

APOLLO

Energy from fuels

HL

Chemistry

First assessment 2025

9 questions | mark schemes

Mark-scheme answers

Chemistry HL | Paper 1A | May 2025 TZ2 | Q19 | 1 marks

19. B

Chemistry HL | Paper 1A | May 2025 TZ2 | Q20 | 1 marks

20. C

9.	(a)		$6\text{CO}_2(\text{g}) + 6\text{H}_2\text{O}(\text{l}) \rightarrow \text{C}_6\text{H}_{12}\text{O}_6(\text{aq}) + 6\text{O}_2(\text{g})$ ✓		1
9.	(b)	(i)	Any two: «ethanol is» renewable / sustainable resource ✓ «ethanol has» low/zero carbon footprint / produces less CO_2 ✓ less sulfur dioxide «than fossil fuels» OR less acid rain «than fossil fuels» ✓ less incomplete combustion «than fossil fuels» OR less carbon monoxide/soot «than fossil fuels» ✓	Accept "ethanol is biodegradable /less toxic than gasoline". Do not accept just "less harmful".	2 max
9.	(b)	(ii)	«bond breaking» 1 C-C + 5 C-H + 1 C-O + 1 O-H + 3 O=O OR 346 + 5(414) + 358 + 463 + 3(498) OR 4731 «kJ» ✓ «bond forming» 4 C=O + 6 O-H OR 4(804) + 6(463) OR 5994 «kJ» ✓ «$\Delta H = 4731 - 5994 =$» -1263 «kJ mol⁻¹» ✓	Award [3] for correct final answer.	3
9.	(c)		«$Q = (4.00 / 46.08) \times 1367 =$» 119 kJ / 119000 J ✓ «$\Delta T = Q / mc = 119000 / (500.0 \times 4.18) =$» 56.9 «K» ✓	Accept 56.8 «K». Allow use of ΔH_c calculated in (b)(ii) without penalty. Answer is $\Delta T = 52.5 / 52.6$ «K».	2

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Question	Answers	Notes	Total
9.	(d)	hydrogen has one shell only ✓ O has greater «effective» nuclear charge / more protons than C ✓ O and C have the same shielding effect/occupied energy levels ✓	3

Mark-scheme answers

Chemistry HL | Paper 1A | Nov 2025 TZ1 | Q23 | 1 marks

23. D

Chemistry HL | Paper 1A | Nov 2025 TZ3 | Q19 | 1 marks

19. C

Chemistry HL | Paper 1A | Nov 2025 TZ3 | Q21 | 1 marks

21. A

Chemistry HL | Paper 1A | Nov 2025 TZ3 | Q22 | 1 marks

22. D

Chemistry HL | Paper 1A | Specimen 2025 | Q22 | 1 marks

22. D

5.	(a)		$C_{17}H_{36}(l) + 26O_2(g) \rightarrow 17CO_2(g) + 18H_2O(l)$ ✓		1
5.	(b)	(i)	$n_{C_{17}H_{36}} = \frac{2.00 \text{ g}}{[(17 \times 12.01 \text{ g mol}^{-1}) + (36 \times 1.01 \text{ g mol}^{-1})]} = \frac{2.00 \text{ g}}{240.53 \text{ g mol}^{-1}} = \text{«} \text{»}$ $0.008315/0.00831 \text{ «mol»} \checkmark$ $\text{« energy = } 11350 \text{ kJ mol}^{-1} \times 0.008315 \text{ mol = » } 94.4 \text{ «kJ»} \checkmark$		2
5.	(b)	(ii)	$94\,400 = 500.0 \text{ g} \times 4.18 \text{ J g}^{-1} \text{ K}^{-1} \times \Delta T \checkmark$ $\Delta T = 45.2 \text{ «K»} \checkmark$		2
5.	(b)	(iii)	Any two: water does not evaporate ✓ heat is not lost to the surroundings OR all heat is transferred to the water ✓ density of water is 1 g cm^{-3} ✓ water is pure ✓ complete combustion ✓		2 max

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Question			Answers	Notes	Total
5.	(c)		CO_2 consumed while plant is growing «and later released when biofuel is combusted» OR photosynthesis uses up CO_2 «later released when biofuel is combusted» ✓		1
5.	(d)	(i)	bonds broken: $4(C-C) / 4 \times 346 \checkmark$ bonds formed: $2(C=C) / 2 \times 614 \checkmark$ $\Delta H^\ominus = \text{«} 4 \times 346 \text{ kJ} - 2 \times 614 \text{ kJ} / 1384 \text{ kJ} - 1228 \text{ kJ} = \text{«} \text{»}$ $\Delta H^\ominus = \text{«+»} 156 \text{ «kJ»} \checkmark$	Award [3] for correct final answer.	3
5.	(d)	(ii)	$\Delta H = \Sigma \Delta H_f(\text{products}) - \Sigma \Delta H_f(\text{reactants})$ $\Delta H = (-311.5 + 2(52.0)) - (-393.9) \checkmark$ $\Delta H = \text{«+»} 186.4 \text{ «kJ mol}^{-1}\text{»} \checkmark$		2
5.	(d)	(iii)	(d)(ii) more accurate than (d)(i) as bond energies are average values OR (d)(ii) more accurate than (d)(i) as not specific to bonds in the reaction ✓		1
5.	(d)	(iv)	positive AND increase in number of moles/molecules «of gas» ✓		1
5.	(d)	(v)	$\Delta H > 0$ «and» $\Delta S > 0$ «AND» reaction spontaneous if $\Delta G = \Delta H - T\Delta S < 0 \checkmark$ at high«er» T reaction «more» spontaneous/ ΔG «more» negative ✓		2

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Question			Answers	Notes	Total
5.	(e)		$\text{C}_2\text{H}_4(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightarrow \text{C}_2\text{H}_5\text{OH}(\text{g})$ ✓		1
5.	(f)	(i)	condensation/esterification AND H_2O / water ✓		1
5.	(f)	(ii)	$\frac{20(12.01) + 38(1.01) + 2(16.00)}{100 \times 310.58} =$ $\frac{(310.58 + 18.02)}{310.58} =$ 94.5 % ✓		1
5.	(f)	(iii)	<i>Any two of:</i> sustainable development ✓ more economical/efficient ✓ better use of natural resources ✓ reduces waste ✓		2 max
5.	(f)	(iv)	$K = \frac{[\text{C}_{17}\text{H}_{33}\text{COOCH}_2\text{CH}_3][\text{H}_2\text{O}]}{[\text{C}_{17}\text{H}_{33}\text{COOH}][\text{CH}_3\text{CH}_2\text{OH}]}$	Accept expressions with $[\text{X}(\text{l})]$ instead of $[\text{H}_2\text{O}]$.	1

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Question			Answers	Notes	Total
5.	(g)	(i)	K small AND $[\text{reactants}]_{\text{eqm}} = [\text{reactants}]_0 / 0.10$ ✓ $n_{\text{oleate}} = \ll (0.10 \times 0.10 \times 9.3 \times 10^{-5})^{1/2} = \gg 9.6 \times 10^{-4} \text{ «mol»}$ ✓		2
5.	(g)	(ii)	remove water OR add more oleic acid OR add more ethanol ✓		1

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Question				Answers	Notes	Total
						