (ii) Use the following data, together with relevant data from the *Data Booklet*, to calculate a value for the lattice energy of strontium chloride. You may find it helpful to construct a Born-Haber cycle.

electron affinity per mole of chlorine atoms	$-349\,kJ\,mol^{-1}$
standard enthalpy of atomisation of Sr(s)	$+164\,kJ\,mol^{-1}$
standard enthalpy of formation of $SrCl_2(s)$	$-830\,kJ\,mol^{-1}$

lattice energy = ... $kJ\,mol^{-1}$

[5]

Q1(d,e)/42/O/N/15

5 (d) (i) What is meant by the term *standard enthalpy change of hydration*, $\Delta H^{\ominus}_{hyd}$?

....

....

.... [2]

Q2(d)/42/M/J/14

1 (d) (i) $Pb^{2+}(g) + 2Cl^{-}(g) \longrightarrow PbCl_2(s)$ [1]

(ii) $\Delta H_f = \Delta H_{at} + E(Cl - Cl) + 1^{st}\ IE + 2^{nd}\ IE + 2 \times E_A(Cl) + LE$

$-359 = 195 + 242 + 716 + 1450 - 2 \times 349 + LE$

$LE = 2 \times 349 - 359 - 195 - 242 - 716 - 1450$

LE = **–2264** (kJ mol^{-1}) [3]

(iii) $LE(PbCl_2) > LE(PbBr_2)$ *or* more exothermic *or* stronger lattice [1]

because Cl^{-} / chloride anion has smaller radius / size than Br^{-} / bromide [1]

[6]

Q2(c)/43/M/J/14

2 (c) (i) $\Delta H^{\ominus} = +2 \times 33.2 - 157.3 + 302.9 = (+)\ 212\ kJ\ mol^{-1}$ ecf [2]

(ii) $\Delta H^{\ominus} = -168.6 + 2 \times 157.3 = (+)146\ kJ\ mol^{-1}$ **allow** ecf from **(c)(i)** [1]

high T / temperature since ΔH is positive / endothermic [1]

Q3(e)/42/O/N/14 **Q 3**

(e) (i)	(enthalpy change) when **1 mole** of an **ionic compound** is **formed** from its **gaseous ions**	1 1	
(ii)	Mg^{2+} has a smaller (ionic) radii than Ca^{2+} **OR** Mg^{2+} is smaller than Ca^{2+}	1	**[3]**

Q1(b(ii)/43/O/N/14 **Q 4**

(ii)	Lattice energy = $\Delta H_f(SrCl_2) - (\Delta H_{atom}(Sr) + \Delta H_{i1}(Sr) + \Delta H_{i2}(Sr) + \Delta H_{atom}(Cl) + 2\Delta H_{ea}(Cl))$ = +(–830) – (+ 164 + 548 + 1060 + 242 + (2 × –349)) = **–2146** (kJ mol^{-1})	1 1 1	**[3]**

Q1(d,e)/42/O/N/15 **Q 5**

(d) (i)	(energy change when) 1 mole of ions **gaseous** (ions) dissolve in **water** (to form an infinitely dilute solution) *or* **gaseous** (ions) form an **aqueous** solution	**2**
(ii)	$\Delta H^\ominus_{latt}Ca(NO_3)_2 + \Delta H^\ominus_{sol}Ca(NO_3)_2 = \Delta H^\ominus_{hyd}\ Ca^{2+} + 2\Delta H^\ominus_{hyd}\ NO_3^-$ $\Delta H^\ominus_{latt}$ – 19 = –1650 + (2x –314) –2259 kJ mol^{-1}	**3**
(e)	$Ca^{(2+)}$ is a smaller (ion) ***or*** $Ca^{(2+)}$ has a larger charge density $Ca^{(2+)}$ has a stronger attraction / bond to H_2O	**2**