



Cambridge IGCSE™

COMBINED SCIENCE

0653/41

Paper 4 Theory (Extended)

May/June 2023

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 2023 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

PUBLISHED**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> For questions that require <i>n</i> responses (e.g. State two reasons ...): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked <i>ignore</i> in the mark scheme should not count towards <i>n</i>. • Incorrect responses should not be awarded credit but will still count towards <i>n</i>. • 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 <i>n</i> 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
/	separates alternative responses for the same marking point
ecf	error carried forward
AVP	any valid point
ORA	or reverse argument
AW	alternative wording
<u>underline</u>	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)	artery ;	1
1(a)(ii)	any one from: frog has only 3 chambers / frog has one ventricle ; humans have four chambers / humans have two ventricles ; no septum in frog / AW ;	1
1(a)(iii)	oxygenated and deoxygenated blood kept separate ; high blood pressure around body / low blood pressure to lungs ;	2
1(b)(i)	(lack of) physical activity ;	1
1(b)(ii)	$(54 \times 350) \div 100$; 189 ;	2
1(b)(iii)	age / genetics / inheritance ;	1
1(c)	scurvy – (fruit and vegetables) are a source of Vit C / Vit C prevents scurvy ; constipation – (vegetables) are a source of fibre / fibre needed for bulk ;	2

Question	Answer	Marks
2(a)(i)	H ⁺ ; hydroxide and water ; Na ⁺ and sodium chloride ;	3
2(a)(ii)	decreases , because used up / forms chlorine ;	1

Question	Answer	Marks
2(b)	(test) lighted splint AND (observation) pops ;	1
2(c)(i)	shows an acid (produced) ;	1
2(c)(ii)	(red to) colourless ; (because litmus is) bleached by chlorine (formed) ;	2

Question	Answer	Mark
3(a)	<u>radiation</u> ;	1
3(b)	reference to molecules moving faster ; reference to expansion of air or gases / gases or air occupy greater volume / molecules move further apart ; the idea that lower density (air) rises / hot air displaced by heavier or denser cool air ;	3
3(c)(i)	vibrating (string) ;	1
3(c)(ii)	speed = frequency $\times$ wavelength / $v = f \lambda$ (<i>in any form</i>) / $\lambda = 330 \div 256$; 1.29 (m) ;	2
3(c)(iii)	compression means, particles or molecules are close together / (air) density is greater / air pressure is greater / ORA for rarefaction ; succession refers to the idea that compressions and rarefactions form a repeating, pattern / (longitudinal) wave ;	2

Question	Answer	Marks																								
4(a)(i)	<table><tr><td>organism</td><td>producer</td><td>herbivore</td><td>secondary consumer</td></tr><tr><td>flying squirrel</td><td></td><td>✓</td><td></td></tr><tr><td>owl</td><td></td><td></td><td>✓</td></tr><tr><td>cougar</td><td></td><td></td><td>✓</td></tr><tr><td>beaver</td><td></td><td>✓</td><td></td></tr><tr><td>fruit</td><td>(✓)</td><td></td><td></td></tr></table> one mark for each correct column	organism	producer	herbivore	secondary consumer	flying squirrel		✓		owl			✓	cougar			✓	beaver		✓		fruit	(✓)			2
organism	producer	herbivore	secondary consumer																							
flying squirrel		✓																								
owl			✓																							
cougar			✓																							
beaver		✓																								
fruit	(✓)																									
4(a)(ii)	cougar is in a higher trophic level / beaver is in lower trophic level ; energy lost (between levels) ; example of energy loss, e.g. respiration / heat / waste / incomplete digestion ;	3																								
4(b)	any two from : large / heavy (compared to wind pollinated) ; has spikes ; sticky ;	2																								

Question	Answer	Marks
5(a)	C_nH_{2n} ;	1
5(b)	C_2H_6 ; C_8H_{16} ;	2
5(c)(i)	(unsaturated because) they contain a (carbon-carbon) double bond ; (hydrocarbons) contain hydrogen and carbon only ;	2
5(c)(ii)	(the idea that methene would contain) only one carbon atom / an alkene needs (at least) two carbon atoms ; the idea that a (C = C) double bond cannot form ;	2
5(d)(i)	bottled gas / heating / cooking ;	1
5(d)(ii)	similar boiling point ;	1

Question	Answer	Marks
6(a)(i)	weight ;	1
6(a)(ii)	force arrow parallel to belt in contact with box pointing up the belt ;	1
6(b)	time = distance $\div$ speed (<i>stated or evidence of use</i>) / (time =) $5 \div 0.2$; 25 (s) ;	2
6(c)(i)	(gain in GPE =) $mg\Delta h$ (<i>stated or evidence of use</i>) / $45 \times 10 \times 2$; 900 (J) ;	2

6(c)(ii)	pressure = force ÷ area (<i>in any form</i>) ; = 450 ÷ 3 000 OR 450 ÷ 0.3 ; (pressure =) 0.15 (N/cm²) OR 1 500 (N/m² or Pa) ; N/cm² OR N/m² OR Pa (<i>to match numerical answer</i>) ;	4
----------	---	----------

Question	Answer	Marks
7(a)(i)	chlorophyll ; chemical ; carbohydrates ;	3
7(a)(ii)	<i>any three from:</i> responds to gravity / gravitropism ; auxin is produced at the shoot tip ; increased (concentration of) auxin on underside (of stem) ; auxin causes cell elongation ;	3
7(b)	large surface area ; increased absorption of, water / mineral (ions) ;	2
7(c)	decomposers feed on / break down, (aquatic) plants ; (aerobic) respiration of decomposers (uses oxygen) ;	2

Question	Answer	Marks
8(a)(i)	3 and 2 ;	1
8(a)(ii)	Fe^{3+} ;	1
8(b)(i)	excludes, oxygen / air ; excludes water ;	2
8(b)(ii)	paint / grease / oil / other suitable coating ;	1
8(c)	4 ; it has a double bond with two electrons in each bond / two pairs of electrons are shared ;	2
8(d)	oxygen, is covalent / has a simple (molecular) structure <u>and</u> iron oxide, is ionic / has a giant structure ; forces between particles / ions, in iron oxide, are stronger than in oxygen (particles / molecules) ;	2

Question	Answer	Marks
9(a)	angle of incidence = angle of reflection AND angles measured to the normal ;	1
9(b)(i)	resistance = voltage $\div$ current (<i>stated or evidence of use</i>) / $5 \div 0.020$; $250 (\Omega)$;	2
9(b)(ii)	$P = I \times V$ (<i>stated or evidence of use</i>) / ($P = $) 0.020×5.0 ; $0.1(0) (\text{W})$;	2
9(b)(iii)	LEDs in parallel, using LED symbol provided ; circuit symbol for resistor and switch ; resistor and switch in main circuit, circuit completed with no additional components or extra wiring causing a short circuit ;	3

