Cambridge International AS & A Level

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CHEMISTRY **9701/32**

Paper 3 (Advanced Practical Skills 2) **May/June 2018**

MARK SCHEME

Maximum Mark: 40

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)	**I Table of data**, to include the following: **Unit** 'covering' all weighings, and correct headings • Mass of crucible and lid • Mass of crucible, lid and **FB 1** (or 'contents before heating') • Mass of crucible, lid and residue / oxide / contents after heating / contents after cooling • Mass of **FB 1** used • Mass of residue / (metal) oxide / MO (obtained) *Do not accept 'mass of **FB 1** after heating' in third weighing.*	1
	II Weighings recorded appropriately • Six weighings recorded in the space provided (*3 for each of expts 1 and 2*) • All weighings recorded to same number of decimal places (one or more)	1
	III Correctly calculates masses of **FB 1** and residue for **Experiment 2** • Mass of **FB 1** used recorded on page 2, correctly subtracted • Mass of **FB 1** used between 0.80–1.00 g • Mass of residue recorded on page 2, correctly subtracted	1
	Accuracy marks based on Experiment 2 • For assessment of accuracy, examiner checks and corrects (if necessary) the masses of **FB 1** used and of **MO** obtained by the supervisor and by the candidate for **Experiment 2**. • Examiner calculates the ratio (mass **FB 1**: mass MO) for the supervisor (2 dp) • Examiner calculates the ratio (mass **FB 1**: mass MO) for the candidate (2 dp) • Examiner calculates **δ,** the difference between these two ratios. **Award IV and V** **if $\delta \leqslant 0.10$** **Award IV** **if $0.10 < \delta \leqslant 0.20$**	2
1(b)(i)	Correctly calculates both mean masses (to 2 dp)	1
1(b)(ii)	Mass of water = difference between the answers in **(i)** **or** from the table Moles of water = $^{\text{mass}}/_{18}$	1

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Question	Answer	Marks
1(b)(iii)	M_r = mass of MO obtained / moles of water **or** M_r = (mass of $M(OH)_2$ obtained / moles of water) – 18 Answer to 2 – 4 sf	**1**
1(b)(iv)	A_r = ans**(iii)** – 16 (expressed to 2, 3 or 4 sig fig) **and** Identity of **M** correct (ie. the closest A_r value in Group 2) (Be ⩽ 16.65 ⩽ Mg ⩽ 32.20 ⩽ Ca ⩽ 63.85 ⩽ Sr ⩽ 112.45 ⩽ Ba)	**1**
1(c)(i)	Heat to constant mass	**1**
1(c)(ii)	MCO_3 will give off CO_2,	**1**
	A_r determined will be smaller (due to the impurity) **and** the (%) mass of CO_2 (given off from $MgCO_3$) is greater than the mass of water (given off by $Mg(OH)_2$)	**1**

Question	Answer	Marks
2(a)(i)	**Unambiguous headings, units and six pieces of data listed.** • mass of container and **FB 3** • mass of container • mass of **FB 3** used • first / start / initial temperature • maximum temperature (*allow final temp, temp after mixing*) • temperature rise / change	**1**
	Precision of readings shown in 2(a) and 2(b) • all four thermometer readings are shown to 0.0 or 0.5 ^oC • all four temperature readings > 30 ^oC	**1**

Question	Answer	Marks
2(a)(ii)	**Accuracy marks** • Check subtractions of supervisor and candidate temperature. • Calculate the difference between the corrected candidate's and supervisor's temp rise (δ) If $\delta \leqslant$ 3.0 ^{o}C award **two marks** If $\delta \leqslant$ 5.0 ^{o}C award **one mark**	**2**
2(a)(ii)	Energy change = 30 × 4.2 × temp rise Answer must be expressed to 2, 3 or 4 sf	**1**
2(a)(iii)	Moles of **FB 3** = $^{\text{mass used}}/_{74.1}$ Answer must be expressed to 2, 3 or 4 sf.	**1**
2(a)(iv)	• $\Delta H_1 = {}^{(\text{answer (ii)}\,/}_{\text{answer (iii))}} \times 1000$ • Negative sign must be shown on answer line. • Answer should be expressed to 2, 3 or 4 sig fig	**1**
2(b)(i)	**Six pieces of data.** • mass of container and **FB 4** • mass of container • mass of **FB 4** used • first / start / initial temperature • final temperature • temperature rise	**1**
	Accuracy mark • Check subtractions of supervisor and candidate. • Calculate the difference between corrected candidate's and supervisor's temp rise (δ) If $\delta \leqslant$ 5.0^{o}C award one mark	**1**

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Question	Answer	Marks
2(b)(ii)	• Energy released (30 × 4.2 × temp rise) • No of moles used = $\frac{\text{mass of FB 4 used}}{56.1}$ • $\Delta H_2 = \frac{\text{(energy}}{\text{no of moles)} \times 1000}$ • Negative sign Four correct bullets award 2 marks Two correct bullets award 1 mark.	**2**
2(c)	**Attempt at Hess Cycle diagram** • Downward arrow from $Ca(OH)_2$, labelled with value and sign of ΔH_1 from **(a)(iv)** • Downward arrow from CaO, labelled with value and sign of ΔH_2 from **(b)(ii)**	**1**
	$\Delta H_r = \Delta H_1 - \Delta H_2$	**1**
2(d)(i)	To speed up the reaction / it is slow at room temperature / to supply the activation energy	**1**
2(d)(ii)	Acid is in excess / **FB 4** is the limiting reagent (in both cases). Therefore temp rise would be the same	**1**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td colspan="3">FB 5 is H_2SO_4; FB 6 is $BaCl_2$; FB 7 is $AgNO_3$</td></tr>
<tr><td>3(a)</td><td>2 asterisks (*) = 1 mark
<table>
<tr><th>test</th><th>FB 5</th><th>FB 6</th><th>FB 7</th></tr>
<tr><td>+ Mg</td><td>effervescence / bubbling / fizzing*
gas / H_2 pops with a lighted splint*
heat produced / exothermic*</td><td>no reaction / no change / no effervescence / solution remains colourless*</td><td>grey / black and ppt / solid*</td></tr>
<tr><td>+ Na_2CO_3</td><td>effervescence / bubbling / fizzing*
gas / CO_2 turns limewater milky / chalky / cloudy
white / forms a white ppt*</td><td>white ppt*</td><td>white / off-white / cream / pale yellow ppt*</td></tr>
<tr><td>+ NaOH</td><td>no reaction / no change / no ppt / temperature increase*</td><td>no reaction / no change / no ppt*</td><td>brown ppt and insoluble in excess *</td></tr>
<tr><td>+ Ba^{2+}</td><td>white ppt*</td><td>no reaction / no change / no ppt*</td><td>(ignore any observations here)</td></tr>
<tr><td>+ FB 5</td><td></td><td>white ppt*</td><td>no reaction / no change / no ppt*</td></tr>
<tr><td>+ FB 6</td><td></td><td></td><td>white ppt*</td></tr>
<tr><td>+ KI</td><td></td><td></td><td>(pale) yellow ppt*</td></tr>
</table></td><td>9</td></tr>
<tr><td>3(b)(i)</td><td>FB 7 is Ag^+ / silver</td><td>1</td></tr>
<tr><td>3(b)(ii)</td><td>$Mg + 2H^+ \rightarrow Mg^{2+} + H_2$</td><td>1</td></tr>
<tr><td>3(b)(iii)</td><td>Precipitation</td><td>1</td></tr>
</table>

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Question	Answer	Marks
3(b)(iv)	$Ag^{+}(aq) + Cl^{-}(aq) \rightarrow AgCl(s)$	**1**

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