InkChemistry

QUESTION WORKBOOK

Enthalpies of solution and hydration

Thermodynamics · Unit C08

AQA 3.1.8.1 · OCR A 5.2.1

17 questions · 57 marks

NAVY SCREEN EDITION

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SECTION A · Short, 1 to 2 marks

A1 ESH-Q3

Give equations, with state symbols, for the enthalpy of hydration of the magnesium ion and for the enthalpy of solution of calcium chloride. [2]

SECTION B · Standard, 3 to 5 marks

B1 ESH-Q1

State what is meant by the terms enthalpy of hydration and enthalpy of solution, and state how the starting states of the two differ. [4]

B2 ESH-Q4

Describe how water molecules are arranged around a sodium ion and around a chloride ion in aqueous solution, and explain why every enthalpy of hydration is negative. [4]

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B3 ESH-Q9

Calculate the enthalpy of solution of magnesium chloride. The lattice enthalpy of dissociation of $MgCl_2$ is +2525 kJ mol^{-1}; the enthalpies of hydration are -1920 kJ mol^{-1} for Mg^{2+} and -364 kJ mol^{-1} for Cl^-. [4]

B4 ESH-Q15

Evaluate this claim: 'The enthalpy of solution of sodium chloride is positive, so sodium chloride cannot dissolve in water at room temperature.' [4]

B5 ESH-Q2

Calculate the enthalpy of hydration of the fluoride ion, given that the enthalpy of solution of sodium fluoride is +1 kJ mol^{-1}, its lattice enthalpy of dissociation is +913 kJ mol^{-1}, and the enthalpy of hydration of Na^+ is -406 kJ mol^{-1}. [3]

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B6 ESH-Q5 Explain why the enthalpy of hydration of Mg^{2+}, -1920 kJ mol^{-1}, is much more exothermic than that of Na^{+}, -406 kJ mol^{-1}. [3]

B7 ESH-Q6 Explain why the enthalpy of hydration becomes less exothermic from Li^{+} to Cs^{+}. [3]

B8 ESH-Q8 Calculate the enthalpy of solution of potassium bromide. The lattice enthalpy of dissociation of KBr is +689 kJ mol^{-1}; the enthalpies of hydration are -322 kJ mol^{-1} for K^{+} and -348 kJ mol^{-1} for Br^{-}. [3]

B9 ESH-Q10 Calculate the lattice enthalpy of dissociation of lithium chloride. Its enthalpy of solution is -37 kJ mol^{-1}; the enthalpies of hydration are -519 kJ mol^{-1} for Li^{+} and -364 kJ mol^{-1} for Cl^{-}. [3]

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B10 ESH-Q12 Suggest why the Group 2 hydroxides become more soluble down the group, in terms of lattice enthalpy and hydration enthalpy. [3]

B11 ESH-Q14 Compare the hydration of a sodium ion, radius 102 pm, with the hydration of a chloride ion, radius 181 pm. [3]

B12 ESH-Q17 Outline how the enthalpy of solution of a salt can be measured in a school laboratory. [3]

B13 ESH-Q19 Explain why the entropy change when magnesium sulfate dissolves in water is negative, although its ions leave an ordered lattice. [3]

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B14 ESH-Q20 Suggest why hydrated calcium chloride, $CaCl_2 \cdot 6H_2O$, dissolves in water endothermically, although anhydrous calcium chloride dissolves exothermically. [3]

B15 ESH-Q21 Explain why sodium chloride dissolves in water but not in hexane. [3]

SECTION C · Long, 6 marks or more

C1 ESH-Q16 Explain, in terms of lattice enthalpy and hydration enthalpy, why magnesium sulfate is soluble in water and barium sulfate is almost insoluble. [6]

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