Cambridge Assessment International Education

Cambridge IGCSE™

CO-ORDINATED SCIENCES **0654/31**

Paper 3 Theory (Core) **May/June 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 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.

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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 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.

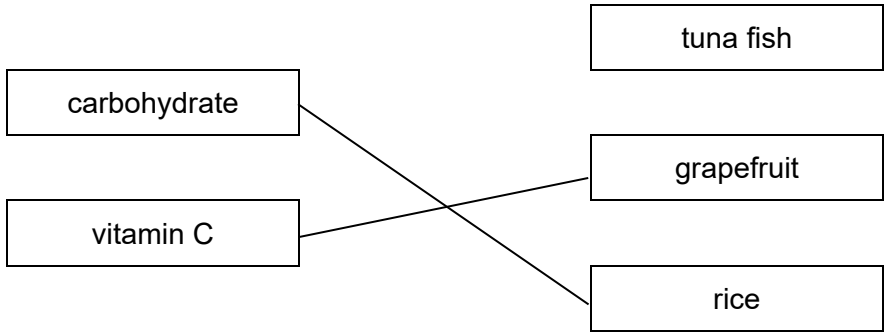
7 Guidance for chemical equations

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.

Acronyms and shorthand in the mark scheme

Acronym / shorthand	**Explanation**
Brackets ( )	Words not explicitly needed in an answer, however if a contradictory word / phrase / unit to that in the brackets is seen the mark is not awarded.
Underlining	The underlined word (or a synonym) must be present for the mark to be scored. If the word is a technical scientific term, the word must be there.
/ or **OR**	Alternative answers any one of which gains the credit for that mark.
owtte	Or words to that effect.
ORA	Or reverse argument.
AW	Alternative wording
AVP	Alternative valid point

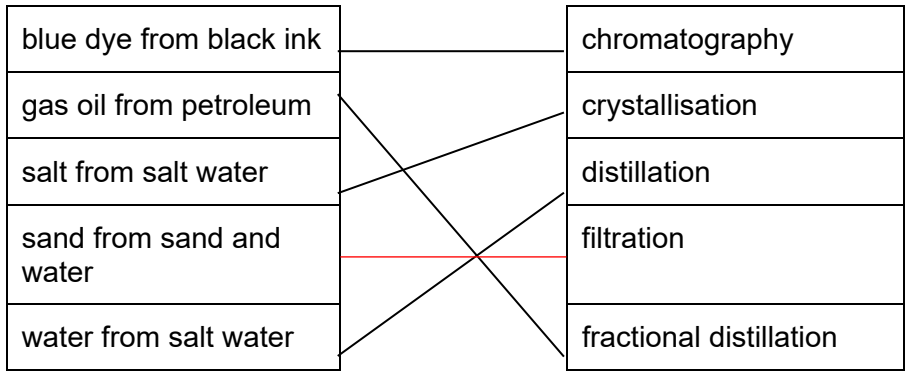
Question	Answer	Marks
1(a)(i)	**F** ; **E** ; **J** ; **A** ;	**4**
1(a)(ii)	**D** – pancreas ; **H** – liver ;	**2**
1(a)(iii)	breakdown ; chemical ;	**2**
1(b)	 ;;	**2**
1(c)	making haemoglobin / prevent anaemia / AVP ;	**1**

Question	Answer	Marks
2(a)(i)	gain of oxygen ;	**1**
2(a)(ii)	paint it ; stops contact with air and water ; etc.	**2**

Question	Answer	Marks
2(b)	recycled ; OWTTE	1
2(c)	iron acts as a catalyst ; iron forms coloured compounds ;	2
2(d)(i)	stronger ;	1
2(d)(ii)	iron % 65 ; 80 × 65 / 100 = 52 (kg) ;	2
2(e)	can be shaped or bent ;	1

Question	Answer	Marks
3(a)(i)	skis increase surface area ; pressure is less with skis ; ORA	2
3(a)(ii)	sound wave is reflected ;	1
3(b)(i)	**L** ;	1
3(b)(ii)	**K** ;	1
3(c)(i)	5 (m / s) ;	1
3(c)(ii)	line has a slope / gradient ;	1
3(c)(iii)	area under graph or ½ × 5 × 20 ;	1
3(d)	skin cancer ;	1

Question	Answer	Marks
4(a)(i)	agriculture and (untreated) sewage ; 41 (%) ; 5 (%) ;	**3**
4(a)(ii)	*any **one** from:* spread diseases ; AVP ;	**1**
4(b)(i)	(29 – 11) = 18 (cm) ;	**1**
4(b)(ii)	warm / suitable temperature ; oxygen ;	**2**

Question	Answer	Marks
5(a)	substance in mixture / method of separation  ;;;	**3**
5(b)	to avoid poisoning ;	**1**
5(c)(i)	element contains only one type of atom / compound consists of (atoms of) two or more elements (chemically combined) ;	**1**

Question	Answer	Marks
5(c)(ii)	electricity ; bromine and lead ; cathode ;	**3**
5(d)	calcium magnesium lead copper ;;	**2**

Question	Answer	Marks
6(a)(i)	thermal ; kinetic ; electrical ;	**3**
6(a)(ii)	splits ;	**1**
6(b)(i)	(2) positive ;	**1**
6(b)(ii)	protons decrease by 2 or down to 92 ; neutrons decrease by 2 or down to 143 ;	**2**
6(b)(iii)	3 half lives ; 6.0 divided by 2 three times ; 0.75 (g) ;	**3**

Question	Answer	Marks
7(a)	**A** – cuticle ; **B** – (lower) epidermis ; **C** – stoma / stomata ;	**3**
7(b)	one chloroplast with label line ; with correct name ; nucleus labelled with an **X** ;	**3**
7(c)	(process used in plants / producers) to manufacture glucose ; from raw materials / carbon dioxide and water ; using light energy ;	**3**
7(d)	amino acids circled ;	**1**
7(e)	root hair (cell) ;	**1**
7(f)	xylem ;	**1**

Question	Answer	Marks
8(a)(i)	1 shared pair of electrons ; all else correct ;	**2**
8(a)(ii)	covalent ; bonding between 2 non-metals / shared electron pairs ;	**2**
8(b)	oxygen ; carbon dioxide **and** water ;	**2**
8(c)(i)	carbon monoxide ;	**1**
8(c)(ii)	poisonous ;	**1**

Question	Answer	Marks
9(a)(i)	all symbols correct ; heater and motor in parallel connection ; switches correctly placed ;	**3**
9(a)(ii)	16 (Ω) ; combined resistance in parallel is less than either individual resistance ;	**2**
9(a)(iii)	electrons ;	**1**
9(a)(iv)	increase current ; increase strength of magnetic field ;	**2**
9(b)(i)	**liquid -** all molecules touching random arrangement ; **gas –** molecules widely separated (no more than seven shown) and random arrangement ;	**2**
9(b)(ii)	100 (°C) ;	**1**

Question	Answer	Marks
10(a)(i)	stimulus – (change in) temperature ; effector – muscle (in arm) ;	**2**
10(a)(ii)	X – motor neurone ;	**1**
10(a)(iii)	brain ;	**1**
10(b)	evidence of conversion ; (1500 / 0.1 **or** 1.5 / 0.0001) = 15000 / 1.5×10^4 ;	**2**
10(c)	hormone hormone nerve impulse ;;	**2**

Question	Answer	Marks
10(d)	*any **two** from:* increased depth of breathing / breathing rate ; increased pulse rate / heart rate ; widened pupils ; AVP ;;	**2**

Question	Answer	Marks
11(a)(i)	limestone does not pass through (the holes in) the filter paper **and** water does pass through (the holes in) the filter paper ; limestone particles are larger / water particles are smaller (than the holes in the filter paper) ;	**2**
11(a)(ii)	use universal indicator (paper / solution) ; use colour to determine pH from chart ;	**2**
11(b)(i)	combustion of carbon containing fuels ;	**1**
11(b)(ii)	global warming / climate change ;	**1**
11(c)(i)	45 (cm^3) ;	**1**
11(c)(ii)	190 (s) ;	**1**
11(c)(iii)	steeper line ; but levelling off at 45 (cm^3) ;	**2**
11(c)(iv)	decrease particle size / use powder / increase surface area ; increase acid concentration ;	**2**

Question	Answer	Marks
12(a)	volume = mass/density (in any form) or 1.97×10^{30} / 1410 ; = 1.4×10^{27} (m^3) ;	**2**
12(b)(i)	convection ;	**1**

Question	Answer	Marks
12(b)(ii)	radiation ;	**1**
12(b)(iii)	sound waves need a medium / cannot travel through a vacuum ;	**1**
12(c)(i)	infrared to the right of visible light ;	**1**
12(c)(ii)	gamma radiation ;	**1**
12(c)(iii)	all electromagnetic waves / they travel at same speed ;	**1**
12(d)(i)	amplitude correctly labelled ;	**1**
12(d)(ii)	wavelength correctly labelled ;	**1**