Cambridge O Level

Cambridge Assessment International Education
Cambridge Ordinary Level

CHEMISTRY **5070/22**

Paper 2 Theory **May/June 2018**

MARK SCHEME

Maximum Mark: 75

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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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.

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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.

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Question	Answer	Marks
1(a)	hydrogen (1)	**1**
1(b)	chlorine (1)	**1**
1(c)	propane (1)	**1**
1(d)	nitrogen (1)	**1**
1(e)	ammonia (1)	**1**

Question	Answer	Marks
2(a)	red-brown (1)	**1**
2(b)(i)	**Any two from:** • solution turns from blue to (pale) green (1) • (iron filings get coated with) pink solid / pink deposit / pink coating (1) • temperature (of mixture) increases (1)	**2**
2(b)(ii)	iron (atom) loses electrons (1)	**1**
2(b)(iii)	copper ions gain electrons / copper(II) gains electrons (1)	**1**
2(c)	transition metal oxide catalyst **AND** reaction (1) e.g. manganese(IV) oxide / manganese dioxide **AND** decomposition of hydrogen peroxide **OR** vanadium(V) oxide **AND** reaction of sulfur dioxide with oxygen / vanadium pentoxide **AND** formation of SO_3 (from SO_2)	**1**
2(d)	low(er) temperatures needed / low(er) pressure needed / less heat needed / less energy needed / conserves energy resources / cheap(er) heating costs / cheap(er) fuel costs / cheap(er) pressure costs	**1**

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Question	Answer	Marks
3(a)(i)	mix (solutions) together **AND** then filter / add solutions (to each other) **AND** then filter / take the mixture **AND** filter (1) wash the residue (with distilled water / solvent) (1) place residue in warm place (to dry) / place in oven (to dry) / use of filter paper (to dry) / leave (to dry) on windowsill (1)	**3**
3(a)(ii)	$Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$ formulae and balance correct (1) correct state symbols dependent on correct formulae (1)	**2**
3(b)(i)	photochemical (1)	**1**
3(b)(ii)	$2AgCl \rightarrow 2Ag + Cl_2$ (1)	**1**
3(c)	(moles of nitric acid) = 4.5×10^{-3} (1) **EITHER** moles from first marking point $\times$ $\frac{170}{1}$ **OR** 0.765 g (silver nitrate) (1) $(0.765 \times 0.8) = 0.612$ g (silver nitrate) (1) **OR** moles from first marking point $\times$ $\frac{0.8}{1}$ **OR** 3.6×10^{-3} moles (silver nitrate) (1) $(3.6 \times 10^{-3} \times 170) = 0.612$ g silver nitrate (1)	**3**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(a)</td><td>moles of SiO_2 = 5 OR $\frac{300}{60}$

OR moles of P_4 = $\frac{300}{360}$ OR 0.83 (1)

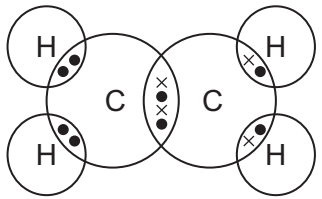
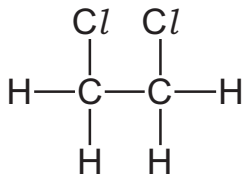
mass of P_4 (= moles of $SiO_2 \times 124 \div 6$ OR = moles of $P_4 \times 124$) = 103.3 (1)</td><td>2</td></tr>
<tr><td>4(b)</td><td>Any two from:

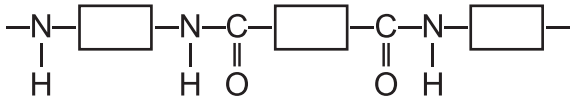
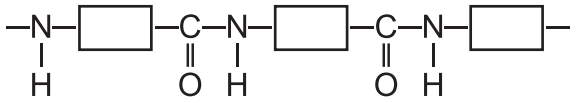
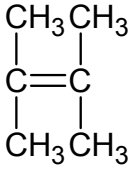
• low melting point / low boiling point (1)

• poor conductor of electricity / poor conductor of heat (1)

• does not dissolve in water (1)</td><td>2</td></tr>
<tr><td>4(c)</td><td>has a giant (ionic) structure (1)

strong attraction between <u>ions</u> / difficult to break attraction between <u>ions</u> / lot of energy needed to overcome (strong) attractive forces between <u>ions</u> (1)</td><td>2</td></tr>
<tr><td>4(d)</td><td><table><tr><td>particle</td><td>$^{30}_{15}P$</td><td>$^{31}_{15}\mathbf{P^{3-}}$</td></tr><tr><td>number of electrons</td><td>15</td><td>18</td></tr><tr><td>number of neutrons</td><td>15</td><td>16</td></tr><tr><td>number of protons</td><td>15</td><td>15</td></tr><tr><td></td><td>(1)</td><td>(1)</td></tr></table></td><td>2</td></tr>
</table>

Question	Answer	Marks
5(a)	petroleum is heated / crude oil is heated (1) fractional distillation / fractionating column (1) idea that separation works because naphtha has different boiling point to other fractions / idea of different boiling points at different places in the column / naphtha comes off at particular height in the column (1)	**3**
5(b)(i)	(molecular formula) fits the (general) formula C_nH_{2n+2} (1)	**1**
5(b)(ii)	$C_{12}H_{26} \rightarrow C_6H_{12} + C_6H_{14}$ / $C_{12}H_{26} \rightarrow 2C_6H_{12} + H_2$ formula for C_6H_{12} (1) equation balanced dependent on alkene formula (1)	**2**
5(c)	 (2) If 2 marks not obtained, **one mark** for: **EITHER** two shared pairs of electrons between the two carbon atoms **OR** incorrect number of electrons in carbon-carbon bond (or bond shown by line) BUT one electron pair between each of the two carbon-hydrogen atoms on each of the two carbon atoms (four electron pairs)	**2**
5(d)(i)	 (1)	**1**
5(d)(ii)	$C_2H_4Cl_2$ (1)	**1**

Question	Answer	Marks
6(a)	 **OR**  (1)	**1**
6(b)(i)	monomers react together / monomers combine / monomers add together / monomers join / monomers link (1) to form only one product / to give one product and no other molecule / no by-product formed (1)	**2**
6(b)(ii)	 (1)	**1**
6(b)(iii)	non-biodegradable / causes litter / fills land-fill sites / incineration produces atmospheric pollutants (1)	**1**

Question	Answer	Marks
7(a)	M_r = 97 **OR** % zinc = 67 % (1) (% zinc = 67 so mass of zinc = % × 30) = 20.1 (1)	**2**
7(b)(i)	$ZnS + 1½O_2 \rightarrow ZnO + SO_2$ correct formulae (1) balancing – dependent on correct formulae (1)	**2**

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Question	Answer	Marks
7(b)(ii)	(sulfur dioxide) causes acid rain / (sulfur dioxide) irritates the nose / throat / eyes / lungs (1)	**1**
7(c)	$ZnO + H_2SO_4 \rightarrow ZnSO_4 + H_2O$ (1)	**1**
7(d)	anode: $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$ (1) cathode: $Zn^{2+} + 2e^- \rightarrow Zn$ (1)	**2**
7(e)	**Any two from:** • (protective) barrier **AND** stops water and/or oxygen reaching surface / barrier **AND** stops water / moisture and / or oxygen reaching iron (1) • zinc is more reactive (than iron) / is a better reducing agent (than iron) / zinc loses electrons more easily (than iron) / zinc is higher in the reactivity series (than iron) (1) • zinc reacts with oxygen and / or water in preference to iron / zinc corrodes instead of iron / zinc oxidises more readily than iron / zinc loses electrons and gives then to the iron (1)	**2**

Question	Answer	Marks
8(a)	a reversible reaction / backward **AND** forward reaction (1) the concentrations of reactants **AND** products do not change / amounts of reactants **AND** products constant / moles of reactants **AND** products constant (1) **OR** rate of forward reaction = rate of backward reaction (2)	**2**
8(b)	amount of carbon dioxide increases / moles of carbon dioxide increases / mass of carbon dioxide increases (1) no <u>gas</u> on left but <u>gas</u> on right (1)	**2**
8(c)	endothermic / the enthalpy change is positive (1)	**1**

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Question	Answer	Marks
8(d)(i)	carbon dioxide (1) limewater turns milky (1)	**2**
8(d)(ii)	water (1) copper(II) sulfate goes from white to blue / cobalt chloride goes from blue to pink (1)	**2**
8(d)(iii)	$CaCO_3 + 2HNO_3 \rightarrow Ca(NO_3)_2 + CO_2 + H_2O$ (1)	**1**

Question	Answer	Marks
9(a)	SO_3NH_3 (1)	**1**
9(b)(i)	(a substance that) donates hydrogen ions / (a substance that) produces hydrogen ions (in solution) (1)	**1**
9(b)(ii)	weak acids partially ionise / weak acids do not completely dissociate / weak acids do not fully ionise (1) strong acids completely ionise / strong acids completely dissociate (1)	**2**
9(c)	moles of acid = $0.25 \times 0.15 / 0.0375$ (1) M_r of acid = 97 (1) mass of acid (= moles of acid $\times$ M_r) = 3.6(4) (1)	**3**
9(d)	16.7 (cm^3) (1)	**1**
9(e)	$Mg + 2SO_3NH_3 \rightarrow H_2 + Mg(SO_3NH_2)_2$ correct formula of $Mg(SO_3NH_2)_2$ (1) balanced equation – dependent on correct formulae (1)	**2**

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Question	Answer	Marks
10(a)	butyl ethanoate / butyl acetate (1)	**1**
10(b)(i)	empirical formula is $C_2H_3O_2Na$ (2) If two marks not scored: 1 mark for mole ratio C : H : O : Na is 2.44 : 3.70 : 2.44 : 1.22 **OR** 1 mark for C = 29.3 / 12 H = 3.7 / 1 O = 39.0 / 16 Na = 28.0 / 23	**2**
10(b)(ii)	$CH_3CH_2CH_2CH_2OH$ (1) idea that it must be an alcohol since it can be oxidised / must be butanol since it is oxidised to butanoic acid (1)	**2**
10(c)(i)	(compounds with) the same molecular formula but different structures / (compounds with) the same molecular formula but different arrangements of atoms (1)	**1**
10(c)(ii)	any isomer of butyl ethanoate, e.g. $CH_3CH_2CO_2CH_2CH_2CH_3$ (1)	**1**
10(d)	does not contains a carbon-carbon double bond / has **only** single carbon-carbon bonds (1)	**1**
10(e)(i)	molecules move slow**er** / molecules have less kinetic energy (1)	**1**
10(e)(ii)	solvent / flavourings (1)	**1**

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