

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.

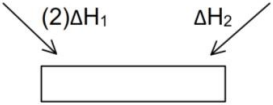
Question 10 (Answer: D)

- 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 $20 + 20 = 40$ cm³, and the whole of it warms up.
- $q = 40 \times 4.2 \times 15$, using the heat capacity per cm³.
- 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 / $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ • (mass of) container (empty OR with residual FA 3) • (mass of) FA 3 / solid / $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ 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 = $\frac{\text{mass FA 3 in 2(a)}}{248.2 \text{ mol}}$ AND answer given to 2–4 s.f.
2(b)(ii)	Correctly calculates energy change = $30 \times 4.18 \times \Delta T \text{ J}$ AND answer given to 2 – 4 sf
2(b)(iii)	Correctly uses $\frac{(b)(ii)}{(b)(i)} \times 1000$ AND plus sign shown AND answer given to 2 – 4 sf
2(c)	M1 repeating experiment with $\text{Na}_2\text{S}_2\text{O}_3$ OR adding $\text{Na}_2\text{S}_2\text{O}_3$ 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 <i>temperature to mass ratio</i> 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.p.)
	IV award if $\delta \leq 0.50$
1(b)(i)	M1: Correctly calculates both M_r values: M_r of $\text{NaHCO}_3 = 84$ AND M_r of $\text{Na}_2\text{CO}_3 = 106$
	M2: Correctly calculates both amounts using subtractions from (a) $n = \text{mass in (a)} / M_r (\text{mol})$ 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 $\Delta H = (\text{b})(\text{ii}) / (\text{b})(\text{i})$ for experiment 1 or experiment 2.
1(b)(iv)	M1: Drawing of enthalpy cycle $(2\text{NaHCO}_3(\text{s}) \rightarrow \text{Na}_2\text{CO}_3(\text{s}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g}))$ 
	M2: Correctly calculates $\Delta H_r = 2\Delta H_1 - \Delta H_2$