A Level AQA Chemistry

Chapter 4 – answers

Question	Answers	Extra information	Mark	AO Spec reference
01.1	16.00 only	Reject 16	1	AO1 MS1.1
01.2	Enthalpy change when 1 mole of substance Is completely burnt in oxygen Products and reactants in standard states under standard conditions		1 1 1	3.1.4.1 AO1
01.3	$C_3H_8O\ (l) + 4\frac{1}{2}O_2\ (g) \rightarrow 3CO_2\ (g) + 4H_2O\ (l)$	Allow any accurate structure of propan-1-ol Must include state symbols	1	3.1.2.5 AO1
01.4	$Q = mc\Delta T$ $Q = 200 \times 4.18 \times 16 = 13376$ J $\text{Moles} = \frac{\text{mass}}{M_r} = \frac{1.17}{60} = 0.0195$ $\Delta_c H = \frac{13376}{0.0195} = -685\,949$ J mol^{-1} −686 kJ mol^{-1}	Or equivalent Must be 3 s.f. must have minus sign 	1 1 1 1 1	3.1.4.2 MS0.0,1.1 AO2
01.5	Heat lost to surroundings Incomplete combustion of fuel Some fuel evaporates between end of experiment and measurement of mass	 Allow not enough oxygen 	1 1 1	3.1.4.2 AO3
02.1	Suitable scale Labels on both axis (time = x, temperature = y) Correct units All points plotted accurately Both lines extrapolated to 5th minute Instantaneous temperature calculated (expected to be 13.6 °C)	Allow splitting of y axis Points must cover over half the page (if scale can be sensibly doubled lose M2 Allow 2 errors ±1 mm	1 1 1 1 1 1	3.1.4.2 AO3

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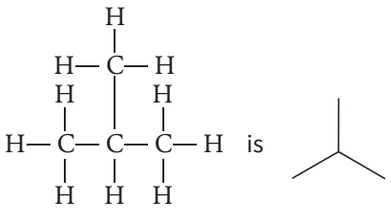
02.2	With T = 13.6 $Q = mc\Delta T$ $Q = 50 \times 4.18 \times 13.6 = 2842(.4)$ Moles = $C \times V = \frac{2 \times 25}{1000} = 0.05$ $\Delta_c H = \frac{2842}{0.05} = -56840\ \text{J mol}^{-1}$ $-56.8\ \text{kJ mol}^{-1}$ must have minus		1 1 1 1 1	3.1.4.2 MS0.0,1.1 AO2
02.3	Same value as **02.2** Still producing water so enthalpy per mole should be the same		1 1	3.1.4.1 AO3
03.1	 is	Only accept r.h.s. as answer	1	3.3.1.1 AO1
03.2	Chain		1	3.3.1.3 AO1
03.3	$C_4H_{10}\ (g) + 6\frac{1}{2}\ O_2\ (g) \rightarrow 4CO_2\ (g) + 5H_2O\ (l)$		1	3.1.2.5 AO3
03.4	The enthalpy change is independent of the route taken		1	3.1.4.3 AO1
03.5	$\Delta_r H = -2878 + 2869 =$ $-9\ \text{kJ mol}^{-1}$	Allow correct cycle **1 mark** for recall of products-reactants or cycle	1 1	3.1.4.3 AO2

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03.6	+9 kJ mol^{-1}	Allow their answer for **3.5** with opposite sign	1	3.1.4.3 AO3
03.7	High activation energy		1	3.1.5.1 AO3
04.1	The mean/average energy needed To break 1 mole of a covalent bonds From a range of compounds		1 1 1	3.1.4.4 AO1
04.2	$\Delta_r H$ = Σreactants – Σproducts = 1072 + (2 × 432) – (3 × 413) – 358 −467 = −128 kJ mol^{-1}		1 1 1	3.1.4.4 MS1.2 AO2
04.3	Bond enthalpies are an approximate/average Over a range of compounds		1 1	3.1.4.4 MS1.2 AO3
04.4	(2 × −715) = (6 × 413) + (2 × 358) + (2 × 467) + 3x –(4 × 799) – (8 × 467) −1430 = −2804 + 3x 1374 = 3x $\frac{1374}{3} = x$ = 458 kJmol^{-1}	Allow correct cycle **1** mark for recall of products-reactants or cycle Correct answer score **3** marks 3rd mark e.c.f. any number/3	1 1 1	3.1.4.4 3.1.4.3 MS1.2 AO2
04.5	−19 = 3X – −1155 −1174 = 3X $\frac{-1174}{3} = X$ = −391.3 kJ mol^{-1}	Allow correct cycle **1** mark for recall of products-reactants or cycle Credit only **2** marks for (+)391.3 Correct answer score 3 marks	1 1 1	3.1.4.3 3.1.4.1 AO2 MS1.1

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05.1	$2C(s) + 3H_2(g) \rightarrow C_2H_6(g)$		1	3.1.4.1 AO1
05.2	1,2-Difluoroethane	only	1	3.3.1.1 AO1
05.3	It is an element		1	3.1.4.1 AO1
05.4	$\Delta_r H = \Sigma$Products – ΣReactants $-1134 = X + (2 \times -273) - (-84)$ $-1134 = X - 462$ $X = -672$ kJ mol^{-1}	Allow correct cycle **1** mark for recall of products-reactants or cycle Credit only **2** marks for (+)672 Correct answer score 3 marks	1 1 1	3.1.4.3 3.1.4.1 AO2 MS1.1
06.1	x-axis = energy y-axis = No of particles/ proportion of particles/ mole fraction	Allow speed	1 1	3.1.5.2 AO1
06.2	Vertical line from x-axis to peak		1	3.1.5.2 AO1
06.3	The new curve starts at the origin and should begin to separate from the original almost immediately the axis peak should be higher and to the right		1	3.1.5.2. 3.1.5.3 AO1

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06.4	A decrease in the number / proportion of molecules with $E \geq E_a$ Fewer effective / productive / successful collisions in a given time / given period	OR fewer molecules have $E \geq E_a$ OR fewer molecules have sufficient / enough energy to react / decompose OR fewer frequent effective / productive / successful collisions OR lower rate of effective / productive / successful collisions	1 1	3.1.5.2. 3.1.5.3
06.5	No effect Shape of graph is the same no matter what pressure, if temperature is the same	OR only temperature changes the shape	1 1	3.1.5.4 AO2
07.1	$-136 = (612 + 436 + 4x) - (2x + 348)$ $-136 = 700 - 2x$ $\frac{-836}{-2} = x = 418$ kJmol^{-1}	Allow correct cycle 1 mark for recall of products-reactants or cycle Correct answer score 3 marks	1 1 1	3.1.4.4 3.1.4.3 MS1.2 AO2
07.2	$\Delta H = (-1387.4 + -286) - (-1560.7)$ $\Delta H = -112.7$ kJmol^{-1} Bond enthalpies are approximations taken from a range of compounds	Allow correct cycle 1 mark for recall of products-reactants or cycle Correct answer score 2 marks	1 1 1	3.1.4.4 3.1.4.3 MS1.2 AO2
07.3	It is an element		1	3.1.4.1 AO1

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07.4	Giant covalent (macromolecule) one covalent bond in hydrogen Lots of energy needed to break the bonds		1 1 1	3.1.3.4 AO1
07.5	More moles of water can be formed More bonds formed	Ignores breaks more bonds	1 1	3.1.4.4 AO3
08.1	$N_2H_4 \rightarrow \frac{1}{3}N_2 + 1\frac{1}{3}NH_3$		1	3.1.2.5 AO1
08.2	ΔH = reactants – products ΔH = {(4 × 388) + 163} – {(4 × 388) + 944/3} = −152 kJ mol^{-1}	Allow e.c.f. from **08.1** Allow correct cycle 1 mark for recall of products-reactants or cycle Correct answer scores 2 marks	1 1 1	3.1.4.4 MS1.2 AO2
08.3	ΔH = Σproducts − Σreactants = (4 × −286) – {96 + (2 × −187)} = −866 kJmol^{-1}	Allow e.c.f. from **08.1** Allow correct cycle 1 mark for recall of products-reactants or cycle Correct answer score 3 marks	1 1 1	3.1.4.1 3.1.4.3 MS1.2 AO2

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08.4	Moles = $\frac{1.45}{32}$ = 0.0453 q = 866 × 0.0453 = 39.24 kJ = 39240 J $\Delta T = \frac{q}{mc} = \frac{39240}{(500 \times 4.18)}$ = 18.8 298 + 18.8 = 316.8 = 317 K	 Answer must be 3 s.f. Allow 43.8°C 	1 1 1 1	3.1.4.2 MS 0.0, 1.1 AO2
08.5	$PV = nRT$ $n = \frac{PV}{RT} = \frac{100000 \times 4.6}{8.31 \times 298}$ = 185.755 moles Mass = 32 × 185.755 = 5944 g 5.9 kg	 Must be 2 s.f.	1 1 1 1	3.1.2.3 MS0.0, 2.2, 2.3, 2.4 AO2

Skills box answers:

1. ΔT =69.5 – 20.5 = 49.0°C % error = $\frac{2 \times 0.5}{49.0} \times 100$ = 2%
2. With 150 cm^3 cylinder: % error = $\frac{1}{150} \times 100$ = 0.67%
   With 25 cm^3 cylinder 6 times: % error = $6 \times \frac{0.2}{25} \times 100$ = 4.8%
   Therefore, using the 150 cm^3 cylinder once is better than using the 25 cm^3 six times.
3. The measured temperature change would be larger as less heat/energy would be lost.
   Therefore, the calculated value for $\Delta_c H$ would be more exothermic
4. The temperature would reach 100°C and not get any higher as the water would be boiling/evaporating/changing state. So the measured value of ΔT would be lower.
   Therefore, the measured value of $\Delta_c H$ would be less exothermic.