
CHEMISTRY

0620/42

Paper 4 Theory (Extended)

May/June 2017

MARK SCHEME

Maximum Mark: 80

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2017 series for most Cambridge IGCSE[®], Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

© IGCSE is a registered trademark.

This syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

This document consists of **9** printed pages.

Question	Answer	Marks
1(a)(i)	fractional distillation	1
1(a)(ii)	chromatography	1
1(a)(iii)	fermentation / ferment	1
1(a)(iv)	(simple) distillation / distil	1
1(a)(v)	filtration / decantation / centrifugation	1
1(b)(i)	(substance that) cannot be split up / broken down into (two or more) simpler substances by chemical means OR (substance) made of atoms with the same atomic number / number of protons / proton number	1
1(b)(ii)	(two or more) elements joined or combined or bonded (together)	1
1(b)(iii)	(particle) containing different numbers of protons and electrons OR atom or group of atoms that has gained or lost an electron / electrons	1

Question	Answer	Marks																				
2(a)	<u>atoms</u> of the same element / <u>atoms</u> with the same proton number / <u>atoms</u> with the same atomic number	1																				
	different neutron number / different nucleon number / different mass number	1																				
2(b)	<table border="1"> <thead> <tr> <th></th> <th>carbon</th> <th>silicon</th> <th></th> </tr> </thead> <tbody> <tr> <td>proton number</td> <td>6</td> <td>14</td> <td>M1</td> </tr> <tr> <td>electronic structure</td> <td>2,4</td> <td>2,8,4</td> <td>M2</td> </tr> <tr> <td>nucleon number</td> <td>12</td> <td>28</td> <td></td> </tr> <tr> <td>number of neutrons in one atom</td> <td>6</td> <td>14</td> <td>M3</td> </tr> </tbody> </table>		carbon	silicon		proton number	6	14	M1	electronic structure	2,4	2,8,4	M2	nucleon number	12	28		number of neutrons in one atom	6	14	M3	3
		carbon	silicon																			
	proton number	6	14	M1																		
	electronic structure	2,4	2,8,4	M2																		
	nucleon number	12	28																			
number of neutrons in one atom	6	14	M3																			
2(c)(i)	covalent	1																				
2(c)(ii)	award 1 mark for each correct property and one mark for each correct matching reason.	4																				
	property: high melting point / high boiling point reason: bonds between atoms are strong OR covalent bonds are strong / bonds need large amount of energy to break																					
	property: non-conductor / poor conductor (of electricity) / insulator reason: no moving charged particles / no moving ions / no moving electrons / all (outer shell) electrons used in bonding																					
	property: hard reason: bonds between atoms are strong OR covalent bonds are strong																					
	property: brittle reason: bonds between atoms are strong OR covalent bonds are strong / bonds are directional																					
	property: insoluble reason: does not form hydrogen bonds with water / no ions that can be hydrated																					
2(d)(i)	incomplete combustion / incomplete burning / combustion in insufficient air / oxygen	1																				
	of fossil fuels / named fossil fuel / named petroleum fraction / name or formula of a type of substance containing carbon	1																				
2(d)(ii)	toxic / poisonous / combines with or binds to haemoglobin	1																				

Question	Answer	Marks
2(e)(i)	carbon dioxide: (simple) molecular / simple covalent	1
	silicon(IV) dioxide: macromolecular / giant molecular / giant covalent / giant atomic	1
2(e)(ii)	carbon dioxide: weak (force of) attraction between molecules / weak intermolecular forces / weak van der Waals' forces / weak dispersion forces / weak London forces	1
	silicon(IV) dioxide: covalent bonds are strong / force of attraction between atoms is strong / no weak bonds (are present) / all bonds are strong	1
	(weak) forces of attraction in carbon dioxide need small amounts of energy or heat to break / less energy or heat needed to break forces of attraction in carbon dioxide OR (strong) bonds in silicon(IV) dioxide need large amounts of energy or heat to break / more energy or heat needed to break bonds in silicon(IV) dioxide	1
2(f)	$2\text{NaOH} + \text{SiO}_2 \rightarrow \text{Na}_2\text{SiO}_3 + \text{H}_2\text{O}$ IF full credit is not awarded, allow 1 mark for Na_2SiO_3 OR $2\text{OH}^- + \text{SiO}_2 \rightarrow \text{SiO}_3^{2-} + \text{H}_2\text{O}$ M1 species correct M2 balancing	2

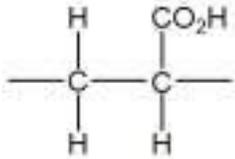
Question	Answer	Marks
3(a)(i)	450 °C	1
	200 atmospheres	1
3(a)(ii)	iron	1
3(b)(i)	4(NO)	1
	5(O ₂) AND 6(H ₂ O)	1
3(b)(ii)	lower yield of NO/lower yield of nitric acid/lower yield of product/equilibrium shifts to left (at higher temperatures)/backward reaction favoured(at higher temperatures) ORA	1
3(b)(iii)	too slow / rate decreases ORA	1
3(c)	4NO + 3O ₂ + 2H ₂ O → 4HNO ₃ M1 all formulae correct M2 balancing	2
3(d)	add copper(II) carbonate (to acid) until it stops dissolving or no more effervescence / bubbling / fizzing	1
	filter (to remove copper(II) carbonate)	1
	evaporate / heat / warm / boil / leave in sun AND until most of the water has gone / some water is left / evaporate some of the water / until it is concentrated / saturation (point) / crystallisation point / crystals form on glass rod or microscope slide / crystals start to form	1
	(for any solution) leave / allow to cool / allow to crystallise OR (for any crystals) filter / wash / dry with filter paper / dry in warm place / dry in a (low) oven / leave to dry	1
	formula of Cu(NO ₃) ₂	1
	equation: CuCO ₃ + 2HNO ₃ → Cu(NO ₃) ₂ + CO ₂ + H ₂ O	1

Question	Answer	Marks
4(a)	any 3 from: catalyst more than one/variable oxidation state/oxidation number/valency form coloured compounds /coloured ions forms complex ions/complexes	3
4(b)	add sodium hydroxide (solution)/NaOH/potassium hydroxide (solution)/KOH	1
	zinc oxide dissolves/reacts OR copper(II) oxide does not dissolve/react	1
	filter/decant/centrifuge (copper(II) oxide)	1
4(c)(i)	$\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^- / 2\text{e}^-$ M1 formula of Zn^{2+} on the right-hand side M2 equation fully correct	2
4(c)(ii)	zinc/Zn nickel/Ni copper/Cu	1
4(c)(iii)	copper (+) and nickel (–)	1
	0.59 V	1

Question	Answer			Marks																
5(a)(i)	<table border="1" data-bbox="349 236 1357 483"> <thead> <tr> <th></th> <th>aqueous potassium chloride</th> <th>aqueous potassium bromide</th> <th>aqueous potassium iodide</th> </tr> </thead> <tbody> <tr> <td>chlorine</td> <td></td> <td></td> <td>✓</td> </tr> <tr> <td>bromine</td> <td>x</td> <td></td> <td>✓</td> </tr> <tr> <td>iodine</td> <td>x</td> <td>x</td> <td></td> </tr> </tbody> </table> <p data-bbox="349 523 819 622">5 cells completed correctly = [3] 3 or 4 cells completed correctly = [2] 2 cells completed correctly = [1]</p>				aqueous potassium chloride	aqueous potassium bromide	aqueous potassium iodide	chlorine			✓	bromine	x		✓	iodine	x	x		3
	aqueous potassium chloride	aqueous potassium bromide	aqueous potassium iodide																	
chlorine			✓																	
bromine	x		✓																	
iodine	x	x																		
5(a)(ii)	$\text{Cl}_2 + 2\text{KBr} \rightarrow 2\text{KCl} + \text{Br}_2$ <p>OR</p> $\text{Cl}_2 + 2\text{Br}^- \rightarrow 2\text{Cl}^- + \text{Br}_2$			1																
5(b)(i)	white			1																
5(b)(ii)	0.02 (mol)			1																
5(b)(iii)	0.02 (mol)			1																
5(b)(iv)	1:2			1																
	VCl_2			1																

Question	Answer	Marks
5(c)(i)	solid	1
5(c)(ii)	$2\text{Na} + \text{At}_2 \rightarrow 2\text{NaAt}$ M1 formula of NaAt M2 equation fully correct	2
5(d)(i)	393 (kJ)	1
5(d)(ii)	416 (kJ)	1
5(d)(iii)	-23 (kJ/mol)	1

Question	Answer	Marks
6(a)(i)	alkene	1
	carboxylic acid	1
6(a)(ii)	any 2 from: same / similar chemical properties (same) general formula (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 / example of a physical property variation	2
6(b)	carboxylic acid / aldehyde	1
	ester	1
6(c)(i)	colourless / decolourised	1
	bubbles / fizzing / effervescence	1

Question	Answer	Marks
6(c)(ii)	addition	1
	 <p>repeat unit</p>	1
	continuation bonds at both ends	1