WJEC (Eduqas) Chemistry A-level

SP C2.2a - Indirect Determination of an Enthalpy Change of Reaction

Flashcards

Give the chemical equation for the reaction between magnesium oxide and carbon dioxide to form magnesium carbonate

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$$MgO + CO_2 \rightarrow MgCO_3$$

Define enthalpy change

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Enthalpy change is the heat energy evolved or absorbed in a reaction at constant pressure.

What is Hess's law?

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Hess's law states that the total enthalpy change of a reaction is independent of the route taken.

What apparatus is required to determine the enthalpy change of reaction of magnesium oxide and carbon dioxide to form magnesium carbonate?

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- Calorimeter (polystyrene cup)
- Thermometer
- 25 cm^3 pipette and filler
- Stopwatch
- Spatula
- Weighing boat

Outline how to indirectly determine the enthalpy change of reaction of magnesium oxide and carbon dioxide

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1. Measure 50 cm^3 of HCl into the calorimeter using the pipette. Place the thermometer into the HCl and leave it to allow the temperature reading to stabilise.
2. Accurately weigh out 0.90 g of MgO in a weighing boat. Record the mass.
3. Record the temperature of the acid and start the stopwatch. Record the temperature of the acid every 30 seconds for 2 minutes and 30 seconds. At 3 minutes, add the MgO to the HCl and mix thoroughly.
4. When the stopwatch reaches 3 minutes 30 seconds, record the temperature of the reaction mixture.
5. Record the temperature of the mixture every 30 seconds until the temperature drops for 5 readings.
6. Weigh the weighing boat again. Record the mass of MgO added to the calorimeter.
7. Use the data to construct a graph and calculate the enthalpy change of the reaction.
8. Repeat steps 2 through 8 using approximately 3.5g of $MgCO_3$.
9. Using the values of ΔH, calculate the enthalpy change for the reaction: $MgO(s) + CO_2(g) \rightarrow MgCO_3(s)$

How can ΔH_1 and ΔH_2 of the respective reactions of MgO and $MgCO_3$ with HCl be used to calculate ΔH_3 of the following reaction?

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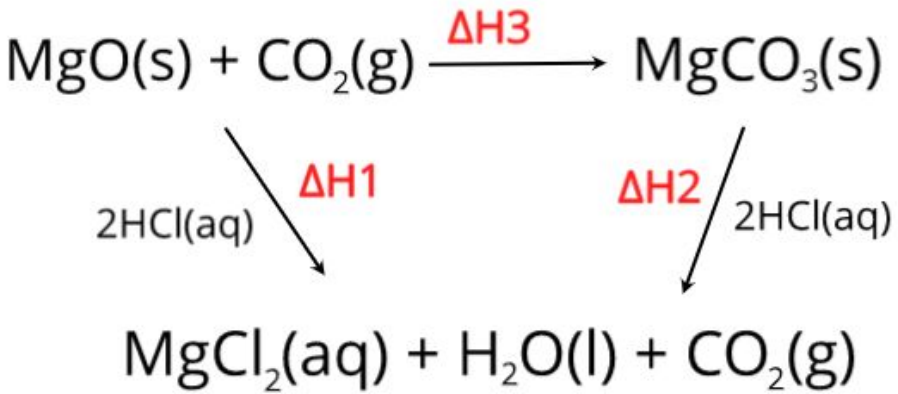
Hess's law: $\Delta H_3 = \Delta H_1 - \Delta H_2$



When filling the pipette with HCl, how should the measurement be taken?

When filling the pipette with HCl, how should the measurement be taken?

The bottom of the meniscus (curve of the liquid) should be in line with the 25 cm^3 mark. The reading should be taken at eye level to avoid parallax errors.

Give the equation used to calculate enthalpy change

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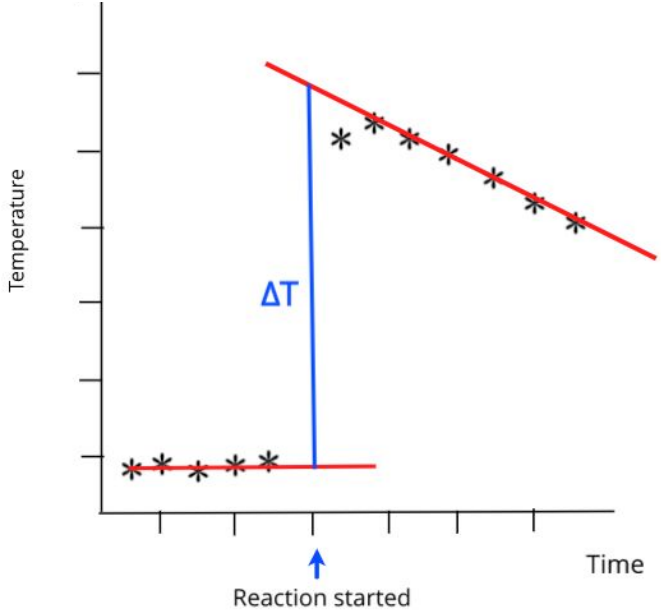
$$q = mc\Delta T$$

- **q** enthalpy change (J)
- **m** is the mass of the solution which changes temperature (g)
- **c** is the specific heat capacity (J $g^{-1}K^{-1}$)
- **ΔT** change in temperature of the solution (K)

How can you use a graph to find an accurate temperature change of a reaction?

How can you use a graph to find an accurate temperature change of reaction?

Plot the temperature of the solution before reaction and after the reaction. Draw two lines of best fit and extrapolate them to the point that the reaction started.



Why is it generally hard to get accurate results in calorimetry experiments?

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There is always heat lost to the surroundings which means the temperature measurements are not completely accurate.

How can you prevent heat loss to the surroundings/apparatus?

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- Use a polystyrene cup to hold the reaction mixture because polystyrene is a good insulator.
- Place a lid on the reaction mixture.
- Place the polystyrene cup in a beaker of cotton wool to increase insulation.
- Avoid large temperature differences between the surroundings and the calorimeter.

Other than preventing heat loss, how can the accuracy of the experiment be improved?

Other than preventing heat loss, how can the accuracy of the experiment be improved?

1. Read the thermometer at eye level to avoid parallax errors.
2. Stir the solution to evenly distribute the temperature.
3. Use a digital thermometer for more accurate and faster readings.

What is the weighing by difference technique?

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The weighing by difference technique ensures the mass of solid is recorded as accurately as possible.

Weigh the weighing boat with the solid added and record the mass. Add the solid to the reaction mixture. Reweigh the empty weighing boat to find out exactly how much solid was added to the reaction mixture.

How could you reduce the uncertainty in the mass measurement?

How could you reduce the uncertainty in the mass measurement?

- Use a digital balance with a greater resolution.
- Use a larger mass.