

Markscheme

Specimen paper

Chemistry

Standard level

Paper 2

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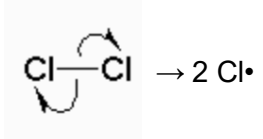
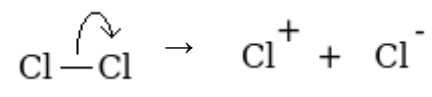
Question			Answers	Notes	Total
1.	(a)		$n_C = \frac{39.99 \text{ g}}{12.01 \text{ g mol}^{-1}} = 3.33 \text{ «mol»}$ $n_H = \frac{6.73 \text{ g}}{1.01 \text{ g mol}^{-1}} = 6.66 \text{ «mol»}$ $n_O = \frac{53.28 \text{ g}}{16.00 \text{ g mol}^{-1}} = 3.33 \text{ «mol»} \checkmark$ $\text{CH}_2\text{O} \checkmark$		2
1.	(b)		$n_{\text{HX}} (= n_{\text{NaOH}}) = 0.750 \text{ «mol dm}^{-3}\text{»} \times 0.02230 \text{ «dm}^3\text{»} / 0.0167 \text{ «mol»} \checkmark$ $M_{\text{HX}} = \left(\frac{1.51 \text{ g}}{0.0167 \text{ mol}} \right) = 90.4 \text{ g mol}^{-1} \checkmark$	Accept 90.3 «g mol ⁻¹ ».	2
1.	(c)		$\text{C}_3\text{H}_6\text{O}_3 \checkmark$	Accept consistent feasible structural formula.	1
1.	(d)		carboxyl/COOH $\checkmark$	Do not accept “carbonyl/C=O”.	1

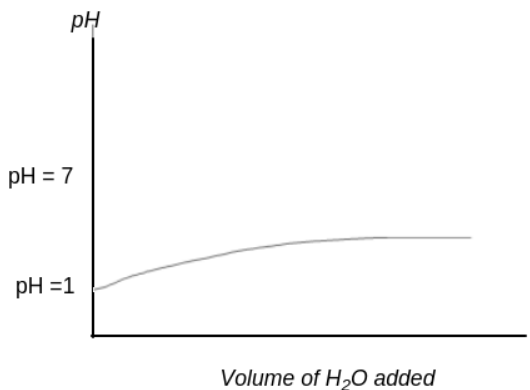
Question			Answers	Notes	Total
2.	(a)	(i)	Gold: +79 AND Helium: +2 ✓		1
2.	(a)	(ii)	repelled by «hitting/close contact with» gold nucleus ✓		1
2.	(a)	(iii)	atom is mainly empty space/vacuum OR nucleus is very small «compared to the size of the atom» ✓		1
2.	(b)	(i)	discrete/series of lines of different frequency/wavelength ✓		1
2.	(b)	(ii)	energy of photon relates to a frequency «in the spectrum» ✓ energy of photon depends on difference in energy levels ✓		2
2.	(b)	(iii)	H half/lower nuclear charge/number of protons ✓ H larger/double radius ✓		2
2.	(b)	(iv)	electron-electron interactions «need to be taken in account» ✓		1
2.	(c)		<i>Any one of:</i> new evidence new technology developments in related models models incomplete/failed to account for all observations ✓		1

Question			Answers	Notes	Total
3.	(a)		separate curves/lines for Li and K sketched AND both increasing ✓ steeper gradient for Li OR curve/line for Li higher ✓		2
3.	(b)		equal masses «of different substances» do not contain equal amounts/moles ✓		1
3.	(c)		«Avg electronegativity = 1.8 Δ electronegativity = 1.6» % covalent character = 45-55 ✓ ionic ✓		2
3.	(d)		$[:C \equiv C:]^{2-}$ 2- charge ✓ $:C \equiv C:$ ✓		2

Question			Answers	Notes	Total
4.	(a)		$\text{C}_{17}\text{H}_{36}(\text{l}) + 26\text{O}_2(\text{g}) \rightarrow 17\text{CO}_2(\text{g}) + 18\text{H}_2\text{O}(\text{l}) \checkmark$		1
4.	(b)	(i)	$n_{\text{C}_{17}\text{H}_{36}} = \ll \frac{2.00 \text{ g}}{[(17 \times 12.01 \text{ g mol}^{-1}) + (36 \times 1.01 \text{ g mol}^{-1})]} = \frac{2.00 \text{ g}}{240.53 \text{ g mol}^{-1}} = \gg$ $0.008315/0.00831 \text{ «mol» } \checkmark$ $\ll \text{ energy} = 11350 \text{ kJ mol}^{-1} \times 0.008315 \text{ mol} = \gg 94.4 \text{ «kJ» } \checkmark$		2
4.	(b)	(ii)	$94\,400 = 500.0 \times 4.18 \times \Delta T \checkmark$ $\Delta T = 45.2 \text{ «K» } \checkmark$		2
4.	(b)	(iii)	<i>Any two:</i> water does not evaporate $\checkmark$ heat is not lost to the surroundings OR all heat is transferred to the water $\checkmark$ density of water is $1 \text{ g cm}^{-3} \checkmark$ water is pure $\checkmark$ complete combustion $\checkmark$		2 max

Question			Answers	Notes	Total
4.	(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
4.	(d)		bonds broken: 4(C – C) / 4 × 346 ✓ bonds formed: 2(C=C) / 2 × 614 ✓ $\Delta H^\ominus = \ll 4 \times 346 - 2 \times 614 / 1384 - 1228 = \gg$ «+»156 «kJ» ✓	Award [3] for correct final answer.	3
4.	(e)		C ₂ H ₄ (g) + H ₂ O(g) → C ₂ H ₅ OH(g) ✓		1
4.	(f)	(i)	H ₂ O / water ✓		1
4.	(f)	(ii)	«20(12.01) + 38(1.01) + 2(16.00) = 310.58 $\frac{100 \times 310.58}{(310.58 + 18.02)} =$ 94.5 % ✓		1
4.	(f)	(iii)	Any two of: sustainable development ✓ more economical/efficient ✓ better use of natural resources ✓ reduces waste ✓		2 max

Question			Answers	Notes	Total
5.	(a)	(i)	 $\text{Cl}-\text{Cl} \rightarrow 2 \text{Cl}^\bullet$ 2 Cl• ✓ single-barbed/fish-hooks ✓	Accept chlorine atoms.	2
5.	(a)	(ii)	 $\text{Cl}-\text{Cl} \rightarrow \text{Cl}^+ + \text{Cl}^-$ <i>full/double-barbed arrow AND charges on both ions are required for mark. ✓</i>		1
5.	(a)	(iii)	Cl^+ AND can accept a pair of electrons to form a new bond ✓		1

Question			Answers	Notes	Total
5.	(b)	(i)	hydrogen bonding stronger than dipole-dipole ✓		1
5.	(b)	(ii)	«increase because» stronger London/dispersion forces ✓ more electrons OR surface contact ✓		2
5.	(c)	(i)	 start at pH = 1 ✓ curve with decreasing gradient ✓ must finish below pH = 7 ✓		3
5.	(c)	(ii)	12 ✓		1

