



# Cambridge IGCSE™

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**COMBINED SCIENCE**

**0653/41**

Paper 4 Theory (Extended)

**May/June 2022**

MARK SCHEME

Maximum Mark: 80

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**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 2022 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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This document consists of **11** printed pages.

**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 '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.

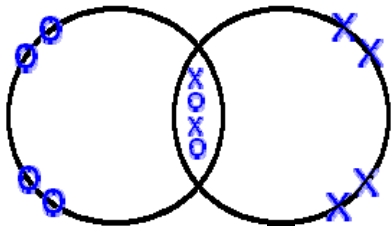
**7** Guidance for chemical equations

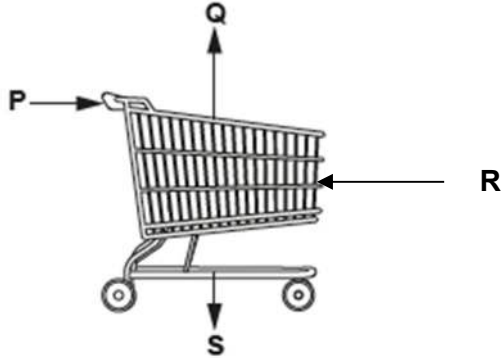
Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Question	Answer	Marks
1(a)(i)	alveoli ;	1
1(a)(ii)	diaphragm ;	1
1(a)(iii)	less oxygen can bind (to haemoglobin) / less oxygen transported (by red blood cells) ; so less (aerobic) respiration ;	2
1(a)(iv)	produce mucus ; mucus traps particles ;	2
1(b)(i)	6 (%) ;	1
1(b)(ii)	<i>Any two from:</i> the percentage of people with COPD increases with age ;  more males than females have COPD (in all age groups) ; the difference between males and females increases with age ;	2

Question	Answer	Marks
2(a)	7 / VII / halogens ;	1
2(b)	-2 ; gains (two) electrons to give a full outer shell ;	2

Question	Answer			Marks												
2(c)(i)	<table border="1" data-bbox="734 213 1473 687"> <thead> <tr> <th data-bbox="734 213 871 316">Formula</th> <th data-bbox="871 213 1171 316">Type of structure</th> <th data-bbox="1171 213 1473 316">Element or compound?</th> </tr> </thead> <tbody> <tr> <td data-bbox="734 316 871 437"><math>X_2Z</math></td> <td data-bbox="871 316 1171 437">simple covalent molecules</td> <td data-bbox="1171 316 1473 437">compound</td> </tr> <tr> <td data-bbox="734 437 871 558"><math>X_2</math></td> <td data-bbox="871 437 1171 558">simple covalent molecules</td> <td data-bbox="1171 437 1473 558">element</td> </tr> <tr> <td data-bbox="734 558 871 687"><math>Z_2</math></td> <td data-bbox="871 558 1171 687">simple covalent molecules</td> <td data-bbox="1171 558 1473 687">element</td> </tr> </tbody> </table>			Formula	Type of structure	Element or compound?	$X_2Z$	simple covalent molecules	compound	$X_2$	simple covalent molecules	element	$Z_2$	simple covalent molecules	element	1
Formula	Type of structure	Element or compound?														
$X_2Z$	simple covalent molecules	compound														
$X_2$	simple covalent molecules	element														
$Z_2$	simple covalent molecules	element														
2(c)(ii)	 <p data-bbox="338 1029 645 1098"><i>fully correct (2)</i> <i>double bond correct (1)</i></p>			2												
2(c)(iii)	$X_2$ has a covalent bond ;			1												
2(c)(iv)	hydrogen ;			1												

Question	Answer	Marks
3(a)(i)	 <p>arrow pointing to left with label <b>R</b> ;</p>	<b>1</b>
3(a)(ii)	<b>(S =) 150 (N) ;</b>	<b>1</b>
3(a)(iii)	<b>(Q =) 150 (N) AND</b> no vertical movement, (so forces must be equal and opposite) ;	<b>1</b>
3(b)(i)	reading 0.4 for speed from graph ; $KE = \frac{1}{2} mv^2$ (in any form) / $= \frac{1}{2} \times 15 \times 0.4 \times 0.4$ ; 1.2 (J) ;	<b>3</b>
3(b)(ii)	acceleration = change in speed $\div$ time / $= (0.8 - 0.4) \div 2$ ; 0.2 ; m / s <sup>2</sup> ;	<b>3</b>
3(b)(iii)	work done = $F \times d$ (in any form) ; distance travelled = area under graph between 4s and 10s / $(0.8 \times 6)$ ; $(= (0.8 \times 6) \times 25 =) 120$ (J) ;	<b>3</b>

Question	Answer	Marks
4(a)(i)	ovary labelled ;	1
4(a)(ii)	<i>any two from:</i> small petals ; feathery stigma ; pollen / anther / filaments / stamens / stigma outside (flower) ;	2
4(b)(i)	(6) CO <sub>2</sub> + (6) H <sub>2</sub> O ;  light and (6) O <sub>2</sub> ;	2
4(b)(ii)	absorbs / traps / uses light energy ;  (light energy is) transferred / converted to chemical energy ;	2
4(c)	<i>any three from:</i> <i>(as temperature decreases)</i>  transpiration rate decreases ; so less water lost ;  correct reference to <b>evaporation</b> from (mesophyll) cells ;  correct reference to <b>diffusion</b> (of water vapour) from stomata ;	3
4(d)	carbon dioxide enters leaf through stomata ; carbon dioxide is needed for photosynthesis ;	2



Question	Answer	Marks
5(a)(i)	(dip paper in) and observe the colour ; compare colour to a chart / idea that colour indicates the pH ;	2
5(a)(ii)	gives a value to one decimal place idea / idea of greater precision of measurements ; do not need to use a reference chart / can be reused / avoids the uncertainty of judging colours ;	2
5(b)(i)	$2\text{NH}_3 + \text{H}_2\text{SO}_4$ formula of both correct ; balancing correct dependent on correct formulae ;	2
5(b)(ii)	nitric acid ;	1
5(b)(iii)	leave in warm place / heat ; evaporate water ;	2

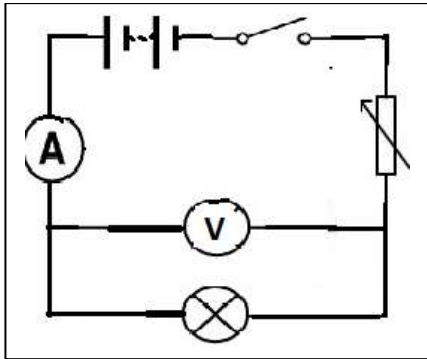
Question	Answer	Marks							
6(a)(i)	$3 \times 10^8 \text{ m/s}$ ;	1							
6(a)(ii)	speed = distance/time ( <i>in any form</i> ) ; 8 minutes 20 secs = $(8 \times 60 + 20) = 500\text{s}$ OR speed = $3 \times 10^5 \text{ km/s}$ ; distance = $3 \times 10^5 \times 500 = 150 \times 10^6 \text{ (km)}$ / $1.5 \times 10^8 \text{ km}$ ;	3							
6(a)(iii)	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="width: 40px; height: 40px;"></td> <td style="width: 40px; height: 40px;"></td> <td style="width: 40px; height: 40px; text-align: center;">(ultraviolet)</td> <td style="width: 40px; height: 40px;"></td> <td style="width: 40px; height: 40px; text-align: center;">infrared ;</td> <td style="width: 40px; height: 40px; text-align: center;">(microwaves)</td> <td style="width: 40px; height: 40px;"></td> </tr> </table>			(ultraviolet)		infrared ;	(microwaves)		1
		(ultraviolet)		infrared ;	(microwaves)				
6(b)(i)	change in density (of the medium) / change in speed (of wave) ;	1							

Question	Answer	Marks
6(b)(ii)	<b>radiation / heat / light</b> reflected by shiny / white / absorbed by dull/black ; dull/black absorbs more <b>radiation</b> (than the shiny / white) ;	<b>2</b>

Question	Answer	Marks
7(a)(i)	liver ;	<b>1</b>
7(a)(ii)	insoluble <b>AND</b> soluble ;	<b>1</b>
7(b)	<i>any three from:</i> (similarities) are enzymes / speed up digestion ; breakdown large / insoluble, food <b>molecules</b> ;  (differences) amylase breaks down / digests starch / carbohydrates / produces sugars ; lipase breaks down / digests fats / oils / lipids / produces fatty acids / glycerol ;	<b>3</b>
7(c)	plasma ;	<b>1</b>

Question	Answer	Marks
8(a)(i)	(equation) 3 <b>AND</b> carbon monoxide removes oxygen from iron (oxide) ;	<b>1</b>
8(a)(ii)	carbon monoxide <b>AND</b> carbon dioxide ; carbon monoxide, is toxic / restricts oxygen transport in the blood ; carbon dioxide causes, climate change / enhanced greenhouse effect / global warming ;	<b>3</b>
8(a)(iii)	3+ / Fe <sup>3+</sup> ;	<b>1</b>
8(b)(i)	sodium <b>AND</b> because it is the most reactive ;	<b>1</b>

Question	Answer	Marks
8(b)(ii)	Cu heating with carbon <b>AND</b> Mg electrolysis ; Cu because less reactive than iron / carbon ; Mg because more reactive than aluminium / carbon ;	3

Question	Answer	Marks
9(a)(i)	$R = V \div I$ (in any form) / $6.0 \div 0.75$ ; $8.0 (\Omega)$ ;	2
9(a)(ii)	Power = $V \times I$ (in any form) / $6.0 \times 0.75$ ; $4.5 (W)$ ;	2
9(b)	 <p>correct symbols for switch <b>AND</b> voltmeter ; correct symbol for variable resistor ; complete circuit with voltmeter parallel to lamp only and switch correctly positioned;</p>	3