



CHEMISTRY

0620/43

Paper 4 Theory (Extended)

October/November 2019

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 International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2019 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

PUBLISHED**Generic Marking Principles**

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Question	Answer				Marks																				
1(a)	<table border="1" data-bbox="338 220 1111 480"> <thead> <tr> <th data-bbox="338 220 573 284">particle</th> <th colspan="2" data-bbox="573 220 840 284">charge</th> <th colspan="2" data-bbox="840 220 1111 284">relative mass</th> </tr> </thead> <tbody> <tr> <td data-bbox="338 284 573 347">electron</td> <td data-bbox="573 284 728 347">M1</td> <td data-bbox="728 284 840 347">–1</td> <td colspan="2" data-bbox="840 284 1111 347"></td> </tr> <tr> <td data-bbox="338 347 573 411">neutron</td> <td data-bbox="573 347 728 411">M2</td> <td data-bbox="728 347 840 411">0</td> <td data-bbox="840 347 972 411">M3</td> <td data-bbox="972 347 1111 411">1</td> </tr> <tr> <td data-bbox="338 411 573 475">proton</td> <td colspan="2" data-bbox="573 411 840 475"></td> <td data-bbox="840 411 972 475">M4</td> <td data-bbox="972 411 1111 475">1</td> </tr> </tbody> </table> <p data-bbox="779 480 1111 515">(1) (1)</p> <p data-bbox="338 515 573 550">Mark by column</p>				particle	charge		relative mass		electron	M1	–1			neutron	M2	0	M3	1	proton			M4	1	2
particle	charge		relative mass																						
electron	M1	–1																							
neutron	M2	0	M3	1																					
proton			M4	1																					
1(b)	<table border="1" data-bbox="338 585 1202 979"> <thead> <tr> <th data-bbox="338 585 542 683">number of electrons</th> <th data-bbox="542 585 732 683">number of neutrons</th> <th data-bbox="732 585 902 683">number of protons</th> <th data-bbox="902 585 1202 683">symbol</th> </tr> </thead> <tbody> <tr> <td data-bbox="338 683 542 746">M1 13 (1)</td> <td data-bbox="542 683 732 746"></td> <td data-bbox="732 683 902 746"></td> <td data-bbox="902 683 1202 746"></td> </tr> <tr> <td data-bbox="338 746 542 810">M2 10 (1)</td> <td data-bbox="542 746 732 810">M3 13 (1)</td> <td data-bbox="732 746 902 810"></td> <td data-bbox="902 746 1202 810"></td> </tr> <tr> <td data-bbox="338 810 542 979"></td> <td data-bbox="542 810 732 979"></td> <td data-bbox="732 810 902 979"></td> <td data-bbox="902 810 1202 979"> M4 19 9 (1) M5 F (1) M6 – (1) </td> </tr> </tbody> </table>				number of electrons	number of neutrons	number of protons	symbol	M1 13 (1)				M2 10 (1)	M3 13 (1)						M4 19 9 (1) M5 F (1) M6 – (1)	6				
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Question	Answer	Marks
2(a)	F	1
2(b)	I	1
2(c)	F (1) H (1) I (1)	3
2(d)	G (1) good conductor when solid (1)	2
2(e)	D (1) high melting point (1) non-conductor of electricity when solid or liquid (1)	3
2(f)	E (1) only conducts when liquid / conducts when liquid but not when solid (1)	2

Question	Answer	Marks
3(a)	bauxite	1
3(b)(i)	improves conductivity / better conductor (1) lower (operating) temperature (1)	2
3(b)(ii)	positive: $2\text{O}^{2-} \rightarrow \text{O}_2 + 4\text{e}^-$ (1) negative: $\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}$ (1)	2
3(b)(iii)	anodes or carbon react with oxygen (1) (form) carbon dioxide (1)	1
3(c)(i)	$\text{Mg(s)} + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Cu(s)} + \text{Mg}^{2+}(\text{aq})$ ionic equation correct (1) state symbols (1)	2
3(c)(ii)	any two from: <ul style="list-style-type: none"> • solid dissolves / disappears • blue colour of solution fades OR paler solution OR colour of solution disappears OR becomes colourless solution • pink or orange or brown AND solid 	2
3(c)(iii)	unreactive coating of aluminium oxide	1
3(d)	$2\text{Al} + \text{Fe}_2\text{O}_3 \rightarrow 2\text{Fe} + \text{Al}_2\text{O}_3$ Fe_2O_3 and Al_2O_3 both correct (anywhere) (1) Equation completely correct (1)	2
4(a)	P_4	1

Question	Answer	Marks
4(b)(i)	$\text{P}_4 + 6\text{Cl}_2 \rightarrow 4\text{PCl}_3$ formulae correct (1) equation balanced (1)	2
4(b)(ii)	3 bonding pairs and 1 lone pair on P (1) six non-bonding electrons on 3 chlorine atoms (1)	2
4(c)(i)	method 1 <ul style="list-style-type: none"> • (bond breaking) = 1221 or (326 × 3) + 243 (1) • (bond forming) = 1630 or (326 × 5) (1) • energy change = –409 kJ (1) negative sign essential OR method 2 (ignoring 3 P–Cl bonds on both sides) <ul style="list-style-type: none"> • bond breaking = 243 (1) • bond forming = 652 or 326 × 2 (1) • energy change = –409 kJ (1) negative sign essential 	3
4(c)(ii)	exothermic AND energy released when bonds form is greater than energy absorbed to break bonds OR exothermic AND overall energy change has a negative sign	1
4(d)	fewer OR less molecules OR moles + on right OR in product (1) ORA equilibrium shifts to the right (1)	2

Question	Answer	Marks
4(e)	any two numbers correct (1) equation fully balanced (1) $\text{Ca}_3\text{P}_2 + 6\text{H}_2\text{O} \rightarrow 3\text{Ca}(\text{OH})_2 + 2\text{PH}_3$	2
4(f)(i)	NH_4^+	1
4(f)(ii)	PH_4I	1
4(g)	$\text{Ca}_3(\text{PO}_4)_2$	1
4(h)(i)	93.94 / 31 and 6.06 / 1 OR 3.03 and 6.06 OR 1 : 2 ratio (1) PH_2 (1)	2
4(h)(ii)	P_2H_4	1

Question	Answer	Marks
5	M1 5 moles of calcium nitrate (1) M2 10 moles ammonium nitrate (1) or ecf M1 × 2 M 3 M_r of ammonium nitrate = 80 M4 800 g or ecf M2 × M3	4

Question	Answer	Marks
6(a)	strong = exists entirely as ions in solution / fully dissociated 100% dissociated in solution (1) acid = proton donor (1)	2
6(b)	50.0 (cm ³)	1
6(c)(i)	yellow flame	1
6(c)(ii)	solid dissolves / disappears (1) blue solution (1)	2
6(d)(i)	white precipitate	1
6(d)(ii)	$\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s})$ correct ionic equation (1) state symbols (1)	2

Question	Answer	Marks
7(a)	carbon-carbon double bond / C = C	1
7(b)(i)	3	1
7(b)(ii)	$ \begin{array}{ccccccc} & \text{H} & & & \text{H} & & \\ & & & & & & \\ \text{H} & - \text{C} & - & \text{C} = & \text{C} & - & \text{C} & - \text{H} \\ & & & & & & & \\ & \text{H} & & & \text{H} & & \text{H} & \\ & & & & & & & (1) \end{array} $ but-2-ene (1)	2

Question	Answer	Marks
7(b)(iii)	CH ₂ (1) CH ₂ (1)	2
7(c)	(broken down by) hydrolysis (1) acid (used to break down) (1) enzymes (used to break down) (1) chromatography (used to separate) (1) locating agent / (view under) UV light (used to detect) (1) measure <i>R_f</i> (values) or retention factor / compare with standards (used to identify) (1)	6
7(d)(i)	Nylon / Kevlar	1
7(d)(ii)	water	1