



## Cambridge IGCSE™

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COMBINED SCIENCE

0653/43

Paper 4 Theory (Extended)

October/November 2021

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 October/November 2021 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

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This document consists of **10** 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.

**Mark scheme abbreviations**

- ; separates marking points
- / alternative responses for the same marking point
- ecf error carried forward
- AVP any valid point
- ORA or reverse argument
- AW alternative wording
- underline actual word given must be used by candidate (grammatical variants accepted)
- ( ) the word / phrase in brackets is not required but sets the context

Question	Answer	Marks															
1(a)(i)	cervix ;	<b>1</b>															
1(a)(ii)	encloses fetus / holds or produces amniotic fluid ;	<b>1</b>															
1(a)(iii)	<i>any three from:</i> via umbilical cord ; to the placenta ; passes into mother's blood ; correct reference to diffusion ;	<b>3</b>															
1(b)	<i>any two from:</i> contraction ; of ventricles / muscle ; AVP ;	<b>2</b>															
1(c)	<table border="1" data-bbox="336 746 1377 1077"> <thead> <tr> <th></th> <th>male gametes</th> <th>female gametes</th> </tr> </thead> <tbody> <tr> <td>name</td> <td>sperm(s) ;</td> <td>(eggs)</td> </tr> <tr> <td>where they are made</td> <td>testes ;</td> <td>(ovaries)</td> </tr> <tr> <td>number released at any one time</td> <td>(over 40 million)</td> <td>one ;</td> </tr> <tr> <td>adaptive feature</td> <td>flagellum / enzymes ;</td> <td>(jelly coating)</td> </tr> </tbody> </table>		male gametes	female gametes	name	sperm(s) ;	(eggs)	where they are made	testes ;	(ovaries)	number released at any one time	(over 40 million)	one ;	adaptive feature	flagellum / enzymes ;	(jelly coating)	<b>4</b>
	male gametes	female gametes															
name	sperm(s) ;	(eggs)															
where they are made	testes ;	(ovaries)															
number released at any one time	(over 40 million)	one ;															
adaptive feature	flagellum / enzymes ;	(jelly coating)															

Question	Answer	Marks
2(a)	ammonium nitrate AND sodium chloride ; an upwards arrow shows, energy change is positive / energy has been taken in / energy of the products is greater than the energy of the reactants ;	2
2(b)(i)	thermometer / temperature probe ; stop-watch;	2
2(b)(ii)	increases then decreases ; (increases because) energy given out / exothermic reaction ; (decreases because) reaction is finished (and so it cools) ;	3
2(b)(iii)	(34.5 – 22.0 =) 12.5 (°C) ;	1

Question	Answer	Marks							
3(a)(i)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%;">(gamma radiation)</td> <td style="width: 10%;"></td> <td style="width: 10%;"></td> <td style="width: 15%;">visible light ;</td> <td style="width: 10%;">infrared ;</td> <td style="width: 15%;">(microwaves)</td> <td style="width: 15%;"></td> </tr> </table>	(gamma radiation)			visible light ;	infrared ;	(microwaves)		2
(gamma radiation)			visible light ;	infrared ;	(microwaves)				
3(a)(ii)	$3 \times 10^8$ (m / s) AND all <u>electromagnetic</u> waves travel with same speed ;	1							
3(b)	$v = f\lambda$ in any form / $3 \times 10^8 \div 635 \times 10^{-9}$ ; $4.72 \times 10^{14}$ ; Hz ;	3							
3(c)(i)	thermal ;	1							
3(c)(ii)	dull black surfaces are good absorbers (of radiation) ;	1							
3(d)	molecular vibration ; transfer by electrons ;	2							

Question	Answer	Marks
4(a)(i)	arrow drawn pointing from grasshopper to eagle ;	1
4(a)(ii)	grasshopper / squirrel ;	1
4(a)(iii)	<i>any two from:</i> energy is lost between trophic levels ; named example of energy loss ; the longer the chain the less energy is available ;	2
4(b)	soil has a higher water potential / water moves from area of high water potential to low water potential ; reference to osmosis ; across a partially permeable membrane ;	3

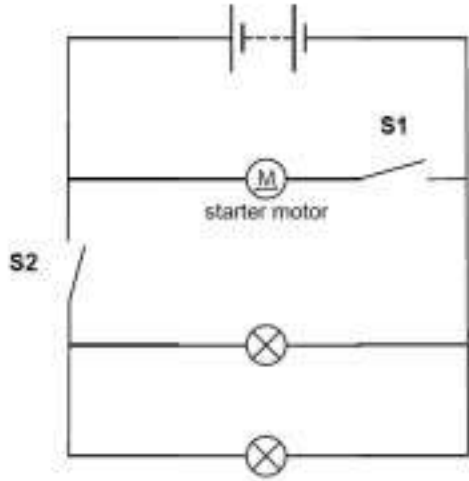
Question	Answer	Marks
5(a)	<i>iron:</i> $\leq 2500\text{ }^{\circ}\text{C}$ AND <i>aluminium oxide:</i> $> 2500\text{ }^{\circ}\text{C}$ ; at $2500\text{ }^{\circ}\text{C}$ , iron is a liquid and aluminium oxide is a solid ;	2
5(b)	aluminium displaces iron / aluminium removes oxygen from iron ; because aluminium is more reactive than iron ;	2
5(c)	iron(III) oxide / $\text{Fe}^{3+}$ ; causes aluminium to gain oxygen ;	2
5(d)	charge on, iron(II) is $2+$ AND iron(III) is $3+$ ; total positive charge needs to match total negative charge ;	2

Question	Answer	Marks
6(a)	(total surface area = $2 \times 0.28 =$ ) $0.56 \text{ (m}^2\text{)}$ ; pressure = force $\div$ area <i>in any form</i> / $8000 \times 10 \div 0.56$ ; $1.4 \times 10^5 \text{ (Pa)}$ ;	3
6(b)(i)	acceleration = change in speed $\div$ time / $4 \div 8$ ; $0.5 \text{ (m / s}^2\text{)}$ ;	2
6(b)(ii)	deceleration ; not constant ;	2
6(b)(iii)	maximum speed identified as $4 \text{ m / s}$ ; $KE = \frac{1}{2}mv^2$ <i>in any form</i> / $\frac{1}{2} \times 8000 \times 4^2$ ; $64\,000 \text{ (J)}$ ;	3

Question	Answer	Marks
7(a)(i)	as temperature increases so does the rate ; rate decreases above $35 \text{ }^\circ\text{C}$ ;	2
7(a)(ii)	enzymes denature / shape of active site changes ; substrate no longer fits into active site ;	2
7(b)(i)	any palisade cell labelled ;	1
7(b)(ii)	gas exchange ;	1
7(b)(iii)	<i>any three from:</i> magnesium ions needed to make chlorophyll ; (deficiency means) less chlorophyll will be made ; (less chlorophyll means) less light energy transferred to chemical energy ; idea that the chemical energy is in the form of carbohydrates (so less are made) ;	3



Question	Answer	Marks
8(a)(i)	<i>bromine</i> : (dark) orange / brown ; <i>iodine</i> : solid ;	<b>2</b>
8(a)(ii)	all contain the same number of electrons (seven electrons) in the outer shell ;	<b>1</b>
8(b)(i)	single bond between atoms shown as two shared electrons ; (dependent mark) rest of molecule correct ;	<b>2</b>
8(b)(ii)	molecules have only two atoms ; of the same type ;	<b>2</b>
8(c)(i)	rubidium ; outer electron (is furthest from nucleus and so) more easily lost / rubidium is further down Group I ;	<b>2</b>
8(c)(ii)	$KCl$ ;	<b>1</b>

Question	Answer	Marks
9(a)	if one (head)lamp breaks, the other still works / still a complete circuit ;	1
9(b)	correct time conversion / $5 \times 60 \times 60 / 18\,000$ ; $Q = It$ in any form / $5 \times 18\,000 / 5 \times 5 \times 60 \times 60$ ; 90 000 (C) ;	3
9(c)	 <p>switch <b>S1</b> for starter motor in correct position ; switch <b>S2</b> for headlamps in correct position ; switch symbols correct AND no short circuits, open circuits or additional components ;</p>	3