Calorimetry Map

Cambridge International AS & A Level Chemistry · Topic 5 Chemical energetics · Calorimetry

1 q = mcΔT

5.1.7

- **q**: energy transferred, J
- **m**: mass of water or solution
- **c** = 4.18 J g^{-1} °C^{-1}
- **ΔT**: temperature change
- kJ = J ÷ 1000



2 Reactions in solution

5.1.7

- Polystyrene cup, lid, beaker
- m: **total** volume (1.00 g cm^{-3})
- n: reactant **not in excess**
- **ΔH = −q ÷ n**
- Rise: ΔH −; fall: ΔH +

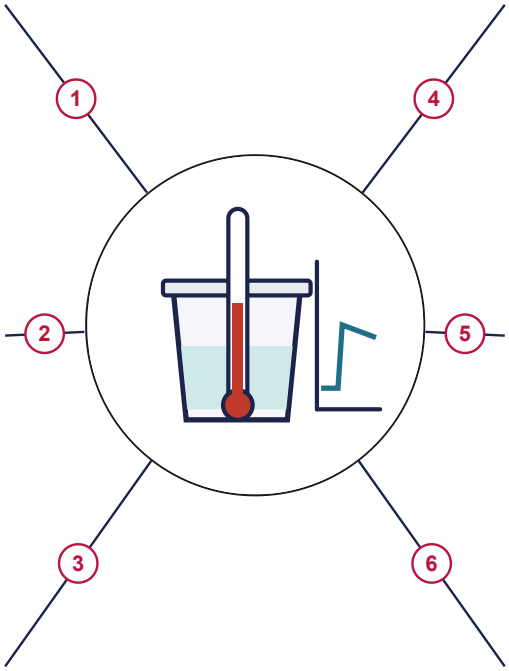


3 Combustion of a fuel

5.1.7

- Spirit burner, copper can
- m: mass of **water**
- n: mass of **fuel burned** ÷ M
- Draught shield, lid, stir
- Cap and reweigh at once





4 Errors and assumptions

5.1.7

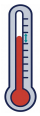
- **Heat loss**: the main error
- Incomplete combustion
- Fuel evaporating
- Assume: solution = water
- Values come out too small



5 Uncertainty

5.1.7

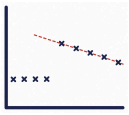
- % = uncertainty ÷ value × 100
- ΔT: **two readings**
- Bigger ΔT: smaller %
- % error vs the data value
- Error > uncertainty: systematic



6 Cooling-curve correction

5.1.7

- Readings before and after
- None at the mixing time
- Best-fit **cooling** line
- **Extrapolate back** to mixing
- Corrects for heat lost



Three worked results

c = 4.18 J g^{-1} °C^{-1}; 1.00 g cm^{-3} for solutions

Experiment	m / g	ΔT / °C	q / J	n / mol	ΔH / kJ mol^{-1}
HCl + NaOH, 2.00 mol dm^{-3}, 25.0 cm^3 each	50.0	+13.4	2801	0.0500	−56.0
Zn + $CuSO_4$(aq), 0.200 mol dm^{-3}, 50.0 cm^3	50.0	+10.2	2132	0.0100	−213
KNO_3 dissolving in water	50.0	−3.3	690	0.0200	+34.5
Ethanol in a spirit burner, 0.46 g	200	+12.0	10 032	0.0100	−1.00 × 10^3

Three steps every time

1 Energy

- q = mcΔT
- m of the water
- answer in J

2 Amount

- n = m ÷ M
- or n = c × V
- the limiting reactant

3 Per mole

- ΔH = −q ÷ n
- J → kJ
- **sign and units**

The Hess's law section uses calorimetry results in its cycles (Hess's law practical).

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