1 What is the equation for the first electron affinity of sulfur?

☒ **A** $S(s) + e^- \rightarrow S^-(g)$

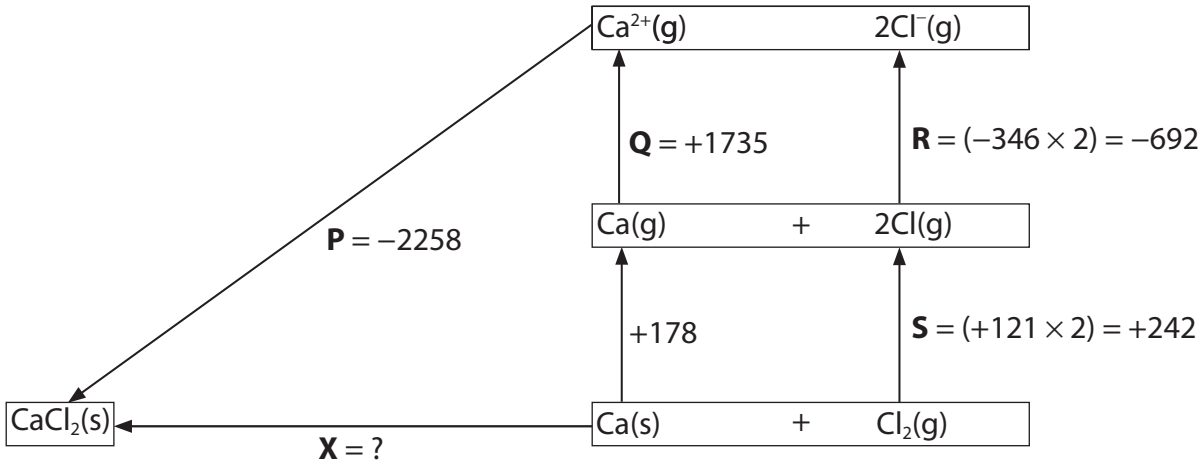
☒ **B** $S(g) + e^- \rightarrow S^-(g)$

☒ **C** $S(s) \rightarrow S^+(g) + e^-$

☒ **D** $S(g) \rightarrow S^+(g) + e^-$

(Total for Question = 1 mark)

2 The diagram shows a Born-Haber cycle for calcium chloride. It is not drawn to scale. All units are in kJ mol^{-1}.



(a) Which enthalpy change is correctly labelled on the diagram?

(1)

☒ **A** Enthalpy change for the formation of calcium chloride (**P**).

☒ **B** First ionization energy of calcium (**Q**).

☒ **C** Electron affinity of chlorine (**R**).

☒ **D** Twice the enthalpy change of atomization of chlorine (**S**).

(b) What is the value of **X**, in kJ mol^{-1}?

(1)

☒ **A** +795

☒ **B** −795

☒ **C** +3721

☒ **D** −3721

(Total for Question = 2 marks)

3 Which of the following data is **not** needed to calculate the lattice energy of sodium chloride when using a Born-Haber cycle?

☒ **A** Enthalpy change of formation of sodium chloride.

☒ **B** Enthalpy change of atomization of sodium.

☒ **C** First ionization energy of chlorine.

☒ **D** Electron affinity of chlorine.

(Total for Question = 1 mark)

4 The lattice energy of magnesium oxide is more negative than the lattice energy of magnesium fluoride because

☒ **A** oxide ions are larger than fluoride ions.

☒ **B** oxide ions are larger than magnesium ions.

☒ **C** oxide ions are more highly charged than fluoride ions.

☒ **D** there is only one oxide ion but two fluoride ions per magnesium ion.

(Total for Question = 1 mark)

5 Which of the following quantities, used in the calculation of the lattice energy of lithium oxide, Li_2O, has a negative value?

☒ **A** The enthalpy change of atomization of lithium.

☒ **B** The first ionization energy of lithium.

☒ **C** The first electron affinity of oxygen.

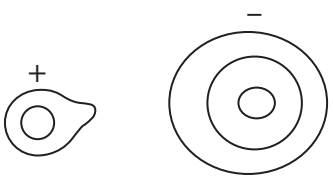
☒ **D** The second electron affinity of oxygen.

(Total for Question = 1 mark)

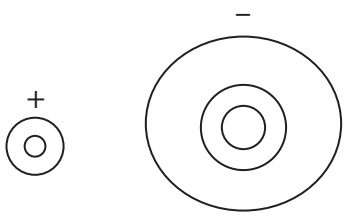
6 Which of the diagrams below best represents the shapes of the electron contours in sodium fluoride?

☒ **A**

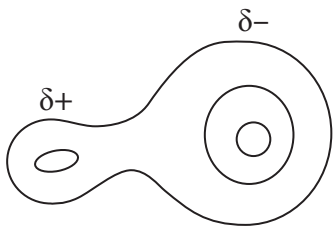
☒ **B**



☒ **C**



☒ **D**



(Total for Question = 1 mark)

7 Which of the equations below represents the first electron affinity for oxygen?

☒ **A** $O_2(g) + 2e^- \rightarrow 2O^-(g)$

☒ **B** $O_2(g) - 2e^- \rightarrow 2O^-(g)$

☒ **C** $\frac{1}{2}O_2(g) + e^- \rightarrow O^-(g)$

☒ **D** $O(g) + e^- \rightarrow O^-(g)$

(Total for Question = 1 mark)

8 Which of the following oxides would be expected to have the most exothermic lattice energy?

☒ **A** Na_2O

☒ **B** MgO

☒ **C** CaO

☒ **D** K_2O

(Total for Question = 1 mark)

9 In the Born-Haber cycle for potassium iodide, which of the following steps is **exothermic**?

☒ **A** $K(s) \rightarrow K(g)$

☒ **B** $K(g) \rightarrow K^+(g) + e^-$

☒ **C** $\frac{1}{2}I_2(s) \rightarrow I(g)$

☒ **D** $I(g) + e^- \rightarrow I^-(g)$

(Total for Question = 1 mark)

10 Magnesium chloride, $MgCl_2$, has two lattice energy values quoted in the data booklet. The first is the experimental value, obtained from the Born-Haber cycle, 2526 kJ mol ^{1}; the second is the theoretical value, 2326 kJ mol ^{1}. Why are the two values different?

☒ **A** The cation polarizes the anion leading to some covalent bonding.

☒ **B** The anion polarizes the cation leading to some covalent bonding.

☒ **C** Magnesium chloride is a covalent substance.

☒ **D** The results from the Born-Haber cycle are too inaccurate to be reliable.

(Total for Question 1 mark)

11 Which of the following represents the process occurring when the enthalpy change of atomization of bromine is measured?

☒ **A** $\frac{1}{2}Br_2(l) \rightarrow Br(g)$

☒ **B** $\frac{1}{2}Br_2(g) \rightarrow Br(g)$

☒ **C** $Br_2(l) \rightarrow Br^+(g) + Br\ (g)$

☒ **D** $Br_2(g) \rightarrow Br^+(g) + Br\ (g)$

(Total for Question 1 mark)

12 The standard enthalpy changes of formation of some sulfur species are:

Species	$\Delta H_f^{\ominus}$ / kJ mol ^{1}
$S_8(s)$	0
$S_8(g)$	+103
S(g)	+279

The enthalpy of atomization of sulfur is (in kJ mol ^{1})

☒ **A** 103

☒ **B** 279

☒ **C** 279

☒ **D** (103 ÷ 8) + 279

(Total for Question 1 mark)

13 Which of these equations represents the electron affinity of chlorine?

☒ **A** $Cl_2(g) + 2e^- \rightarrow 2Cl^-(g)$

☒ **B** $Cl_2(g) - 2e^- \rightarrow 2Cl^-(g)$

☒ **C** $\frac{1}{2}Cl_2(g) + e^- \rightarrow Cl^-(g)$

☒ **D** $Cl(g) + e^- \rightarrow Cl^-(g)$

(Total for Question = 1 mark)

14 Which of these ions has the greatest ability to polarize an anion?

☒ **A** Ba^{2+}

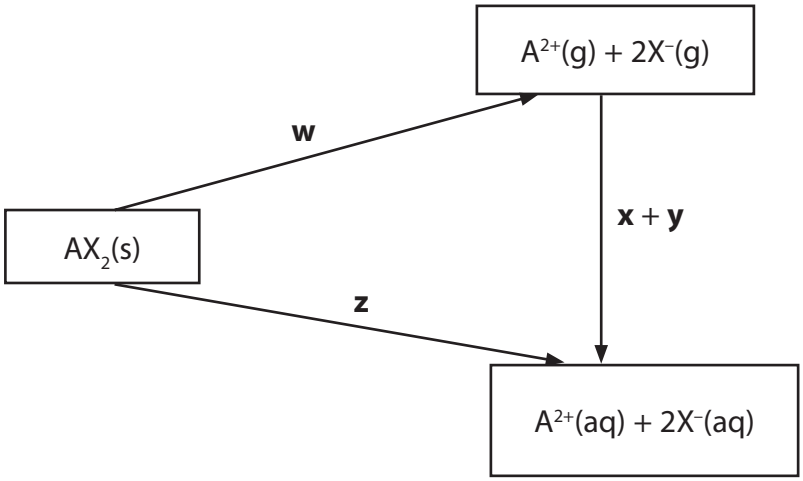
☒ **B** Ca^{2+}

☒ **C** Cs^+

☒ **D** K^+

(Total for Question = 1 mark)

15 The following cycle represents the enthalpy changes **w**, **x**, **y** and **z**, occurring when an ionic solute, $AX_2(s)$, dissolves in water.



Which of the changes is the lattice energy of $AX_2(s)$?

☒ **A** ½ **w**

☒ **B** − **w**

☒ **C** **z**

☒ **D** **z** − **x** − **y**

(Total for Question = 1 mark)

16 The enthalpy change of atomization of iodine is the value of ΔH for the process

☒ **A** $I_2(s) \rightarrow I_2(g)$

☒ **B** $I_2(s) \rightarrow 2I(g)$

☒ **C** $I_2(g) \rightarrow 2I(g)$

☒ **D** $\frac{1}{2}I_2(s) \rightarrow I(g)$

(Total for Question 1 mark)

17 The ionic radii in nm of some ions are given below.

Li^+	0.074	F	0.133
Ca^{2+}	0.100	Cl	0.180
		O^2	0.140
		S^2	0.185

(a) Which of the following compounds has the most exothermic lattice energy? They all have the same crystal structure.

(1)

☒ **A** LiF

☒ **B** LiCl

☒ **C** CaO

☒ **D** CaS

(b) Which of the following compounds will show the greatest difference between the experimental (Born-Haber) lattice energy and that calculated from a purely ionic model?

(1)

☒ **A** LiF

☒ **B** Li_2O

☒ **C** CaO

☒ **D** CaS

(Total for Question 2 marks)

18 The equation for the enthalpy of hydration for a magnesium ion is

☒ **A** $Mg^{2+}(s) + aq \rightarrow Mg^{2+}(aq)$

☒ **B** $Mg^{2+}(g) + aq \rightarrow Mg^{2+}(aq)$

☒ **C** $Mg^{2+}(aq) \rightarrow Mg^{2+}(g) + aq$

☒ **D** $Mg^{2+}(aq) \rightarrow Mg^{2+}(s) + aq$

(Total for Question 1 mark)

19 Which reaction has an enthalpy change equal to the enthalpy of hydration of the sodium ion?

☒ **A** $Na^{+}(g) + \text{excess } H_2O(l) \rightarrow Na^{+}(aq)$

☒ **B** $Na^{+}(g) + 1 \text{ mol of } H_2O(l) \rightarrow Na^{+}(aq)$

☒ **C** $Na^{+}(s) + \text{excess } H_2O(l) \rightarrow Na^{+}(aq)$

☒ **D** $Na^{+}(s) + 1 \text{ mol of } H_2O(l) \rightarrow Na^{+}(aq)$

(Total for Question 1 mark)