# Lattice energy - 2021

**1.** Nov/2020/Paper_41/No.2

**(a)** The lattice energies of three ionic compounds are given.

| compound | lattice energy / kJ mol$^{-1}$ |
|---|---|
| LiF(s) | –1022 |
| CaO(s) | –3513 |
| SrO(s) | –3310 |

**(i)** Define the term *lattice energy*.

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..... [2]

**(ii)** Explain why the lattice energy of CaO is more exothermic than the lattice energy of LiF.

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..... [1]

**(iii)** Use the data in the table to estimate approximate values for the lattice energies of magnesium oxide and barium oxide.

$\Delta H_{latt}$MgO(s) = ..... kJ mol$^{-1}$

$\Delta H_{latt}$BaO(s) = ..... kJ mol$^{-1}$ [1]

**(b) (i)** Write an equation for the reaction between BaO and $H_2O$.
Include state symbols.

..... [1]

**(ii)** State and explain how the solubilities of the hydroxides of the Group 2 elements vary down the group.

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..... [4]

**(c)** Use the following data and relevant data from the *Data Booklet* to calculate a value for the lattice energy of magnesium fluoride, $MgF_2(s)$.

You might find it helpful to construct an energy cycle.
Show your working.

| | |
|---|---|
| electron affinity of F(g) | $= -348\,kJ\,mol^{-1}$ |
| enthalpy change of atomisation of Mg(s) | $= +147\,kJ\,mol^{-1}$ |
| enthalpy change of formation of $MgF_2(s)$ | $= -1102\,kJ\,mol^{-1}$ |

$\Delta H_{latt} MgF_2(s)$ = ..... [3]

**(d)** **(i)** Define the term *electron affinity*.

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..... [2]

**(ii)** The electron affinity of carbon, C(g), is $-120\,kJ\,mol^{-1}$.

Suggest an explanation for the difference between the electron affinity of fluorine and the electron affinity of carbon.

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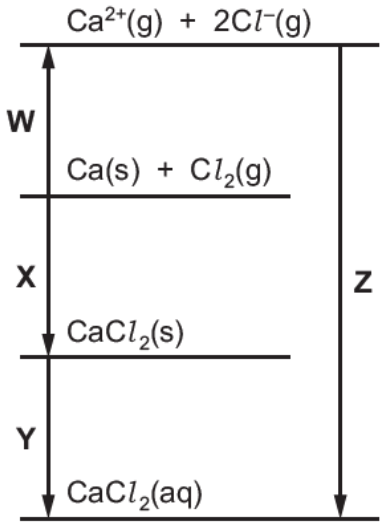
..... [1]

[Total: 15]

**2.** Nov/2020/Paper_42/No.3

**(a)** The energy cycle shown can be used, along with suitable data, to calculate the enthalpy change of hydration of $Ca^{2+}(g)$.
Each arrow indicates a transformation, **W**, **X**, **Y** and **Z**. Each transformation consists of one or more steps.




The following data and data from the *Data Booklet* should be used.

| | |
|---|---|
| electron affinity of $Cl(g)$ | = –349 kJ mol$^{-1}$ |
| enthalpy change of atomisation of Ca(s) | = +193 kJ mol$^{-1}$ |
| enthalpy change of formation of $CaCl_2(s)$ | = –795 kJ mol$^{-1}$ |
| enthalpy change of solution of $CaCl_2(s)$ | = –83 kJ mol$^{-1}$ |
| enthalpy change of hydration of $Cl^-(g)$ | = –364 kJ mol$^{-1}$ |

**(i)** Calculate the value of the enthalpy change corresponding to transformation **W**.
Show your working.

enthalpy change **W** = ..... kJ mol$^{-1}$ [2]

**(ii)** Use your answer to **(a)(i)** and other data to calculate the value of the enthalpy change corresponding to transformation **Z**.

enthalpy change **Z** = ..... $kJ\,mol^{-1}$ [2]

**(iii)** Use your answer to **(a)(ii)** to calculate the enthalpy change of hydration of $Ca^{2+}(g)$.

enthalpy change of hydration of $Ca^{2+}(g)$ = ..... $kJ\,mol^{-1}$ [2]

**(iv)** Write an expression, in terms of **W**, **X**, **Y** and/or **Z**, to show how the enthalpy changes of **two** of the transformations can be used to calculate the lattice energy of $CaCl_2(s)$.

lattice energy of $CaCl_2(s)$ = ..... [1]

**(v)** State whether the lattice energy of $CaCl_2(s)$ is more or less exothermic than the lattice energy of $MgF_2(s)$.

Explain your answer.

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..... [1]

**(b)** The sulfates of the Group 2 elements vary in solubility down Group 2.

**(i)** Give the names of **two** solutions that could be mixed to form barium sulfate.

..... [1]

**(ii)** State and explain how the solubilities of the sulfates of the Group 2 elements vary down Group 2.

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..... [4]

[Total: 13]

**3.** June/2020/Paper_42/No.7b,7c

**(b)** Use the following data and relevant data from the *Data Booklet* to calculate a value for the enthalpy change of formation of zinc bromide, $ZnBr_2(s)$.

You might find it helpful to construct an energy cycle.

| | |
|---|---|
| electron affinity of Br(g) | = –325 kJ mol$^{-1}$ |
| enthalpy change of atomisation of Zn(s) | = +131 kJ mol$^{-1}$ |
| enthalpy change of vaporisation of $Br_2(l)$ | = +31 kJ mol$^{-1}$ |
| lattice energy of $ZnBr_2(s)$ | = –2678 kJ mol$^{-1}$ |



enthalpy change of formation of $ZnBr_2(s)$ = ..... kJ mol$^{-1}$ [4]

**(c)** The lattice energies of $ZnBr_2$, $ZnCl_2$ and ZnO are shown.

| compound | lattice energy / kJ mol$^{-1}$ |
|---|---|
| $ZnBr_2$ | –2678 |
| $ZnCl_2$ | –2734 |
| ZnO | –3971 |

**(i)** Explain why there is a difference between the lattice energies of $ZnBr_2$ and $ZnCl_2$.

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..... [1]

**(ii)** Explain why there is a difference between the lattice energies of $ZnCl_2$ and ZnO.

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..... [1]