GROUP 2: THERMAL STABILITY OF THE CARBONATES AND NITRATES

1. a) If you heat barium carbonate to a high enough temperature it decomposes. What colour is barium carbonate, and what colour is the solid product. Write the equation for the reaction.

   b) Would you need a higher or a lower temperature to decompose calcium carbonate?

   c) What would you see if you heated barium nitrate to a high enough temperature to make it decompose? Name the products of the reaction, and write the equation.

   d) Would you need a higher or a lower temperature to decompose strontium nitrate?

Questions 2 and 3 are concerned with two different ways of explaining the trends in thermal stability of the carbonates and nitrates as you go down Group 2. You may well not have to know about both of these explanations. Find out which explanation your examiners are going to want you to know, and then just do that question. It is quite possible that your examiners won't want either explanation, in which case, don't waste your time doing either question!

2. a) The Group 2 ions get bigger as you go down the group, and have less polarising effect on nearby negative ions. Explain what this means using carbonate ions as an example.

   b) How does this account for the trend in thermal stability of the Group 2 carbonates as you go down the group?

3. a) The enthalpy changes for the thermal decomposition of a Group 2 carbonate into an oxide and carbon dioxide are as follows:

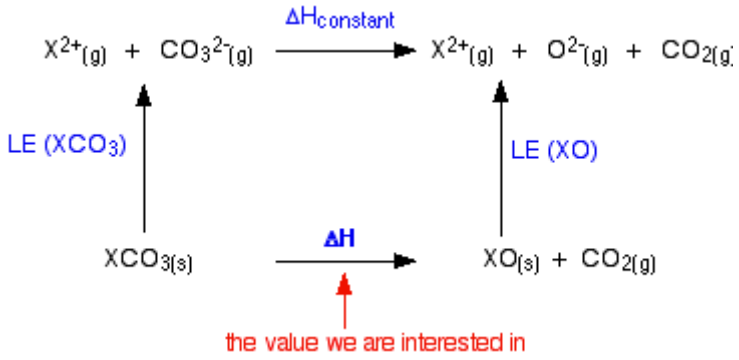
	Enthalpy change (kJ mol^{-1})
$MgCO_3$	+117
$CaCO_3$	+178
$SrCO_3$	+235
$BaCO_3$	+267

   Explain how this relates to the temperature the carbonate decomposes at.

   b) These values are calculated using the Hess's Law cycle shown on the next page.

   $LE(XCO_3)$ and LE(XO) are the lattice dissociation enthalpies for a Group 2 carbonate and oxide.

   $\Delta H_{constant}$ is the enthalpy change for splitting the carbonate ion into an oxide ion and carbon dioxide. It has the same value for all the carbonates.



Work out an expression for ΔH (the value we are interested in).

c) As you go down the group, the values of both LE(XCO_3) and LE(XO) fall (become less positive). Explain why?

d) The two lattice dissociation enthalpies fall at different rates. Which one falls faster? Explain why this is.

e) Use the expression you obtained in part (b) and your answer to part (d) to explain why the enthalpy changes for the decomposition become more positive as you go down the group.