Cambridge International AS & A Level

CHEMISTRY **9701/52**

Paper 5 Planning, Analysis and Evaluation **May/June 2020**

MARK SCHEME

Maximum Mark: 30

Published

Students did not sit exam papers in the June 2020 series due to the Covid-19 global pandemic.

This mark scheme is published to support teachers and students and should be read together with the question paper. It shows the requirements of the exam. The answer column of the mark scheme shows the proposed basis on which Examiners would award marks for this exam. Where appropriate, this column also provides the most likely acceptable alternative responses expected from students. Examiners usually review the mark scheme after they have seen student responses and update the mark scheme if appropriate. In the June series, Examiners were unable to consider the acceptability of alternative responses, as there were no student responses to consider.

Mark schemes should usually be read together with the Principal Examiner Report for Teachers. However, because students did not sit exam papers, there is no Principal Examiner Report for Teachers for the June 2020 series.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the June 2020 series for most Cambridge IGCSE™ and Cambridge International A & AS Level components, and some Cambridge O Level components.

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.

Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	<u>‘List rule’ guidance</u> (see examples below) For questions that require ***n*** responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided • Any response marked *ignore* in the mark scheme should not count towards ***n*** • Incorrect responses should not be awarded credit but will still count towards ***n*** • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response • Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

6	<u>Calculation specific guidance</u> Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'. For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values. For answers given in standard form, (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme. Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.
7	<u>Guidance for chemical equations</u> Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme. State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Defining the Problem

P1	Identify the apparatus suitable for carrying out each step of the procedure.
P2	Express the aim in terms of a prediction.

Methods

M1	Describe precautions that should be taken to keep risks to a minimum.
M2	Describe the method to be used when carrying out the experiment.
M3	Describe how the data might be used to reach a conclusion
M4	Describe the arrangement of the apparatus
M5	Measuring instruments should be chosen to measure the correct quantity to a suitable precision.

Dealing with data

D1	Use calculations to enable simplification or explanation of data
D2	Use a table or graph to draw attention to the key points in quantitative data.

Evaluation

E1	Identify the extent to which provided readings have been replicated
E2	Suggest and explain the effect that a change in the conditions used for the experiment might have on the results obtained.
E3	Identify and explain the weaknesses of the experimental procedure used.

Conclusion

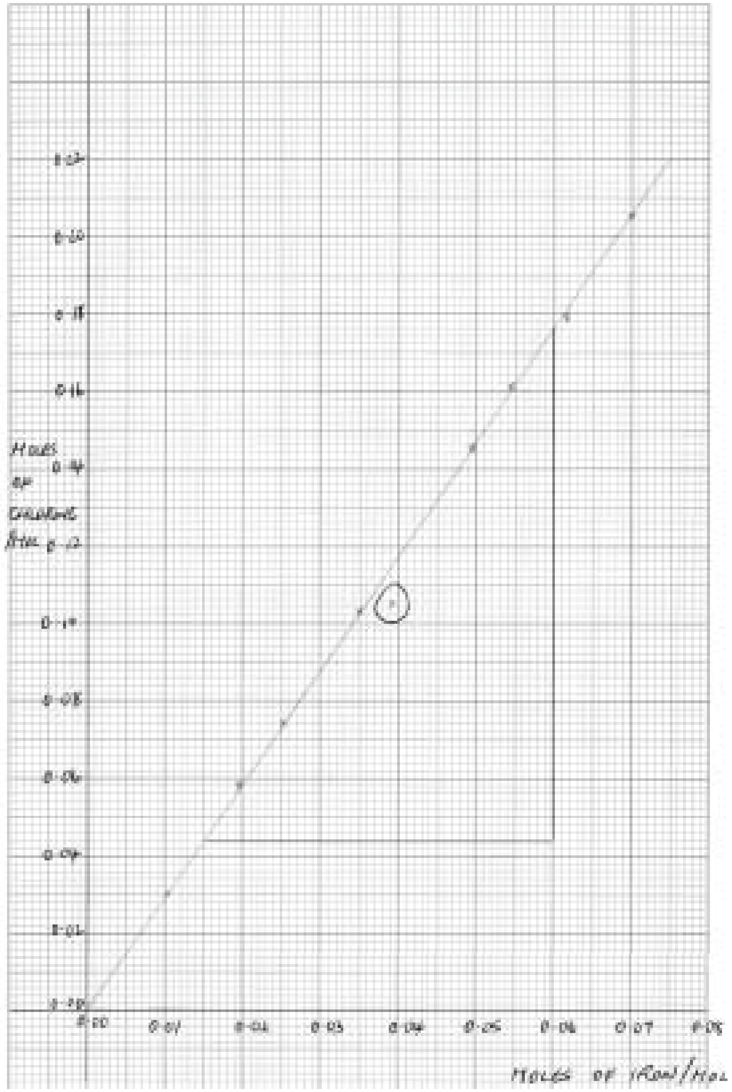
C1	Draw conclusion from an investigation
C2	Suggest improvements

Question	Answer	Marks
1(a)(i)	The sample will contain air from the apparatus **OR** gas mixture not pure gas	**1**
1(a)(ii)	**M1** Gas is soluble so should not be collected over water	**1**
	M2 There is a danger of suck-back	**1**
1(b)(i)	Mass of U-tube + soda lime before the experiment **AND** Mass of U-tube + soda lime after the experiment	**1**
1(b)(ii)	Soda lime is alkaline / a neutralisation reaction will occur.	**1**
1(c)	Carry out the experiment in a fume cupboard	**1**
1(d)(i)	**M1** use of correct T (294 K) and V (100×10^{-6} m^3)	**1**
	M2 Correct use of pV = nRT ($9.8 \times 10^4 \times 100 \times 10^{-6} / 8.31 \times 294$) = 4.01×10^{-3}	**1**
1(d)(ii)	divide mass of **X** by the number of moles calculated in (d)(i) **OR** 0.251/ 1(d)(i) = 62.6	**1**
1(d)(iii)	(Smaller mass of gas **X** absorbed, so) lower Mr value	**1**
1(d)(iv)	*P/T* is less **AND** Because if M_r is higher, n is less and therefore *P/T* is less	**1**
1(e)	Repeat the experiment (×3) and take an average	**1**
1(f)	Replace the soda lime with an acid (to absorb the alkaline gas)	**1**

Question	Answer	Marks
2(a)(i)	The mass of the empty reaction tube **AND** The mass of the empty side-arm conical flask	**1**
2(a)(ii)	The iron could react with oxygen or air (instead of the chlorine)	**1**
2(a)(iii)	any one from: • The mass of air in the flask is equal to mass of chlorine in the flask • All the iron (wool) has reacted • Any residue in the reaction tube is iron	**1**
2(b)(i)	see table below	**3**

Student	Mass of iron / g	Mass of iron chloride / g	Mass of chlorine / g	Moles of iron	Moles of chlorine
1	0.57	1.64	1.07	0.0102	0.0301
2	1.10	3.16	2.06	0.0197	0.0580
3	1.40	4.03	2.63	0.0251	0.0741
4	1.95	5.61	3.66	0.0349	0.103
5	2.18	5.89	3.71	0.0391	0.105
6	2.75	7.90	5.15	0.0493	0.145
7	3.05	8.77	5.72	0.0547	0.161
8	3.45	9.80	6.35	0.0618	0.179
9	3.90	11.18	7.28	0.0699	0.205

M1 Mol of iron (column 5)
M2 Mol of chlorine (column 6) [
M3 all entries to 3 SF

Question	Answer	Marks
2(b)(ii)	 **M1** 5 points plotted correctly **M2** Line of best fit drawn	2

Question	Answer	Marks
2(b)(iii)	**M1** Circle around the point at 0.0391,0.105	1
	M2 Viable reason why the number of moles of chlorine is too small. *e.g.* not all the mass of iron chloride formed was collected in the conical flask **OR** Iron chloride dust particles escaped with excess chlorine gas	1
2(c)	**M1** Coordinates read and recorded correctly	1
	M2 Gradient calculated	1
2(d)	Calculate the moles of each element and find the mole ratio	1
2(e)(i)	2 x 0.005/4.03 x 100 = 0.248%	1
2(e)(ii)	Lower percentage error **AND** Larger mass used	1
2(f)(i)	(55.8/126.8) x 100 = 44.0 **OR** empirical formula calculation 44/55.8 : 56/35.5 → 0.7885 : 1.5775 → 1 : 2 → $FeCl_2$	1
2(f)(ii)	In method (f) conversion of Fe to Fe^{2+} takes place as $E^{\ominus}_{cell}$ is + 0.44V **AND** Conversion of to Fe^{2+} to Fe^{3+} is not feasible as $E^{\ominus}_{cell}$ is – 0.77V	1