Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CHEMISTRY **0620/42**

Paper 4 Theory (Extended) **May/June 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.

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

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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.

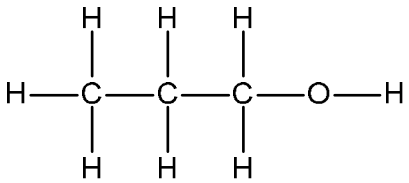
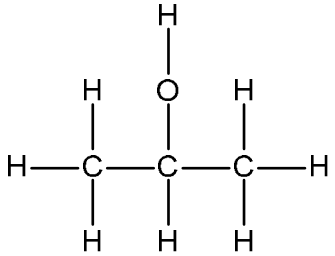
GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

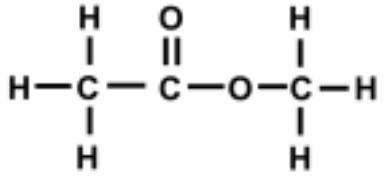
Question	Answer	Marks
1(a)	methane	**1**
1(b)	oxygen	**1**
1(c)	aluminium oxide	**1**
1(d)	oxygen	**1**
1(e)	methane	**1**
1(f)	silicon(IV) oxide	**1**

Question	Answer	Marks
2(a)(i)	**M1** protons (are the same) / 11 protons (1) **M2** electrons (are the same) / 11 electrons (1) **M3** neutrons (are different) / 11,12,13 neutrons (1)	**3**
2(a)(ii)	same number of protons and electrons (1)	**1**
2(a)(iii)	**M1** same **number** of electrons (1) **M2** (same number of) electrons in outer shell (1)	**2**
2(a)(iv)	(they all have) 1 more proton than electrons / 11 protons and 10 electrons	**1**
2(b)(i)	diamond / graphite / graphene **ANY TWO**	**1**
2(b)(ii)	carbon monoxide	**1**

Question	Answer	Marks
3(a)(i)	covalent	**1**
3(a)(ii)	forces of attraction between molecules **AND** are weak / need a small amount of energy to break	**1**
3(a)(iii)	no **moving** or **flowing** or **mobile charged particles** or **ions** or **electrons**	**1**
3(b)(i)	$P_4 + 5O_2 \rightarrow P_4O_{10}$ **M1** all formulae correct (1) **M2** equation correctly balanced (1)	**2**
3(b)(ii)	redox / combustion	**1**
3(c)	$P_4O_{10} + 12NaOH \rightarrow 4Na_3PO_4 + 6H_2O$ **M1** Na_3PO_4 (1) **M2** equation completely correct (1)	**2**
3(d)	**M1** 3 pairs of bonding electrons (1) **M2 only** 1 lone pair on P (1)	**2**
3(e)(i)	proton / H^+ / hydrogen ion acceptor	**1**
3(e)(ii)	$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$ **M1** $(NH_4)_2SO_4$ (1) **M2** equation completely correct (1)	**2**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(a)</td><td>water / natural gas / hydrocarbons</td><td>1</td></tr>
<tr><td>4(b)</td><td>
<table>
<tr><td>effect on the rate of the reverse reaction</td><td>effect on the percentage of methanol in the equilibrium mixture</td></tr>
<tr><td>M1 increases(1)</td><td>no change</td></tr>
<tr><td>increases</td><td>M3 decreases(1)</td></tr>
<tr><td>M2 decreases(1)</td><td>M4 decreases(1)</td></tr>
</table>
</td><td>4</td></tr>
<tr><td>4(c)(i)</td><td>any 2 from:
• same or similar chemical properties or reactions (1)
• (same) general formula (1)
• (consecutive members) differ by CH_2 (1)
• same functional group (1)
• common (allow similar) methods of preparation (1)
• physical properties vary in predictable manner / show trends / gradually change
OR
example of a physical property variation i.e. melting point / boiling point / volatility (1)</td><td>2</td></tr>
</table>

Question	Answer	Marks
4(c)(ii)	**M1**  (1) **M2** propan-1-ol (1) **M3**  (1) **M4** propan-2-ol (1)	**4**
4(c)(iii)	structural isomers / structural isomerism	**1**
4(d)(i)	ethyl methanoate	**1**
4(d)(ii)	**M1** methanoic acid (1) **M2** ethanol (1)	**2**

Question	Answer	Marks
4(d)(iii)	 **M1** correct displayed ester linkage (1) **M2** whole molecule fully correct (1)	**2**

Question	Answer	Marks
5(a)	**M1** 0.0025 / 2.5 × 10^{-3} (moles of H_2SO_4) (1) **M2** 0.0025 / 2.5 × 10^{-3} (moles of $CuSO_4 \bullet 5H_2O$) (1) **M3** 0.625(g) (1)	**3**
5(b)	some copper(II) sulfate remains in solution / some copper(II) sulfate does not form crystals **OR** some of the crystals decomposed **OR** some crystals lost in transfer	**1**
5(c)	**M1 no more** bubbling / fizzing / effervescence (1) **M2 solid** or **powder** stops dissolving (1)	**2**
5(d)	**M1** (lumps have) small**er** surface area **OR powder** has larger surface area (1) **M2** (lumps have) fewer collisions per unit time / less collision frequency **OR powder** has more collisions per unit time / more collision frequency	**2**
5(e)	copper(II) oxide **or** copper(II) hydroxide	**1**
5(f)	filtration	**1**
5(g)(i)	**M1** containing the maximum amount of **dissolved** solute / no more solute can **dissolve** (1) **M2** at any given temperature (1)	**2**

Question	Answer	Marks
5(g)(ii)	when crystals form on a glass rod withdrawn from solution / on a sample of solution placed on microscope slide etc.	**1**
5(g)(iii)	(heating to dryness) would remove water **of crystallisation**	**1**

Question	Answer	Marks
6(a)	**M1** solid (1) **M2** black (1)	**2**
6(b)(i)	**M1** colourless (1) **M2** to brown / orange / yellow (1)	**2**
6(b)(ii)	$Cl_2 + 2KBr \rightarrow 2KCl + Br_2$ **OR** $Cl_2 + 2Br^- \rightarrow 2Cl^- + Br_2$ **M1** all formulae (1) **M2** equation balanced correctly (1)	**2**
6(c)	**M1** two ticks for Cl_2 / KI, Br_2 / KI (1) **M2** three crosses for Br_2 / KCl, I_2 / KCl and I_2 / KBr (1)	**2**

Question	Answer	Marks
7(a)(i)	**M1** Ni / Nickel (1) **M2** (it) loses or donates electrons (1)	**2**
7(a)(ii)	redox	**1**
7(b)	**M1** $Pb \rightarrow Pb^{2+} + 2e(^{-})$ / (1) **M2** $Ag^{+} + e(^{-}) \rightarrow Ag$ (1)	**2**
7(c)	most reactive nickel / Ni lead / Pb least reactive silver / Ag	**1**
7(d)	**nickel has** **M1** higher density (1) **ORA** **nickel has** **M2** higher melting point / boiling point (1) **ORA**	**2**
7(e)	solutions of nickel compounds are coloured **ORA**	**1**
7(f)(i)	**M1** electrolyte aqueous or solution of named nickel salt (1) **M2 anode** impure nickel (1) **M3 cathode** pure nickel (1)	**3**
7(f)(ii)	nickel produced at cathode under the liquid surface (1)	**1**