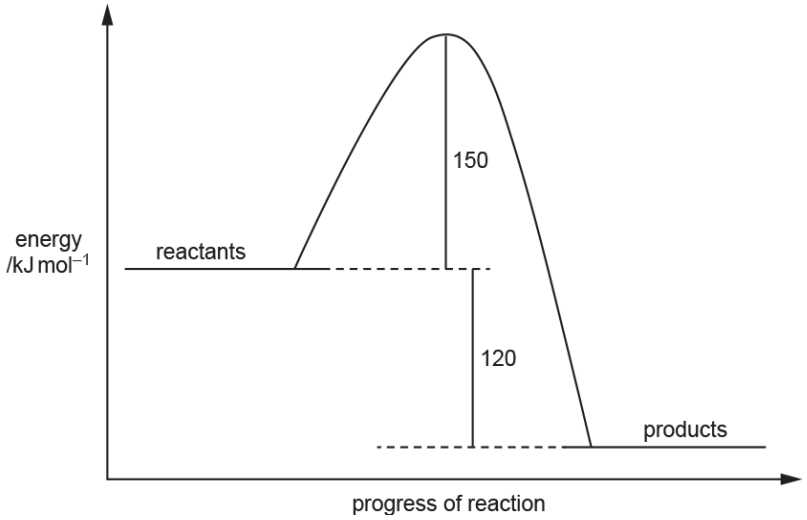
Enthalpy (MCQ)

1. A reversible reaction has the enthalpy profile diagram shown below.



Which statement about this reaction is correct?

A The activation energy of the forward reaction is 120 kJ mol^{-1}.
B The activation energy of the reverse reaction is 270 kJ mol^{-1}.
C The enthalpy change of the forward reaction is −30 kJ mol^{-1}.
D The reverse reaction is exothermic.

Your answer ☐ **[1]**

2. Hydrogen and chlorine react as shown below.

$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$ $\Delta H^{\ominus} = -184.6$ kJ mol^{-1}

Which statement about this reaction is correct?

A Less energy is released on bond making than is taken in during bond breaking.
B The enthalpy change for the reverse equation is +184.6 kJ mol^{-1}.
C The enthalpy change of formation of HCl (g) is −184.6 kJ mol^{-1}.
D The temperature decreases during the reaction.

Your answer ☐ **[1]**

3. The equation for the reaction of aluminium sulfide, Al_2S_3, with oxygen is shown below.

$$2Al_2S_3(s) + 9O_2(g) \rightarrow 2Al_2O_3(s) + 6SO_2(g)$$

The table shows standard enthalpy changes of formation, $\Delta_f H^{\ominus}$.

Substance	$Al_2S_3(s)$	$O_2(g)$	$Al_2O_3(s)$	$SO_2(g)$
$\Delta_f H^{\ominus}$ / kJ mol^{-1}	−723.8	0	−1675.7	−296.8

What is the standard enthalpy change of combustion of $Al_2S_3(s)$, in kJ mol^{-1}?

A −3684.6
B −1842.3
C +1842.3
D +3684.6

Your answer ☐ **[1]**

4. A student carried out an experiment to measure the enthalpy change of combustion of methanol.

The energy from the combustion of methanol was used to heat a beaker containing water.

The student's calculated enthalpy change of combustion was **more** exothermic than the value in data books.

Which error could have caused this difference?

A Some methanol had evaporated from the wick before the final weighing.
B In the calculation, the student used the molar mass of ethanol instead of methanol.
C There was incomplete combustion.
D The water boiled for 5 minutes before the final temperature was taken.

Your answer ☐ **[1]**

5. 50.0 cm^3 of 1.00 mol dm^{-3} NaOH is neutralised by 50.0 cm^3 of 1.00 mol dm^{-3} HNO_3.
The temperature increases by 6.0 °C.

The experiment is repeated using:
25.0 cm^3 of 1.00 mol dm^{-3} NaOH and 25.0 cm^3 of 1.00 mol dm^{-3} HNO_3.

What is the increase in temperature in the second experiment?

A 1.5°C
B 3.0°C
C 6.0°C
D 12.0°C

Your answer ☐ **[1]**

6. The table shows standard enthalpy changes of combustion, $\Delta_c H$.

Substance	**$\Delta_c H$ / kJ mol^{-1}**
C(s)	−393.5
$H_2(g)$	−285.8
$C_4H_{10}(g)$	−2876.5

What is the enthalpy change for the following reaction?

$4C(s) + 5H_2(g) \rightarrow C_4H_{10}(g)$

A −2197.2 kJ mol^{-1}
B −126.5 kJ mol^{-1}
C +126.5 kJ mol^{-1}
D +2197.2 kJ mol^{-1}

Your answer ☐ **[1]**

7. The enthalpy change of formation of butane can be calculated using the enthalpy changes of combustion, $\Delta_c H$, below.

Substance	C(s)	$H_2(g)$	$C_4H_{10}(s)$
$\Delta_c H$ / kJ mol^{-1}	−394	−286	−2877

Calculate the enthalpy change of formation of $C_4H_{10}(g)$.

$$4C(s) + 5H_2(g) \rightarrow C_4H_{10}(g)$$

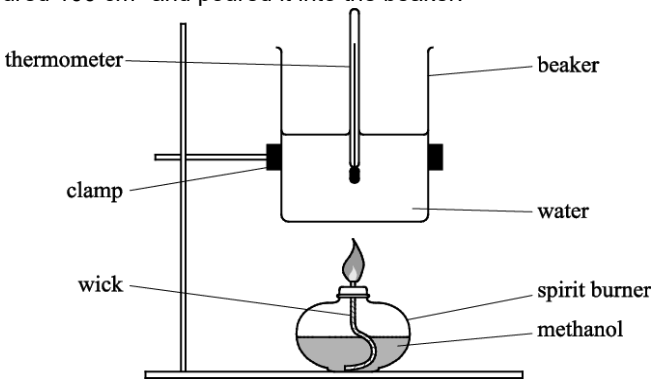
A −2197 kJ mol^{-1}
B −129 kJ mol^{-1}
B +129 kJ mol^{-1}
D +2197 kJ mol^{-1}

Your answer ☐

[1]

8(a). A student used the apparatus below in an experiment to determine the enthalpy change of combustion of methanol.

The student measured 100 cm^3 and poured it into the beaker.



The student measured a temperature rise of 10.5 °C.

The student calculated the amount of energy transferred to the water.

Which of the following uses the appropriate number of significant figures and correct standard form to represent the result of the calculation?

A. 4.389×10^3 J
B. 4.39×10^3 J
C. 43.9×10^2 J
D. 44.0×10^2 J

Your answer ☐

[1]

(b). The student's calculated enthalpy change was less exothermic than the value in data books.

Which of the following errors could have contributed to this result?

Error 1:	After the final temperature was recorded, the student removed the burner from under the beaker. The flame burnt for a further 5 minutes before weighing the spirit burner.
Error 2:	The student recorded the final temperature 5 minutes after removing the burner.
Error 3:	The student spilt some water on the bench when pouring the water from the measuring cylinder into the beaker.

A. 1, 2 and 3
B. Only 1 and 2
C. Only 2 and 3
D. Only 1

Your answer ☐

[1]

9. The table below shows standard enthalpy changes of formation, $\Delta_f H$.

Compound	$NH_4NO_3(s)$	$H_2O(g)$	$CO_2(g)$
$\Delta_f H$ **/ kJ mol^{-1}**	−366	−242	−394

What is the enthalpy change for the following reaction?

$$2NH_4NO_3(s) + C(s) \rightarrow 2N_2(g) + 4H_2O(g) + CO_2(g)$$

A. –630 kJ mol^{-1}
B. –540 kJ mol^{-1}
C. +540 kJ mol^{-1}
D. +630 kJ mol^{-1}

Your answer ☐

[1]

END OF QUESTION PAPER

Mark scheme – Enthalpy (MCQ)

Question			Answer/Indicative content	Marks	Guidance
1			**B**	1 (AO1.2)	**Examiner's Comments** This part discriminated extremely well. Most candidates correctly identified option B but a sizeable number of less able candidates chose the different options in almost equal amounts. It was difficult to recognise where candidates were having problems and the incorrect responses were probably mainly guesses.
			Total	**1**	
2			**B**	1 (AO1.1)	**Examiner's Comments** Many candidates found this question difficult with less than half choosing the correct option of B. Options A and C proved to be the main discriminators in almost equal amounts. Although first encountered at GCSE level, energies associated with bond breaking and bond making continue to cause candidates problems at AS and A Level. The discriminator C would have been chosen by candidates who did not recognise that −184.6 kJ is released when 2 mol HCl is formed and that the enthalpy change of formation would be half this value.
			Total	**1**	
3			**B**	**1**	**Examiner's Comments** This question proved to be the most difficult of the multiple-choice questions. Most candidates constructed a correct energy cycle using the provided equation. This gave an energy change of −3684.6 kJ mol^{-1} (A). The question asks for the enthalpy change of combustion for Al_2S_3, which is half this value (option B). As with question 2, candidates are advised to read the question carefully.
			Total	**1**	
4			**B**	**1**	**Examiner's Comments** Candidates find questions based on practical procedures difficult and this

					question proved to be no exception. A similar number of candidates selected each option, suggesting that most guessed. The correct option is B.
			Total	**1**	
5			C	**1**	**Examiner's Comments** Very few candidates obtained the correct temperature change and this proved to be the most difficult of the multiple choice questions. The majority of candidates incorrectly answered as B, based on halving the quantities, leading to halving the temperature change.
			Total	**1**	
6			B	**1**	**Examiner's Comments** The majority of candidates obtained the correct answer. As expected, the common incorrect answer was C: the correct value but the incorrect sign.
			Total	**1**	
7			B	1	**Examiner's Comments** Generally scored well.
			Total	**1**	
8	a		B	1	
	b		B	1	
			Total	**2**	
9			A	1	
			Total	**1**	