CAMBRIDGE
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CHEMISTRY **0620/41**

Paper 4 Theory (Extended) **May/June 2024**

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 May/June 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre–U components, and some Cambridge O Level components.

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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 descriptions 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	‘List rule’ guidance 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 Calculation specific guidance

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 Guidance for chemical equations

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.

If the candidate uses different terminology to the terminology on the Mark Scheme full credit must be given if the meaning is the same.

Any response that is worth more than 1 mark must be annotated by tick(s). The number of ticks should be the same as the number of marks awarded. This applies even if other annotations such as BOD or ECF are used. Ticks should be placed as near as possible to the place where the mark is awarded. Please see Practice scripts for examples.

Question	Answer	Marks
1(a)	Contact process	**1**
1(b)	distillation	**1**
1(c)	electrolysis	**1**
1(d)	fractional distillation	**1**
1(e)	fermentation	**1**
1(f)	cracking	**1**
1(g)	chromatography	**1**

Question	Answer	Marks
2	**M1** : C*l*: 17 **AND** 20 (1) **M2** Cu^{+}: 29 **AND** 28 (1) **M3** 33(above) **and** 16(below) on left hand side of symbol (1) **M4** S (1) **M5** 2^{-} (1)	**5**

Question	Answer	Marks
3(a)	$2Na + F_2 \rightarrow 2NaF(2)$ **M1** NaF(1) Has to be the only product **M2** equation completely correct(1)	**2**
3(b)(i)	**electrons** move **OR** **electrons** are mobile **OR** **electrons** flow	**1**
3(b)(ii)	**M1** one shared dot and cross(1) **M2** 6 non–bonding electrons (either) dots or crosses on each fluorine atom to complete both octets (1)	**2**
3(b)(iii)	**M1** liquid(1) **M2 BOTH** melting point is below –200 °C **AND** boiling point is above –200 °C(1) **OR** **BOTH** –200 °C is higher than –220 °C/ melting point **AND** lower than –188 °C/ boiling point(1) **OR** –200 °C is **between** melting point **or** –220 °C **and** boiling point or –188 °C(1)	**2**
3(b)(iv)	**M1 ionic bonds** in NaF(1) **M2** attraction between molecules **or** intermolecular forces in F_2(1) **M3** weak**er** attraction (between particles) in F_2 **ORA** (1)	**3**

Question	Answer	Marks
3(c)(i)	**M1 breakdown** by (the passage of) **electricity**(1) **M2** of an **ionic compound** in **molten or aqueous** (state) (1)	**2**
3(c)(ii)	$2H^+ + 2e(^-) \rightarrow H_2$ **M1** $H^+ + e(^-)$ on left hand side(1) **M2** equation fully correct(1)	**2**

Question	Answer	Marks
4(a)	**M1** The **rate** of forward reaction equals the rate of the reverse reaction(1) **M2 concentrations** of reactants and products are no longer changing(1)	**2**
4(b)(i)	same number of gas moles on both sides of the equilibrium **OR** same number of gas molecules on both sides of the equilibrium	**1**
4(b)(ii)	iodine **particles** or **molecules** (forced) closer together **OR** same number of iodine **particles** or **molecules** in a smaller volume	**1**
4(c)	endothermic	**1**
4(d)	**M1** –1 (1) **M2** zero (1)	**2**
4(e)(i)	copper	**1**

Question	Answer	Marks
4(e)(ii)	no effect	**1**
4(e)(iii)	(activation energy is) low**er**	**1**

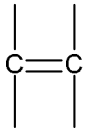
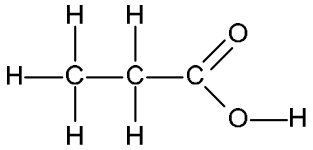
Question	Answer	Marks
5(a)(i)	**M1** lead(II) nitrate(1) **M2** sodium bromide / potassium bromide / ammonium bromide(1)	**2**
5(a)(ii)	**M1** filter precipitate **or** lead(II) bromide **or** solid **or** residue(1) **M2** wash the residue with distilled water **AND** dry e.g. between filter papers(1)	**2**
5(a)(iii)	$Pb^{2+}(aq) + 2Br^{-}(aq) \rightarrow PbBr_2(s)$ **M1** $PbBr_2$ as the **only** product (1) **M2** $Pb^{2+} + 2Br^{-}$ as the **only** reactants in a balanced equation(1) **M3** state symbols (aq) + (aq) → (s)(1)	**3**
5(b)	**M1** acidified aqueous potassium manganate(VII) (1) **M2** purple to colourless (1)	**2**
5(c)	**M1** $2CoO + 4NO_2$ (1) **M2** $8H_2O$ (1)	**2**

Question	Answer	Marks
5(d)(i)	**M1 heat** again **and weigh** again **OR** repeat steps 2 and 3(1) **M2** until mass is constant (1)	**2**
5(d)(ii)	**M1** 0.005 / 5 $\times 10^{-3}$ (1) **M2** 0.63 (1) **M3** (0.63 / 18 =) 0.035 (1) **M4** (0.035 ÷ 0.005 =) 7 (1)	**4**

Question	Answer	Marks
6(a)(i)	limestone **OR** calcium carbonate	**1**
6(a)(ii)	(molten) iron	**1**
6(a)(iii)	silicon(IV) oxide **OR** silicon dioxide	**1**
6(a)(iv)	coke or carbon **and** oxygen	**1**
6(a)(v)	**Any two from:** • nitrogen • carbon dioxide • argon	**2**

Question	Answer	Marks
6(b)(i)	the temperature in the furnace is above **or** higher than the boiling point of zinc **ORA** **OR** the boiling point of zinc is below **or** less than the temperature of the furnace **ORA**	**1**
6(b)(ii)	condensation / condensing	**1**
6(c)(i)	galvanising	**1**
6(c)(ii)	**M1** zinc is more reactive than iron (1) **M2** zinc is oxidised / zinc loses electrons / zinc forms positive ions / zinc forms zinc ions (1)	**2**
6(d)(i)	amphoteric	**1**
6(d)(ii)	Na_2ZnO_2	**1**
6(d)(iii)	zinc sulfate	**1**

Question	Answer	Marks
7(a)(i)	**M1** C 82.76 / 12: H 17.24/1 (1) **OR** evaluation i.e. 6.90:17.24 **M2** fractions showing division of both by smaller ie 6.9 / 6.9 and 17.24 / 6.9 **OR** evaluation ie 1:2.5 **OR** 4:10 **M3** C_2H_5 (1)	**3**

Question	Answer	Marks
7(a)(ii)	C_5H_{10}	**1**
7(b)	**M1**  any C=C with both carbons having a valency of 4(1) **M2** correct displayed formula of (cis or trans) but–2–ene(1) **M3** but–2–ene	**3**
7(c)	C_8H_{16}	**1**
7(d)(i)	structural isomers	**1**
7(d)(ii)	**M1** ethanoic acid(1) **M2** methanol(1)	**2**
7(d)(iii)	**M1** Displayed formula of propanoic acid showing **ALL** atoms and bonds  (1) **M2** propanoic acid(1)	**2**