WJEC (Wales) Chemistry A-level

SP 2.1b - Determination of an Enthalpy Change of Combustion

Flashcards

Define enthalpy change

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

Define standard enthalpy change of combustion

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The enthalpy change when one mole of a compound is burned completely in oxygen under standard conditions in their standard states.

What type of reaction is a combustion reaction?

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Exothermic reaction:

Energy is transferred to the surroundings.

What apparatus is required to determine the enthalpy change of combustion?

What apparatus is required to investigate the enthalpy change of combustion?

- Digital mass balance
- Conical flask
- Spirit burner
- Heatproof mat
- Thermometer
- Clamp and stand

Give the experimental procedure to investigate the enthalpy change of combustion of methanol

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1. Add 100 cm^3 of deionised water to a 250 cm^3 conical flask.
2. Place the conical flask in the clamp and position it on the stand at a height so that the spirit burner can fit underneath it.
3. Weigh a spirit burner and lid containing methanol. Record the mass.
4. Record the initial temperature of the water.
5. Place the spirit burner under the conical flask and light the wick.
6. Allow the flame to heat the water to around 40 °C.
7. Extinguish the flame and record the final temperature of the water.
8. Re-weigh the spirit burner and lid and record the mass. Calculate the mass of methanol used.
9. Determine the energy released by methanol and calculate the enthalpy change of combustion.

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)

0.23 moles of a fuel raised the temperature of 100g of water from 293 K to 357 K. What is the standard enthalpy of combustion of the fuel? The specific heat capacity of water is 4.18 J $g^{-1}K^{-1}$.

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First calculate the amount of heat given off by the fuel: $q = mc\Delta T = 100 \times 4.18 \times (357-293) = 26752$ J = 26.8 kJ

Now find the energy to burn one mole and since it is an exothermic reaction, the final value must be negative:

$\Delta_c H^e = -(26.8 \div 0.023) = -1170$ kJ mol^{-1} (3 s.f.)

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 copper calorimeter to hold the water.
- Place a lid on the calorimeter.
- Avoid large temperature differences between the surroundings and the calorimeter.

Other than heat loss, why might the experimental enthalpy of combustion value be less exothermic than the data book value?

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1. Loss of fuel or water by evaporation.
2. Incomplete combustion of the fuel - this could deposit soot within the burner, affecting the final mass of the fuel.
3. It is unlikely the reaction takes place under standard conditions - unlike the data book value.

What is the weighing by difference technique?

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

Weigh the spirit burner with the fuel and lid and record the mass. Burn the fuel. Reweigh the burner at the end to find out exactly how much fuel was burned during the experiment.

How can you avoid incomplete combustion when investigating the enthalpy of combustion using calorimetry?

How can you avoid incomplete combustion when investigating the enthalpy of combustion using calorimetry?

Ensure there is a consistent flow of air to the spirit burner so that the fuel burns in sufficient oxygen. This will encourage complete combustion to take place.