Cambridge IGCSE™

CO-ORDINATED SCIENCES	**0654/41**
Paper 4 Theory (Extended)	**October/November 2023**
MARK SCHEME	
Maximum Mark: 120	

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

This document consists of **15** 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.

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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)	2 ; 4 ;	**2**
1(a)(ii)	homozygous recessive ;	**1**
1(a)(iii)	 parent genotype correct ; offspring genotype correct ; 25 (%) ;	**3**
1(b)(i)	goblet (cells) ;	**1**
1(b)(ii)	mucus traps, pathogens / bacteria ; cilia unable to remove (thick) mucus ;	**2**
1(c)	(tobacco) smoking ;	**1**

For 1(a)(iii) the Punnett square is:

	A	a
A	AA	Aa
a	Aa	aa

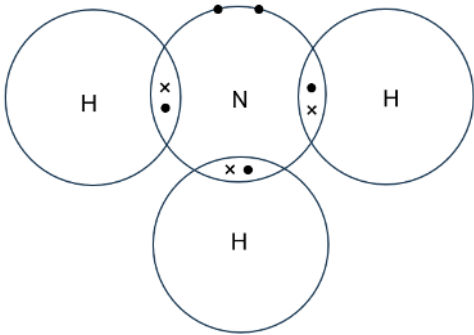| Question	Answer	Marks
2(a)	(compound that) contains **only** carbon and hydrogen (atoms) ;	1
2(b)(i)	single covalent ;	1
2(b)(ii)	C_3H_8 ;	1
2(c)(i)	alkene ;	1
2(c)(ii)	high temperature ; catalyst ;	2
2(c)(iii)	$C_{24}H_{50} \rightarrow C_{10}H_{22} + \textbf{2}\,C_6H_{12} + C_2H_4$ correct number of C in products ; correct number of H in products ;	2
2(d)	**pollutant** **problem** acid rain carbon monoxide particulates turn buildings black global warming sulfur dioxide poisoning of living organisms correct link for carbon monoxide ; correct link for sulfur dioxide ;	2

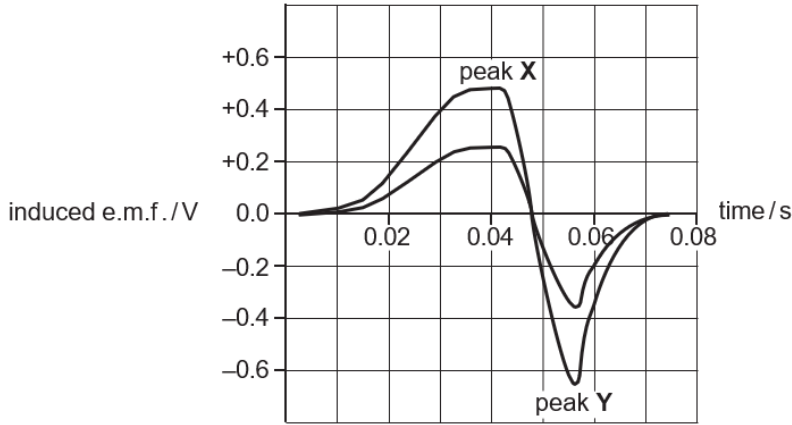| Question	Answer	Marks
3(a)	*any one from*: does **not** release, greenhouse gases / CO_2 ; does **not** contribute to, global warming / climate change ;	**1**
3(b)(i)	$^{141}_{56}Ba \rightarrow \, ^{141}_{57}La + \, ^{0}_{-1}\beta$ La correct ; β correct ;	**2**
3(b)(ii)	use of 4 half lives ; $(4 \times 18 =)$ 72 (minutes) ;	**2**
3(c)(i)	$1.8 \times 10^7 \times 0.12$;	**1**
3(c)(ii)	$(d =)$ $m \div f$ / $(d =)$ $1.35 \times 10^6 \div 2.2 \times 10^6$; $(d =)$ 0.61 **or** 0.63 (m) ;	**2**
3(c)(iii)	the <u>direction</u> (of blade A) changes ;	**1**

Question	Answer	Marks
4(a)(i)	C ;	**1**
4(a)(ii)	evidence of unit conversion / (2 hours =) 120 minutes ; 0.075 (cm^3/min) ;	**2**
4(a)(iii)	carbon dioxide ;	**1**
4(a)(iv)	bread making / named practical use of anaerobic respiration by yeast ;	**1**
4(b)	*any three from*: requires oxygen ; (releases) more energy (per glucose molecule) ; produces carbon dioxide ; produces water ; does **not** produce lactic acid ;	**3**
4(c)	*any one from*: movement ; sensitivity ; growth ; reproduction ; excretion ; nutrition ;	**1**

Question	Answer	Marks
5(a)	1 ;	**1**
5(b)	proton donor proton acceptor ;;	**3**
5(c)(i)	$2HCl + CuCO_3 \rightarrow CuCl_2 + H_2O + CO_2$ formulae ; balancing ;	**2**
5(c)(ii)	*test*: limewater ; *observation*: milky/cloudy / white precipitate ;	**2**
5(d)	relative formula mass of H_2SO_4 = 98 **and** of CuO = 80 ; moles of sulfuric acid (2.45 ÷ 98 =) 0.025 ; moles of copper oxide (1.60 ÷ 80 =) 0.02 ; (there are less moles of copper oxide so) copper oxide is the limiting reactant ;	**4**

Question	Answer	Marks
6(a)(i)	(d =) $v \times t$ / (d =) 5.8×60 ; 348 or 350 (m) ;	**2**
6(a)(ii)	conversion: (0.20 g =) 0.00020 kg ; (KE =) ½ mv^2 / ½ $\times$ 0.00020 $\times$ 5.8^2 ; (KE =) 0.0034 or 3.4×10^{-3} (J) ;	**3**
6(b)	similarity: travel at speed of light / **transverse** waves ; difference: (visible light has lower) frequency / (visible light has longer) wavelength / **ORA** ;	**2**
6(c)	friction (with air) ; (negative) **electrons** (move) ; (electrons move) off (surface of) bee ;	**3**
6(d)	random motion (of pollen grains / particles) ; caused by collisions with water / molecules / other particles ; (movement because of idea of) fast(er) moving small(er) particles ;	**3**

Question	Answer	Marks
7(a)	starch ; simpler sugars ; 25 ; kinetic ; denatured ; active site ;	**6**
7(b)	*any two from*: salivary glands ; pancreas ; small intestine ;	**2**
7(c)(i)	carbon hydrogen oxygen nitrogen ;; four correct = 2 marks two or three correct = 1 mark	**2**
7(c)(ii)	biuret ;	**1**

Question	Answer	Marks
8(a)	D ;	**1**
8(b)(i)	M_r of O_2 = 32 ; moles of O_2 = 7 ; volume of O_2 (7 × 24) = 168 dm^3 ;	**3**
8(b)(ii)	*any one from*: (stainless steel) does not rust / rusts more slowly ; (stainless steel) is stronger / harder / tougher ; change in malleability ;	**1**
8(c)	 one covalent bond between N and H correct ; rest of structure correct ;	**2**
8(d)	each carbon atom bonds to 3 other carbon atoms ; delocalised / free electrons ; (electrons) move ; **or** in diamond each carbon atom bonds to 4 other carbon atoms ; diamond does not have delocalised / free electrons ; (electrons) cannot move / (electrons) held in covalent bonds ;	**3**

Question	Answer	Marks
9(a)(i)	(peak X is positive and peak Y is negative) S causes peak (X) and N causes peak (Y) (as it passes through coil) ; (peak Y has a larger magnitude than X) (idea that) the magnet is increasing in velocity / speed ;	**2**
9(a)(ii)	 same shape graph drawn with line crossing *x*-axis at same point ; both peaks lower than original ;	**2**
9(b)		**2**

	electromotive force (e.m.f.)	potential difference
is measured in volts	✓	✓
is equal to work done per unit charge	✓	✓
relates to the energy supplied by the source	✓	
relates to the energy transferred by a circuit component		✓

;;

Question	Answer	Marks
9(c)	regular / ordered / a lattice strong vibrate fixed ;; four correct = 2 marks two or three correct = 1 mark	**2**
9(d)	atoms vibrate ; (idea that) vibrations passed on to next atom ; (idea of) transfer by (free) electrons ;	**3**

Question	Answer	Marks
10(a)(i)	(fewer trees so) less photosynthesis ; less carbon dioxide removed (by trees) / more carbon dioxide in atmosphere ;	**2**
10(a)(ii)	*any three from*: extinction ; migration ; habitat / shelter / breeding grounds, destroyed ; food sources removed ; food chains / food webs, disrupted / affected ;	**3**
10(b)	(a unit) containing (all of the) organisms and their <u>environment</u> ; interacting together (in a given area) ;	**2**
10(c)	Sun ;	**1**
10(d)	*any two from*: faster / quicker ; requires less energy ; idea that favourable traits are kept ; reproduction still possible if plant is isolated ;	**2**

https://xtremepape.rs/

Question	Answer	Marks
11(a)(i)	bromine / Br_2 ;	1
11(a)(ii)	(lead (II) bromide) contains ions ; (idea that the ions) can **move** ;	2
11(b)	$Cu^{2+} + 2e^- \rightarrow Cu$ formulae ; balancing ;	2
11(c)(i)	+ 0.62 ;	1
11(c)(ii)	*any two from*: copper dissolves at the anode / anode dissolves ; copper atoms become copper ions ; copper ions move into solution ;	2

Question	Answer	Marks
12(a)	($n =$) sin i / sin r or sin 53° / sin 31° ; ($n =$) 1.55 ;	2
12(b)(i)	(wavelength =) 4.8×10^{-7} (m) ;	1
12(b)(ii)	refractive index is inversely proportional to speed ;	1
12(c)	(volume =) 144 (cm^3) ; (mass =) 2.8(0) × 144 ; (mass =) 403 (g) ;	3