Question 7 (Answer: **D**)

- Bond breaking absorbs energy and bond forming releases it – both happen in every reaction.
- The reaction is exothermic because more energy is given out forming the new bonds than is taken in breaking the old ones.
- So A and B are wrong to claim that only one of the two processes occurs.

Question 8 (Answer: **B**)

- Energy absorbed by the water $= 200 \times 4.18 \times 48.0 = 40\,100$ J.
- That is only 45.0% of the total, so the total released is $40\,100/0.450 = 89\,200$ J.
- Per gram: $89\,200/1.60 = 55\,700$ J; C is the total, not the value per gram.

Question 9 (Answer: **C**)

- $q = mc\Delta T$, and m is the mass of *water* being heated, 200 g.
- The temperature change is $41.0 - 23.7 = 17.3$, and a change in °C equals a change in K, so nothing is added.
- So $q = 200 \times 4.18 \times 17.3$; A uses the fuel's mass instead of the water's.

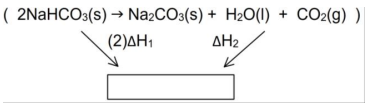
Question 10 (Answer: **D**)

- The pad gets hotter, so the reaction gives out energy – it is exothermic.
- Air activates it because the iron is being oxidised, that is, it rusts.
- Oxidation is loss of electrons, so the iron loses electrons.

Question 10 (Answer: **C**)

- The final solution is $20 + 20 = 40$ cm^3, and the whole of it warms up.
- $q = 40 \times 4.2 \times 15$, using the heat capacity per cm^3.
- The neutralisation forms 0.04 mol of water, so divide by 0.04 to get the value per mole.

2(a)	**I** 6 correct unambiguous headings shown, with units, in list / table • (mass of) container + **FA 3** / solid / $Na_2S_2O_3{\cdot}5H_2O$ • (mass of) container (empty **OR** with residual **FA 3**) • (mass of) **FA 3** / solid / $Na_2S_2O_3{\cdot}5H_2O$ **OR** mass used **OR** mass added • initial temperature / thermometer reading • lowest / minimum / final temperature / thermometer reading • temperature change / decrease Mass units: /g **OR** in g **OR** (g) **OR** g by every reading Temperature units: / °C **OR** in °C **OR** (°C) **OR** °C by every reading
	II All readings shown to appropriate precision • all four balance / thermometer readings shown • both thermometer readings to .0 **OR** .5 • both weighings consistently to either 2 d.p. **OR** to 3 d.p.
	III Subtractions correctly calculated • mass of solid correct **AND** temperature change correct
	IV ΔT is within 1.0 °C of expected temperature change for the mass used
2(b)(i)	Correctly calculates amount of **FA 3** = $\frac{\text{mass FA 3 in 2(a)}}{248.2}$ mol **AND** answer given to 2–4 s.f.
2(b)(ii)	Correctly calculates energy change = $30 \times 4.18 \times \Delta T$ J **AND** answer given to 2 – 4 sf
2(b)(iii)	Correctly uses $\frac{\text{(b)(ii)}}{\text{(b)(i)} \times 1000}$ **AND** plus sign shown **AND** answer given to 2 – 4 sf
2(c)	**M1** repeating experiment with $Na_2S_2O_3$ **OR** adding $Na_2S_2O_3$ in water **M2** any two from: • known volume of water • known mass of solid • measuring the temperature change. **M3** indicating that use of Hess's law is needed **M4** $\Delta H_r = \Delta H$ from their additional experiment – **(b)(iii)**

1(a)	**I** Unambiguous headings **AND** units for all six recorded readings and calculated values in experiment 1: • (mass of) container + **FB 2 /** solid / g • (mass of) container (+ residue) / g • (mass of) **FB 2** / solid (used / added) / g • initial temperature **OR** temperature of **FB 1** / °C • final temperature / °C • temperature change / °C
	II • All four weighings recorded to same decimal places (either 2 or 3). • All four temperatures recorded to .0 or .5°C
	III Correct subtractions to give all four calculated values: • mass of **FB 2** used and mass of **FB 3** used • changes in temperature for experiments 1 and 2.
	Accuracy (Q) marks Calculate the candidate's *temperature to mass ratio* for experiment 1 to 2 d.p.: Ratio = ΔT (experiment 1) / mass of **FB2**. Calculate the supervisor's ratio for experiment 1 to 2 d.p. Calculate the difference, δ, between the candidate's value (rounded to 2 d.p.) and the supervisor's value (rounded to 2 d.
	IV award if $\delta \leqslant 0.50$
1(b)(i)	**M1:** Correctly calculates both M_r values: M_r of $NaHCO_3$ = 84 **AND** M_r of Na_2CO_3 = 106
	M2: Correctly calculates both amounts using subtractions from **(a)** n = mass in **(a)** / M_r (mol) **AND** both answers given to 2–4 sf
1(b)(ii)	Correctly calculates both values of energy change energy change = $20 \times 4.18 \times \Delta T$ (J) **AND** both answers given to 2−4 sf
1(b)(iii)	**M1:** Correct display of ΔH = **(b)(ii)** / **(b)(i)** for experiment 1 or experiment 2.
1(b)(iv)	**M1:** Drawing of enthalpy cycle 
	M2: Correctly calculates $\Delta H_r = 2\Delta H_1 - \Delta H_2$