HL Paper 1

In which reaction will the entropy of the system increase significantly?

- $\label{eq:A.CaCO3} \text{A.} \quad CaCO_3(s) \to CaO(s) + CO_2(g)$
- ${\sf B}.\quad {\rm H_2O}(g)\to {\rm H_2O}(l)$
- $\text{C.} \quad \mathrm{HCl}(g) + \mathrm{NH}_3(g) \to \mathrm{NH}_4\mathrm{Cl}(s)$
- $\label{eq:def-D} \mbox{D.} \quad NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$

Markscheme

А

Examiners report

[N/A]

Consider the values of ΔH^{Θ} and ΔS^{Θ} À for the reaction of nitrogen with oxygen at 298 K.

$$\mathrm{N_2(g)} + \mathrm{O_2(g)}
ightarrow 2\mathrm{NO(g)} \quad \Delta H^\Theta = +181 \ \mathrm{kJ \ mol}^{-1}$$

$$\Delta S^{\Theta} = +25~\mathrm{J\,K^{-1}mol^{-1}}$$

Which statement is correct for this reaction?

- A. ΔG^{Θ} is positive at all temperatures.
- B. ΔG^{Θ} is negative at all temperatures.
- C. ΔG^{Θ} is positive at high temperatures.
- D. ΔG^{Θ} is positive at low temperatures.

Markscheme

D

Examiners report

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\begin{split} & \Delta H^{\theta}_{f} \; (\mathrm{IF}_{7}) = -941 \; \mathrm{kJ \; mol^{-1}} \\ & \Delta H^{\theta}_{f} \; (\mathrm{IF}_{5}) = -840 \; \mathrm{kJ \; mol^{-1}} \\ & \mathrm{A. \; -190} \end{split}
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B. –95
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C. +6

D. +95

Markscheme

В

Examiners report

[N/A]

Which is a correct definition of lattice enthalpy?

- A. It is the enthalpy change that occurs when an electron is removed from 1 mol of gaseous atoms.
- B. It is the enthalpy change that occurs when 1 mol of a compound is formed from its elements.
- C. It is the enthalpy change that occurs when 1 mol of solid crystal changes into a liquid.
- D. It is the enthalpy change that occurs when 1 mol of solid crystal is formed from its gaseous ions.

Markscheme

D

Examiners report

[N/A]

Which equation corresponds to the lattice enthalpy for silver iodide, Agl?

- $\mathsf{A.} \quad \mathrm{AgI}(s) \to \mathrm{Ag}(s) + \mathrm{I}(g)$
- $\mathsf{B}. \quad \mathrm{AgI}(s) \to \mathrm{Ag}(s) + \tfrac{1}{2} \mathrm{I}_2(g)$
- $\text{C.} \quad \mathrm{AgI}(s) \to \mathrm{Ag^+}(\mathrm{aq}) + \mathrm{I^-}(\mathrm{aq})$
- $\mathsf{D}. \quad \mathrm{AgI}(s) \to \mathrm{Ag^+}(g) + \mathrm{I^-}(g)$

[N/A]

D

Which reaction has the largest increase in entropy?

- $\text{A.} \quad H_2(g) + \operatorname{Cl}_2(g) \to 2H\operatorname{Cl}(g)$
- $\mathsf{B}. \quad \mathrm{Al}(\mathrm{OH})_3(s) + \mathrm{NaOH}(\mathrm{aq}) \to \mathrm{Al}(\mathrm{OH})_4^-(\mathrm{aq}) + \mathrm{Na}^+(\mathrm{aq})$
- $\label{eq:constraint} \mbox{C.} \quad \mbox{Na}_2 \mbox{CO}_3(s) + 2 \mbox{HCl}(aq) \rightarrow 2 \mbox{NaCl}(aq) + \mbox{CO}_2(g) + \mbox{H}_2 \mbox{O}(l)$
- $\label{eq:def-basic} \text{D.} \quad \mathrm{BaCl}_2(\mathrm{aq}) + \mathrm{Na}_2\mathrm{SO}_4(\mathrm{aq}) \to \mathrm{BaSO}_4(s) + 2\mathrm{NaCl}(\mathrm{aq})$

Markscheme

С

Examiners report

[N/A]

Which reaction has the greatest increase in entropy?

- $\label{eq:solution} \mbox{A.} \quad \mathrm{SO}_2(g) + 2\mathrm{H}_2\mathrm{S}(g) \rightarrow 2\mathrm{H}_2\mathrm{O}(l) + 3\mathrm{S}(s)$
- ${\sf B}.\quad {\rm CaO}(s)+{\rm CO}_2(g)\to {\rm CaCO}_3(s)$
- $\label{eq:Calculation} \text{C.} \quad \mathrm{CaC}_2(s) + 2\mathrm{H}_2\mathrm{O}(l) \rightarrow \mathrm{Ca(OH)}_2(s) + \mathrm{C}_2\mathrm{H}_2(g)$
- $\mathsf{D}. \quad N_2(g) + O_2(g) \to 2 \mathrm{NO}(g)$

Markscheme

С

Examiners report

[N/A]

Which equation represents enthalpy of hydration?

- B. $Na^+(g) \rightarrow Na^+(aq)$
- $C. \quad \ \ NaCl(s) \rightarrow Na^+(g) + Cl^-(g)$
- $\text{D.} \quad \text{NaCl(s)} \rightarrow \text{Na}^+(\text{aq}) + \text{Cl}^-(\text{aq})$

В

Examiners report

[N/A]

Which ionic compound has the most endothermic lattice enthalpy?

- A. NaCl
- B. KCI
- C. NaF
- D. KF

Markscheme

С

Examiners report

This question on the effect of ionic radius on lattice enthalpy proved to be quite challenging, with a Difficulty Index of 43%, with many students

considering that the larger potassium ion would give rise to a more endothermic lattice enthalpy than the smaller sodium ion.

Which statement is correct?

- A. If $\Delta H < 0$, reaction is always spontaneous.
- B. If $\Delta H > 0$, reaction is never spontaneous.
- C. If $\Delta S < 0$, reaction can be spontaneous if temperature is low enough.
- D. If $\Delta S < 0$, reaction can be spontaneous if temperature is high enough.

[N/A]

Which step(s) is/are endothermic in the Born-Haber cycle for the formation of LiCl?

- A. $\frac{1}{2}Cl_2(g) \rightarrow Cl(g)$ and $Li(s) \rightarrow Li(g)$
- B. $\operatorname{Cl}(g) + e^- \to \operatorname{Cl}^-(g)$ and $\operatorname{Li}(g) \to \operatorname{Li}^+(g) + e^-$
- $\text{C.} \quad \mathrm{Li}^+(g) + \mathrm{Cl}^-(g) \to \mathrm{Li}\mathrm{Cl}(s)$
- D. $\frac{1}{2}Cl_2(g) \rightarrow Cl(g)$ and $Cl(g) + e^- \rightarrow Cl^-(g)$

Markscheme

A

Examiners report

In this question which referred to the Born-Haber cycle for the formation of LiCl, two respondents stated that the question was confusing especially for ESL candidates. In fact, the 68% of candidates got the correct answer, namely A and it was not felt that the wording of the question would have posed any problem even for ESL candidates.

Which ion's hydration energy is the most exothermic?

A. Li⁺

- B. Na⁺
- C. Br⁻
- D. I⁻

Markscheme

A

Examiners report



- B. -829 + 164 + 243 + 550 + 1064 698
- C. (-829) + 164 + 243 + 550 + 1064 698
- D. -829 + 164 + 243 + 550 + 1064 (-698)

С

Examiners report

[N/A]

Which change will **not** increase the entropy of a system?

- A. Increasing the temperature
- B. Changing the state from liquid to gas
- C. Mixing different types of particles
- D. A reaction where four moles of gaseous reactants changes to two moles of gaseous products

[N/A]

Which reaction has the greatest increase in entropy?

- $\label{eq:constraint} \mbox{A.} \quad C_3H_8(g)+5O_2(g)\rightarrow 3CO_2(g)+4H_2O(g)$
- ${\sf B}. \quad {\rm H}_2(g) + {\rm Cl}_2(g) \rightarrow 2 {\rm HCl}(g)$
- $\text{C.} \quad N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
- $\mathsf{D}.\quad C_2H_4(g)+H_2(g)\to C_2H_6(g)$

Markscheme

A

Examiners report

[N/A]

	ΔH	Δs
Α.	+	+
B.	+	-
C.	_	-
D.	-	+

Which combination of ΔH and ΔS signs will always result in a spontaneous reaction at all temperatures?

Markscheme

D

Examiners report

Which compound has the most positive lattice enthalpy of dissociation?

- A. NaCl
- B. NaBr
- C. $MgCl_2$
- $\mathsf{D}.\quad MgBr_2$

Markscheme

С

Examiners report

Three respondents asked why "most positive" had been used in place of "greatest". Lattice enthalpy in the IB Data Booklet is given for the

endothermic reaction whereas in many data books they are given, with a negative sign, for the reverse reaction. The intention was to prevent

misunderstanding.

Which transition represents an enthalpy of hydration?

- A. $2H_2O(I) \rightarrow H_3O^+(aq) + OH^-(aq)$
- B. NaCl (s) \rightarrow Na⁺ (aq) + Cl⁻ (aq)
- C. K⁺⁽s)→K⁺(aq)
- D. $K^+(g) \rightarrow K^+(aq)$

Markscheme

D

Examiners report

[N/A]

Which combination of ΔH and ΔS values corresponds to a non-spontaneous reaction at all temperatures?

	∆н	∆s
A.	_	_
В.	+	-
C.	-	+
D.	+	+

В

Examiners report

[N/A]

Which reactions/processes have a positive entropy change, ΔS^{Θ} ?

- I. $NaCl(s) \rightarrow NaCl(aq)$
- $\label{eq:linear} \text{II.} \quad Na_2CO_3(s) + 2HCl(aq) \rightarrow CO_2(g) + 2NaCl(aq) + H_2O(l)$
- $\label{eq:alpha} \mbox{III.} \quad AgNO_3(aq) + NaCl(aq) \rightarrow AgCl(s) + NaNO_3(aq)$
- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

Markscheme

A

Examiners report

[N/A]

Which change leads to an increase in entropy?

- $\text{A.} \quad \mathrm{CO}_2(g) \to \mathrm{CO}_2(s)$
- $\mathsf{B.} \quad \mathrm{SF}_6(g) \to \mathrm{SF}_6(l)$
- $\text{C.} \quad H_2O(l) \to H_2O(s)$
- $\mathsf{D.} \quad \mathrm{NaCl}(s) \to \mathrm{NaCl}(\mathrm{aq})$

Markscheme

D

Examiners report

Which ionic compound has the most endothermic lattice enthalpy?

- A. Sodium chloride
- B. Sodium oxide
- C. Magnesium chloride
- D. Magnesium oxide

Markscheme

D

Examiners report

This question was thought to be "ambiguous as lattice energy can be defined as an exothermic or endothermic process". Students should be familiar

with the idea of lattice energy as an endothermic process as that is how it is described in the IB Chemistry Data Booklet. A similar question was set in

May 2011, TZ2.

This was the fourth hardest question, being scored correctly by 55.81%. The other answers were fairly evenly spread between A, C and B (in that order).

Which factors will increase the entropy of this system?

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$$

- I. Increasing the temperature without changing the volume of the container.
- II. Decreasing the concentration of the gas without changing the volume of the container.
- III. Increasing the pressure without changing the volume of the container.
- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

Markscheme

A

Examiners report

There were three G2 comments on this question which asked candidates to ascertain which factors would increase the entropy of a given system. All

three comments suggested that the wording of the question could have been clearer. 45% of candidates got the correct answer.

Which system has the most negative entropy change, ΔS , for the forward reaction?

- A. $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
- $B. \quad CaCO_3(s) \to CaO(s) + CO_2(g)$
- $\text{C.} \quad 2S_2O_3{}^{2-}(\text{aq}) + I_2(\text{aq}) \rightarrow S_4O_6{}^{2-}(\text{aq}) + 2I^-(\text{aq})$
- $\mathsf{D}. \quad \mathsf{H}_2\mathsf{O}(\mathsf{I})\to\mathsf{H}_2\mathsf{O}(\mathsf{g})$

Markscheme

A

Examiners report

[N/A]

Which change must be negative when a reaction occurs spontaneously?

- A. ΔH
- B. ΔG
- C. ΔS
- D. ΔT

Markscheme

В

Examiners report

[N/A]

Which statements are correct for ionic compounds?

- I. Lattice energy increases as ionic radii increase.
- II. Within the same group, the melting point of salts tends to decrease as the radius of the cation increases.
- III. Solubility in water depends on the relative magnitude of the lattice energy compared to the hydration energy.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

С

Examiners report

[N/A]

Which processes have a negative value for ΔS^{Θ} ?

- I. $H_2O(l)
 ightarrow H_2O(s)$
- II. $2H_2O_2(l)
 ightarrow 2H_2O(l) + O_2(g)$
- III. $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$
- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

Markscheme

В

Examiners report

[N/A]

Which processes are predicted to have a positive entropy change, ΔS ?

- $\text{I.} \quad I_2(g) \to I_2(s)$
- $\text{II.} \quad 4NH_3(g)+5O_2(g) \rightarrow 4NO(g)+6H_2O(g)$
- $\hbox{III.} \quad CH_3OH(l) \to CH_3OH(g)$
- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

[N/A]

Which equation represents the lattice enthalpy of magnesium sulfide?

A. MgS (s) \rightarrow Mg (g) + S (g) B. MgS (s) \rightarrow Mg⁺ (g) + S⁻ (g) C. MgS (s) \rightarrow Mg²⁺ (g) + S²⁻ (g) D. MgS (s) \rightarrow Mg (s) + S (s)

Markscheme

С

Examiners report

[N/A]

Which equation represents the second electron affinity of oxygen?

- A. $rac{1}{2}\mathrm{O}_2(\mathrm{g})+2\mathrm{e}^ightarrow\mathrm{O}^{2-}(\mathrm{g})$
- $\mathsf{B.} \quad \mathrm{O}(g) + 2\mathrm{e}^- \to \mathrm{O}^{2-}(g)$
- $\mbox{C.} \quad O_2(g)+4e^- \rightarrow 2O^{2-}(g)$
- $\mathsf{D.} \quad \mathrm{O}^-(g) + e^- \to \mathrm{O}^{2-}(g)$

Markscheme

D

Examiners report

[N/A]

Which combinations of values will result in a spontaneous reaction?

	$\Delta H / kJ mol^{-1}$	∆S / J K ⁻¹ mol ⁻¹	<i>T / K</i>
I.	-100	-100	300
II.	+100	-100	300
III.	+100	+100	3000

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

В

Examiners report

[N/A]

What are the signs for the entropy changes associated with this reaction?

 $H_2O(g) \to H_2O(I)$

	$\Delta S_{surroundings}$	ΔS_{system}
Α.	+	_
В.	+	+
C.	_	_
D.	_	+

Markscheme

А

Examiners report

[N/A]

Which combination of ΔH^{θ} and ΔS^{θ} will result in a non-spontaneous reaction at all temperatures?

	∆H ^e	∆S ^e
A.	positive	negative
В.	negative	positive
C.	positive	positive
D.	negative	negative

А

Examiners report

[N/A]

The combustion of glucose is exothermic and occurs according to the following equation:

$$C_6H_{12}O_6~(s)$$
 + $6O_2~(g) \rightarrow 6CO_2~(g)$ + $6H_2O~(g)$

Which is correct for this reaction?

	ΔH ^e	∆S⇔	Spontaneous/ non-spontaneous
A.	negative	positive	spontaneous
В.	negative	positive	non-spontaneous
C.	positive	negative	spontaneous
D.	positive	positive	non-spontaneous

Markscheme

А

Examiners report



Which expression represents the lattice enthalpy in kJ mol⁻¹?

- A. -361 + 428 + 838 + 612
- B. –(–361) + 428 + 838 + 612
- C. -361 + 428 + 838 612
- D. -(-361) + 428 + 838 612

Markscheme

в

Examiners report

[N/A]

What is the correct order for increasing lattice enthalpy?

- $\label{eq:mgO} \mbox{A.} \quad MgO < MgCl_2 < NaCl < CsCl$
- $\label{eq:B.Cl} \mathsf{B.} \quad \mathrm{CsCl} < \mathrm{MaCl} < \mathrm{MgCl}_2 < \mathrm{MgO}$
- $\label{eq:classical_constraint} \textbf{C}. \quad NaCl < CsCl < MgO < MgCl_2$
- $\label{eq:def_def_def_def} \mbox{D.} \quad NaCl < CsCl < MgCl_2 < MgO$

Markscheme

В

Examiners report

Consider the following information:

$$egin{aligned} & ext{CaCO}_3(ext{s}) o ext{CaO}(ext{s}) + ext{CO}_2(ext{g}) \ &\Delta H = +179 ext{ kJ mol}^{-1} \ &\Delta S = +161.0 ext{ J K}^{-1} ext{mol}^{-1} \end{aligned}$$

What happens to the spontaneity of this reaction as the temperature is increased?

- A. The reaction becomes more spontaneous as the temperature is increased.
- B. The reaction becomes less spontaneous as the temperature is increased.
- C. The reaction remains spontaneous at all temperatures.
- D. The reaction remains non-spontaneous at all temperatures.

Markscheme

А

Examiners report

[N/A]

Which equation represents the lattice enthalpy of calcium chloride?

- A. $CaCl(s) \rightarrow Ca^+(g) + Cl^-(g)$
- $\mathsf{B.} \quad \mathrm{CaCl}_2(s) \to \mathrm{Ca}^{2+}(g) + 2\mathrm{Cl}^-(g)$
- $\text{C.} \quad \mathrm{CaCl}_2(g) \to \mathrm{Ca}^{2+}(g) + 2\mathrm{Cl}^-(g)$
- $\label{eq:def-D} \mathsf{D}. \quad \mathrm{Ca}\mathrm{Cl}_2(s) \to \mathrm{Ca}^{2+}(\mathrm{aq}) + 2\mathrm{Cl}^-(\mathrm{aq})$

Markscheme

В

Examiners report

[N/A]

Which ionic compound has the greatest lattice enthalpy?

A. MgO

B. CaO

- C. NaF
- D. KF

Α

Examiners report

[N/A]

A rea	action has a standard enthalpy change, ΔH^{Θ} , of $+10.00~{ m kJmol^{-1}}$ at 298 K. The standard entropy change, ΔS^{Θ} , for the same reaction is
+10	$0.00~{ m JK^{-1}mol^{-1}}.$ What is the value of ΔG^{Θ} for the reaction in $ m kJmol^{-1}$?
A.	+9.75
В.	+7.02
C.	-240
D.	-2970

Markscheme

в

Examiners report

[N/A]

Which process would be expected to have a ΔS^Θ value which is negative?

- $\text{A.} \quad 2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$
- ${\sf B}. \quad {\rm NaCl}(s) \to {\rm Na^+}(g) + {\rm Cl^-}(g)$
- ${\sf C}. \quad {\rm H}_2({\rm g})+{\rm I}_2({\rm g})\rightarrow 2{\rm HI}({\rm g})$
- $\mathsf{D}. \quad \mathrm{OF}_2(g) + \mathrm{H}_2\mathrm{O}(g) \to \mathrm{O}_2(g) + 2\mathrm{HF}(g)$

Markscheme

A

Examiners report

The reaction between but-1-ene and water vapour produces butan-1-ol.

$$\mathrm{C_4H_8(g)} + \mathrm{H_2O(g)} \rightarrow \mathrm{C_4H_9OH(l)}$$

The standard entropy values (S^{Θ}) for but-1-ene, water vapour and butan-1-ol are 310, 189 and $228 \text{ J K}^{-1} \text{mol}^{-1}$ respectively. What is the standard entropy change for this reaction in $\text{J K}^{-1} \text{mol}^{-1}$?

A. –271

- B. +271
- C. –107
- D. +107

Markscheme

А

Examiners report

[N/A]

thick combination of onthing of and onthopy on ango produced a non-opentationed reaction at an temperature.	Which combination of enthalpy	change and entropy of	change produces a non-	spontaneous reaction at	all temperatures?
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	ΔH	ΔS
А.	+	-
B.	+	+
C.	_	-
D.	-	+

Markscheme

А

Examiners report

[N/A]

When hydrogen peroxide decomposes, the temperature of the reaction mixture increases.

 $2\mathrm{H}_2\mathrm{O}_2(\mathrm{aq})\to\mathrm{O}_2(\mathrm{g})+2\mathrm{H}_2\mathrm{O}(\mathrm{l})$

	ΔH	Δs	ΔG
A.	-	-	-
В.	-	+	-
C.	+	+	-
D.	-	+	+

в

Examiners report

[N/A]

Which ionic compound has the largest value of lattice enthalpy?

A. MgS

B. MgO

C. CaBr₂

D. NaF

Markscheme

В

Examiners report

[N/A]

Which reaction has the greatest increase in entropy?

- $\label{eq:alpha} \mbox{A.} \quad 2 \mbox{CH}_3 \mbox{OH}(l) + 3 \mbox{O}_2(g) \rightarrow 2 \mbox{CO}_2(g) + 4 \mbox{H}_2 \mbox{O}(l)$
- $\mathsf{B}. \quad \mathrm{N}_2(g) + 3\mathrm{H}_2(g) \to 2\mathrm{NH}_3(g)$
- $\label{eq:classical_constraint} \mbox{C.} \quad 2 HCl(aq) + MgCO_3(s) \rightarrow MgCl_2(aq) + H_2O(l) + CO_2(g)$
- $\mathsf{D}. \quad \mathrm{NH}_3(g) + \mathrm{HCl}(g) \to \mathrm{NH}_4\mathrm{Cl}(s)$

[N/A]

Which species are arranged in order of increasing entropy?

- $\label{eq:alpha} \mbox{A.} \quad C_3H_8(g) \ < \ CH_3OH(l) \ < \ Hg(l) \ < \ Na(s)$
- ${\tt C.} ~~ {\rm Na}(s) ~<~ {\rm Hg}(l) ~<~ {\rm CH}_3 {\rm OH}(l) ~< {\rm C}_3 {\rm H}_8(g)$
- ${\sf D}.~~Na(s)~<~Hg(l)~< C_{3}H_{8}(g)~<~CH_{3}OH(l)$

Markscheme

С

Examiners report

[N/A]

Which equation represents the electron affinity of chlorine?

- $\text{A.} \quad \mathrm{Cl}(g) + e^- \to \mathrm{Cl}^-(g)$
- $\mathsf{B.} \quad \mathrm{Cl}(\mathrm{g}) + \mathrm{e}^- \to \mathrm{Cl}(\mathrm{g})$
- $\text{C.} \quad \mathrm{Cl}_2(\mathrm{g}) + 2\mathrm{e}^- \to 2\mathrm{Cl}^-(\mathrm{g})$
- $\mathsf{D}. \quad \mathrm{Cl}(g) \to \mathrm{Cl}^+(g) + e^-$

Markscheme

A

Examiners report

[N/A]

What is the correct definition of lattice enthalpy?

- B. Enthalpy change when one mole of a solid ionic compound is separated into its ions in their standard state.
- C. Enthalpy change when one mole of a solid ionic compound is formed from gaseous elements.
- D. Enthalpy change when one mole of a compound is formed from the elements in their standard states.

А

Examiners report

[N/A]

The Born-Haber cycle for the formation of magnesium oxide is shown below.



What is a correct description of the steps X, Y and Z in this cycle?

	Step X	Step Y	Step Z
A.	2nd ionization energy of Mg	enthalpy of formation of MgO	lattice enthalpy of MgO
В.	2nd ionization energy of Mg	lattice enthalpy of MgO	enthalpy of formation of MgO
C.	sum of the 1st and 2nd ionization energies of Mg	lattice enthalpy of MgO	enthalpy of formation of MgO
D.	sum of 1st and 2nd ionization energies of Mg	enthalpy of formation of MgO	lattice enthalpy of MgO

[N/A]

Which combination of ions will give the greatest absolute lattice enthalpy?

- A. A small positive ion with a high charge and a small negative ion with a high charge
- B. A small positive ion with a low charge and a small negative ion with a low charge
- C. A large positive ion with a high charge and a large negative ion with a high charge
- D. A large positive ion with a low charge and a small negative ion with a low charge

Markscheme

A

Examiners report

[N/A]

The rate expression for the reaction between iodine and propanone with an acid catalyst is found to be:

 $\mathrm{rate} = k \mathrm{[H^+]^1 [I_2]^0 [CH_3 \mathrm{COCH_3}]^1}$

What is the overall order of the reaction?

- A. 0
- B. 1
- C. 2
- D. 3

Markscheme

С

Examiners report

 ΔG^{Θ} calculations predict that a reaction is always spontaneous for which of the following combinations of ΔH^{Θ} and ΔS^{Θ} ?

- A. $+\Delta H^{\Theta}$ and $+\Delta S^{\Theta}$
- B. $+\Delta H^{\Theta}$ and $-\Delta S^{\Theta}$
- C. $-\Delta H^{\Theta}$ and $-\Delta S^{\Theta}$
- D. $-\Delta H^{\Theta}$ and $+\Delta S^{\Theta}$

Markscheme

D

Examiners report

There were eight G2 comments on this question. Most stated that a table would have been better for the presentation of the four possible

combinations which is a reasonable suggestion.

	Lattice enthalpy	Electron affinity
A.	$X^+(g) + Y^-(g) \rightarrow XY(g)$	$Y^-(g) + e^- \rightarrow Y^{2-}(g)$
В.	$X^+(g) + Y^-(g) \rightarrow XY(s)$	$Y(g) + e^- \rightarrow Y^-(g)$
С.	$X^+(g) + Y^-(g) \rightarrow XY(s)$	$Y(s) + e^- \rightarrow Y^-(s)$
D.	$X^+(g) + Y^-(g) \rightarrow XY(g)$	$Y(g) + e^- \rightarrow Y^-(g)$

Which row of the table correctly represents the equations for the lattice enthalpy of substance XY and the electron affinity of atom Y?

Markscheme

В

Examiners report

[N/A]

What is the standard entropy change, ΔS^{Θ} , for the following reaction?

 $\rm 2CO(g) + O_2(g) \rightarrow \rm 2CO_2(g)$

	CO(g)	O ₂ (g)	CO ₂ (g)
S^{Θ} / J K ⁻¹ mol ⁻¹	198	205	214

- A. –189
- B. –173
- C. +173
- D. +189

В

Examiners report

[N/A]

What is the enthalpy of solution of $MgF_2(s)$ in kJ mol⁻¹?

Lattice enthalpy of MgF₂(s) = 2926 kJ mol⁻¹ Hydration enthalpy of Mg²⁺(g) = -1963 kJ mol⁻¹ Hydration enthalpy of F⁻(g) = -504 kJ mol⁻¹

- A. 2926 1963 + 2(-504)
- B. 2926 1963 504
- C. -2926 (-1963) (-504)
- D. -2926 (-1963) 2(-504)

Markscheme

A

Examiners report

[N/A]

When solid potassium chlorate, $KClO_3$, dissolves in distilled water the temperature of the solution decreases. What are the signs of ΔH^{Θ} , ΔS^{Θ} and ΔG^{Θ} for this spontaneous process?



В

Examiners report

[N/A]

Which represents the enthalpy change of hydration of the chloride ion?

- A. $Cl^{-}(g) \xrightarrow{H_2O} Cl^{-}(aq)$
- B. $Cl(g) \xrightarrow{H_2O} Cl^-(aq)$

$$C. \quad \frac{1}{2}\operatorname{Cl}_2(g) \xrightarrow{H_2O} \operatorname{Cl}^-(aq)$$

 $\mathsf{D}. \quad \frac{1}{2}\operatorname{Cl}_2(\mathsf{aq}) \xrightarrow{\mathsf{H}_2\mathsf{O}} \operatorname{Cl}^-(\mathsf{aq})$

Markscheme

А

Examiners report

[N/A]

During which process is there a **decrease** in the entropy of the system?

$$\label{eq:alpha} \mbox{A.} \quad \mathrm{Ag}(s) + 2\mathrm{H}^+(\mathrm{aq}) + \mathrm{NO}_3^-(\mathrm{aq}) \rightarrow \mathrm{Ag}^+(\mathrm{aq}) + \mathrm{H}_2\mathrm{O}(\mathrm{l}) + \mathrm{NO}_2(\mathrm{g})$$

- $\text{B.} \quad Ba(OH)_2(s) \to BaO(s) + H_2O(g)$
- $\mathsf{C}. \quad \mathrm{PCl}_3(g) + \mathrm{Cl}_2(g) \to \mathrm{PCl}_5(g)$
- $\mathsf{D}. \quad \mathrm{H}_2\mathrm{O}(s) \to \mathrm{H}_2\mathrm{O}(l)$

Markscheme

С

Examiners report