



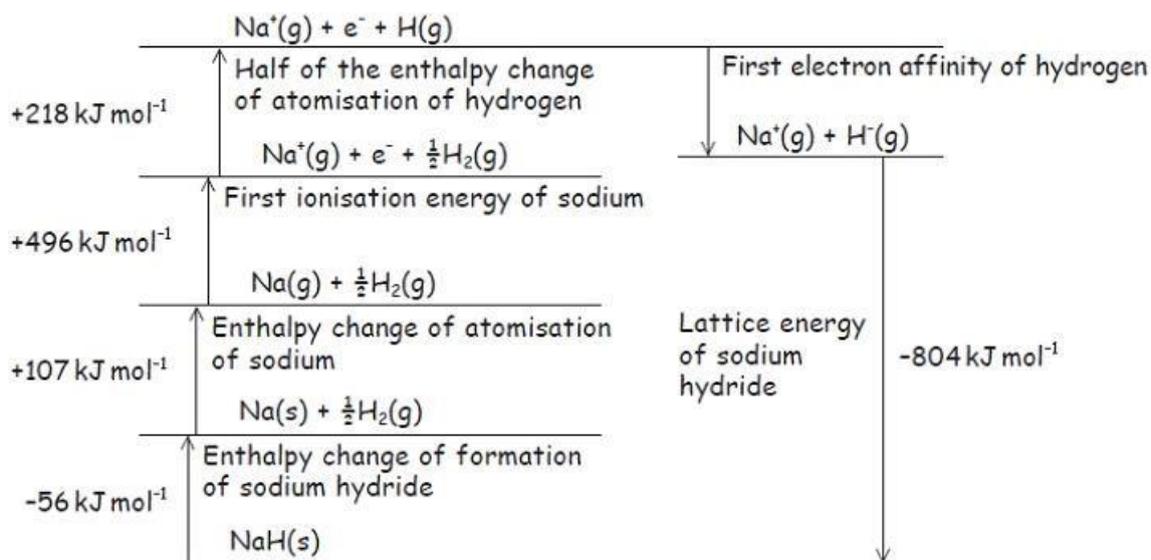
Questions

Q1.

Sodium hydride, NaH, can be used to generate hydrogen for fuel cells.

In order to calculate the first electron affinity of hydrogen, a student was asked to draw a Born-Haber cycle for sodium hydride.

The cycle had **two** errors but the numerical data were correct.



(i) Identify and correct the **two** errors in this Born-Haber cycle.

(2)

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(ii) Calculate the first electron affinity, in kJ mol^{-1} , of hydrogen, using the values given in the cycle.

(1)

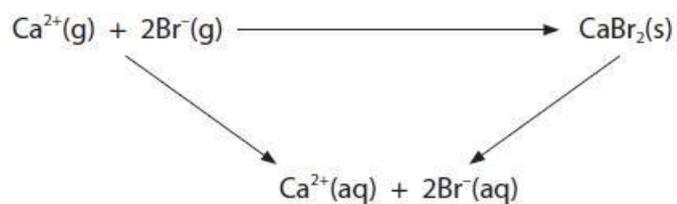
(Total for question = 3 marks)

Edexcel Chemistry A-level - Lattice Energy

Q2.

This question is about lattice energies.

A different energy cycle can be used to calculate lattice energy.



Enthalpy change	Value / kJ mol^{-1}
enthalpy change of solution of CaBr_2	-73
enthalpy change of hydration of Ca^{2+}	-1577
enthalpy change of hydration of Br^{-}	-336

Calculate the lattice energy of calcium bromide.

(2)

(Total for question = 2 marks)

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(ii) Calculate the lattice energy of copper(II) oxide.

(1)

(Total for question = 5 marks)



Q4.

This question is about enthalpy changes and energy changes.

Use the data in the table to answer the questions.

Enthalpy change	Value / kJ mol^{-1}
Enthalpy change of hydration of K^+	-322
Enthalpy change of hydration of Ca^{2+}	-1650
Enthalpy change of solution of KCl	+17.2
Lattice energy of KCl	-711

(i) Name the two properties of ions that affect the value of their enthalpy change of hydration.

(2)

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(ii) Calculate the enthalpy change of hydration for chloride ions by completing the energy cycle, including labels, and using the data in the table.

(3)



enthalpy change of hydration for Cl^- ions kJ mol^{-1}

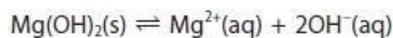
(Total for question = 5 marks)

Edexcel Chemistry A-level - Lattice Energy

Q5.

This question is about the solubility of metal hydroxides.

When excess magnesium hydroxide is added to water and shaken, a saturated solution is formed and the mixture reaches equilibrium.



The equilibrium constant, K_c , for this reaction is

$$K_c = [\text{Mg}^{2+}(\text{aq})][\text{OH}^{-}(\text{aq})]^2$$

(i) Give a reason why the magnesium hydroxide is not included in the expression for K_c .

(1)

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(ii) Give the units for K_c .

(1)

(iii) Calculate the enthalpy change of solution of magnesium hydroxide, using the following data.

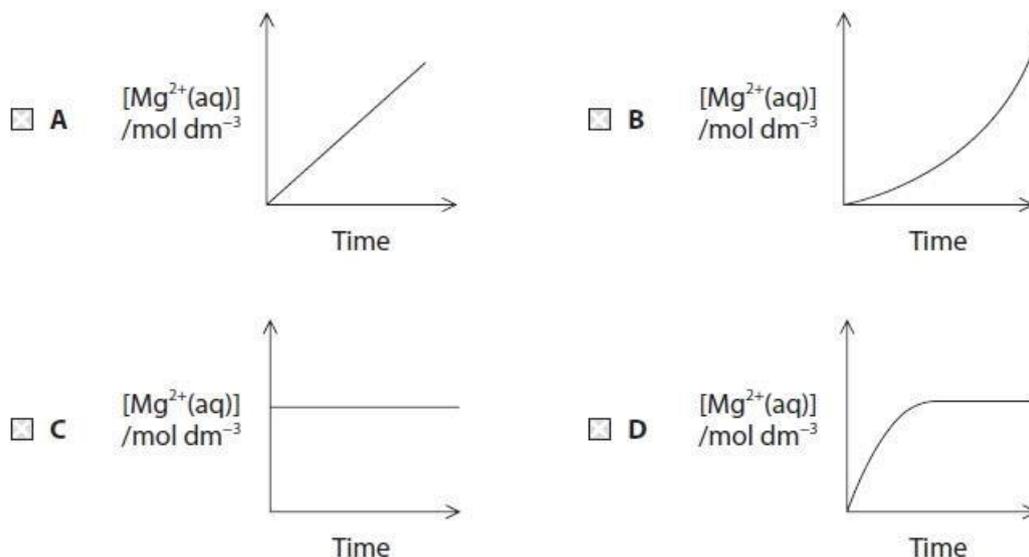
Energy or enthalpy change	Value / kJ mol^{-1}
Lattice energy of $\text{Mg(OH)}_2(\text{s})$	-2842
$\Delta_{\text{hyd}}H$ ($\text{Mg}^{2+}(\text{aq})$)	-1920
$\Delta_{\text{hyd}}H$ ($\text{OH}^{-}(\text{aq})$)	-460

(2)

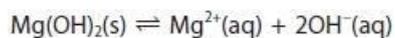


(iv) Which graph shows the change in the concentration of the $\text{Mg}^{2+}(\text{aq})$ ions when some solid magnesium hydroxide is shaken with water and left to reach equilibrium?

(1)



(v) Predict the effect, if any, of adding each of the following to a saturated solution of magnesium hydroxide in contact with solid magnesium hydroxide. Justify your answers in terms of the effect on the equilibrium.



(4)

Magnesium sulfate solution

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Dilute hydrochloric acid

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(Total for question = 9 marks)

Edexcel Chemistry A-level - Lattice Energy

Q6.

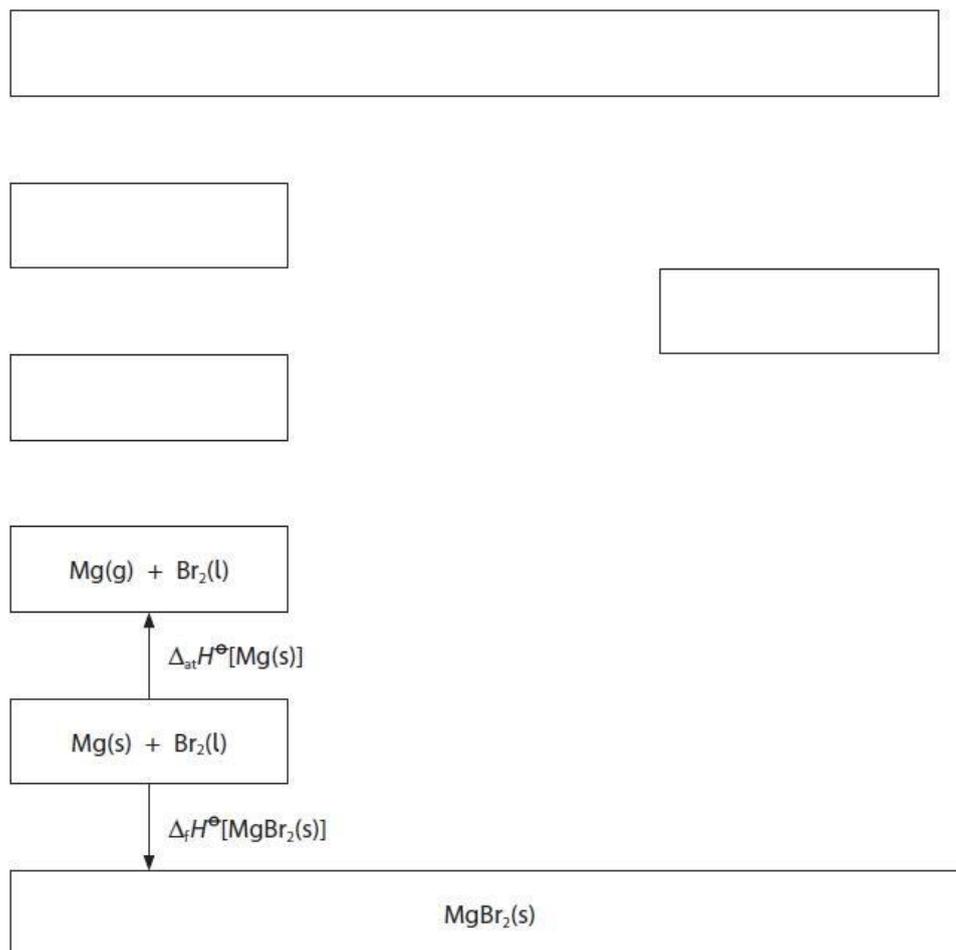
Magnesium bromide, MgBr_2 , is an ionic compound.

The table shows the enthalpy changes needed to calculate the first electron affinity of bromine.

Enthalpy change	Value / kJ mol^{-1}
enthalpy change of atomisation of magnesium, $\Delta_{\text{at}}H^\ominus[\text{Mg}(\text{s})]$	+148
1 st ionisation energy of magnesium, 1 st IE[$\text{Mg}(\text{g})$]	+738
2 nd ionisation energy of magnesium, 2 nd IE[$\text{Mg}^+(\text{g})$]	+1 451
enthalpy change of atomisation of bromine, $\Delta_{\text{at}}H^\ominus[\frac{1}{2}\text{Br}_2(\text{l})]$	+112
lattice energy of magnesium bromide, LE[$\text{MgBr}_2(\text{s})$]	-2 440
enthalpy change of formation of magnesium bromide, $\Delta_f H^\ominus[\text{MgBr}_2(\text{s})]$	-524

(i) Complete the Born-Haber cycle for magnesium bromide with formulae, electrons and labelled arrows. The cycle is not drawn to scale.

(3)





(ii) Calculate the first electron affinity of bromine, in kJ mol^{-1} .

(2)

(Total for question = 5 marks)



Q8.

This question is about ions and ionic compounds.

* The table shows the theoretical and experimental lattice energy values of two compounds.

Compound	Theoretical lattice energy / kJ mol^{-1}	Experimental lattice energy / kJ mol^{-1}
lithium chloride, LiCl	-845	-848
magnesium iodide, MgI_2	-1944	-2327

Comment on the theoretical and experimental lattice energy values, giving the reasons for any differences and similarities.

(6)

(Total for question = 6 marks)

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Q9.

This question is about chlorine.

Write the equation for the first electron affinity of chlorine. Include state symbols.

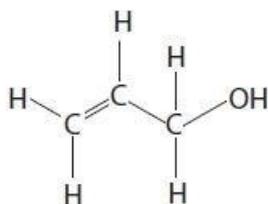
(2)

(Total for question = 2 marks)



Q10.

Prop-2-en-1-ol is an unsaturated alcohol with the structure shown.



A student planned to use bond enthalpy data to calculate a value for the enthalpy change of combustion of prop-2-en-1-ol.

- (i) When researching the bond enthalpy data, the student claimed that it was not necessary to find the value for the C=C bond as they could use the value for a C–C bond and multiply it by two. Explain why the student is **incorrect**.

(2)

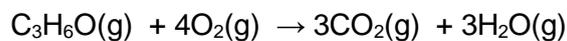
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- (ii) Calculate a value for the enthalpy of combustion of prop-2-en-1-ol using the data shown.



Bond	C–C	C=C	C–O	C=O	O–H	C–H	O=O
Bond enthalpy / kJ mol^{-1}	347	612	358	805	464	413	498

(3)

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(iii) Explain, in terms of entropy, why the combustion of prop-2-en-1-ol is always feasible in the gaseous state.

(2)

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(Total for question = 7 marks)