



Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CHEMISTRY

0620/43

Paper 4 Extended Theory

October/November 2017

MARK SCHEME

Maximum Mark: 80

Published

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This document consists of **7** printed pages.

Question	Answer	Marks
1(a)	mixture	1
1(b)	element	1
1(c)	compound	1
1(d)	mixture	1

Question	Answer	Marks												
2(a)(i)	(two or more) atoms	1												
	combined / joined / sharing electrons (by a covalent bond) / bonded	1												
2(a)(ii)	substance that cannot be split up / broken down / decomposed (into anything simpler) OR (substance) made of atoms with the same atomic number / number of protons / proton number	1												
2(b)(i)	10	1												
2(b)(ii)	22	1												
2(b)(iii)	A AND B	1												
2(b)(iv)	A AND B	1												
2(b)(v)	C AND D	1												
2(c)	<table border="1"> <thead> <tr> <th></th><th>number of protons</th><th>number of electrons</th></tr> </thead> <tbody> <tr> <td>Na</td><td>11</td><td>11</td></tr> <tr> <td>S²⁻</td><td>16</td><td>18</td></tr> <tr> <td>Cl₂</td><td>34</td><td>34</td></tr> </tbody> </table>		number of protons	number of electrons	Na	11	11	S ²⁻	16	18	Cl ₂	34	34	3
	number of protons	number of electrons												
Na	11	11												
S ²⁻	16	18												
Cl ₂	34	34												

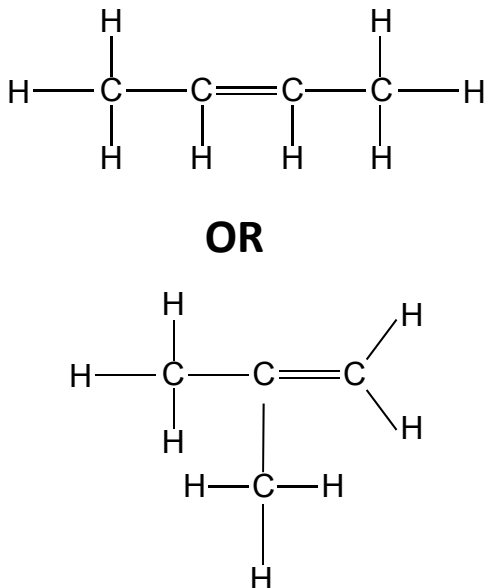
Question	Answer	Marks
3(a)	hematite	1
3(b)	(coke reacts with oxygen / air) to produce heat / increase temperature / exothermically	1
	coke is reducing agent / produces reducing agent / produces carbon monoxide OR coke reduces Fe ₂ O ₃ / (iron) ore / hematite (producing iron)	1
	Fe ₂ O ₃ + 3CO → 2Fe + 3CO ₂ OR Fe ₂ O ₃ + 3C → 2Fe + 3CO OR 2Fe ₂ O ₃ + 3C → 4Fe + 3CO ₂ M1 species correct M2 balanced	2
	limestone (decomposes to calcium oxide which) reacts with / removes acidic impurities / SiO ₂ / sand / silica / silicon(IV) oxide / silicon dioxide	1
	limestone / calcium oxide / lime is involved in the production of slag / calcium silicate	1
3(c)(i)	positive ions / cations	1
	sea of electrons / mobile electrons / delocalised electrons / moving electrons / flowing electrons	1
	attraction between positive ions and electrons	1
3(c)(ii)	layers / rows / sheets of ions	1
	slide / slip / shift (over each other or past each other)	1
3(c)(iii)	particles have different sizes / radii	1
	layers cannot slide / slip / shift	1
3(d)(i)	Fe + H ₂ SO ₄ → FeSO ₄ + H ₂	1

Question	Answer			Marks
3(d)(ii)	$\text{Fe}_2\text{O}_3 + 3\text{H}_2\text{SO}_4 \rightarrow \text{Fe}_2(\text{SO}_4)_3 + 3\text{H}_2\text{O}$ M1 formula of $\text{Fe}_2(\text{SO}_4)_3$ M2 all formulae correct (no additional species) M3 balanced			3
3(e)		observation with aqueous iron(II) sulfate	observation with aqueous iron(III) sulfate	4
	aqueous sodium hydroxide		M3 brown precipitate	
	aqueous potassium iodide	M1 no change	M4 brown solution / black solid	
	aqueous acidified potassium manganate(VII)	M2 (pink / purple to) colourless / decolourised		

Question	Answer	Marks
4(a)	fractional distillation	1
4(b)(i)	oxidation	1
4(b)(ii)	acid(ic)	1
4(c)	$2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$	1
4(d)(i)	no carbon dioxide produced / more efficient	1
4(d)(ii)	storage of hydrogen is difficult / takes more space to store (hydrogen) / high likelihood of (hydrogen) leaks / lack of availability of hydrogen	1
4(e)(i)	$\text{C}_2\text{H}_5\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$ M1 species correct M2 balanced	2
4(e)(ii)	climate change / greenhouse effect / consequence of climate change	1

Question	Answer	Marks
4(e)(iii)	fermentation	1
4(f)	electrolysis	1

Question	Answer	Marks
5(a)(i)	oxygen / O ₂	1
	sodium nitrite / sodium nitrate(III) / NaNO ₂	1
5(a)(ii)	$2\text{Cu}(\text{NO}_3)_2 \rightarrow 2\text{CuO} + \text{O}_2 + 4\text{NO}_2$ M1 CuO M2 rest of equation fully correct	2
5(b)(i)	reversible reaction in which the rate of the forward reaction equals the rate of the backward reaction	1
	concentration of all reactants and products becomes constant / does not change	1
5(b)(ii)	forward reaction is endothermic	1
	(increased temperature) causes equilibrium to shift to the right / to shift in the endothermic direction / to form more nitrogen dioxide / to form more product(s)	1
5(b)(iii)	less brown / lighter / paler / colour fades	1
	more molecules / moles / volume on the right ORA OR equilibrium shifts in the direction of fewer molecules / moles / lower volume	1

Question	Answer	Marks
6(a)(i)	compounds containing carbon and hydrogen only	1
6(a)(ii)	<i>alkanes</i> : C_nH_{2n+2}	1
	<i>alkenes</i> : C_nH_{2n}	1
6(a)(iii)	any 2 from: • same or similar chemical properties • (consecutive members) differ by CH_2 • same functional group • common (allow similar) methods of preparation • physical properties vary in predictable manner / show trends / gradually change OR example of a physical property variation	2
6(a)(iv)	 OR	1
6(a)(v)	structural isomers	1

Question	Answer	Marks
6(b)(i)	more than enough oxygen to react with all of the hydrocarbon	1
6(b)(ii)	125 (cm ³)	1
6(b)(iii)	1:5:3	1
6(b)(iv)	C ₃ H ₈ If full credit is not awarded, allow 1 mark for C _x H _y (g) + 5O ₂ (g) → 3CO ₂ (g) + 4H ₂ O(l)	2

Question	Answer	Marks
7(a)(i)	diffusion	1
7(a)(ii)	silicon(IV) oxide is a solid, whereas carbon dioxide is a gas	1
7(a)(iii)	photosynthesis	1
	chlorophyll / chloroplasts	1
	M2 sunlight / UV (light)	1
	6CO ₂ + 6H ₂ O → C ₆ H ₁₂ O ₆ + 6O ₂ M1 species correct M2 balanced	2
7(b)(i)	condensation	1
7(b)(ii)	hydrolysis	1
7(b)(ii)	HO–□–OH OR H–O–□–O–H	1