Cambridge IGCSE™

CO-ORDINATED SCIENCES	**0654/41**
Paper 4 Theory (Extended)	**May/June 2025**
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 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

This document consists of **18** printed pages.

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 descriptions 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 **_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.

Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	Meaning
✔	correct point or mark awarded
✖	incorrect point or mark not awarded
BOD	benefit of the doubt given
FT	follow through
NBOD	benefit of doubt was considered, but the response was decided to not be sufficiently close for benefit of doubt to be applied.
TV	response is too vague or there is insufficient detail in response
ECF	error carried forward applied
∧	information missing or insufficient for credit
?	unclear response
I	incorrect or insufficient point ignored while marking the rest of the response
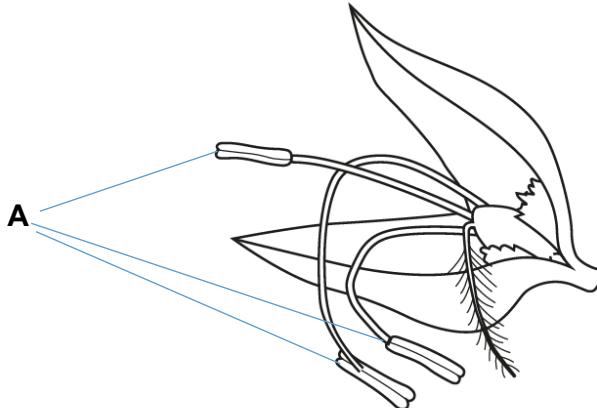
Annotation	Meaning
R	incorrect point or mark not awarded
LNK	two statements are linked
SEEN	point has been noted, but no credit has been given or blank page seen
(green dot)	key point attempted / working towards marking point / incomplete answer / response seen but not credited / blank page seen
BP	blank page

Question	Answer	Marks
1(a)	$6CO_2 + 6H_2O \rightarrow 6O_2 + C_6H_{12}O_6$; ;	**2**
1(b)	respiration ; light ; increases ; 07:00 ;	**4**
1(c)	(less uptake of carbon dioxide because) slower rate of photosynthesis / photosynthesis limited by temperature ; less kinetic energy / not enough KE ; lower frequency of / fewer effective / successful collisions (between enzyme and substrate) ;	**3**

Question	Answer	Marks
2(a)	any **two** from: (pulmonary artery) carries blood away from heart (to lungs), vena cava carries blood to heart {from body); (pulmonary artery) has a thick<u>er</u> wall / more elastic wall ; (pulmonary artery) has blood at high<u>er</u> pressure ; (pulmonary artery) has a narrow<u>er</u> lumen ;	**2**

Question	Answer	Marks
2(b)	any **four** from: (blood flows from pulmonary vein) into <u>left</u> atrium ; left atrium/muscles <u>contract</u> pushing blood ; (atrium) through valve to (left) ventricle ; (muscles of) ventricle <u>contracts</u> pushing blood (into the aorta) ; valves (shut) to prevent backflow of blood ;	**4**
2(c)(i)	ECG / listening to sounds of valves closing ;	**1**
2(c)(ii)	coronary artery ; any **two** from: less / no, supply of, oxygen / oxygenated blood (to heart); less / no, respiration ; less / no, energy for muscle contraction ;	**3**
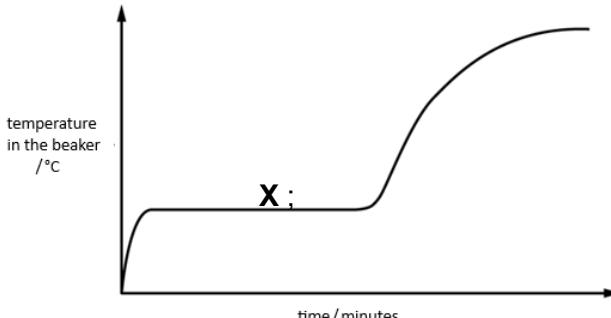
Question	Answer	Marks
3(a)	1.2 / 37 **or** 0.0324 ; 32.4 (µm) ;	**2**
3(b)	phloem cells ;	**1**
3(c)(i)	mitosis ;	**1**
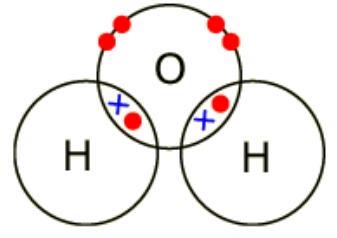
Question	Answer	Marks
3(c)(ii)	any **two** from: replication (of, DNA / chromosomes) ; separation of chromosomes (into two identical sets) ; cells only divide once / splits into two daughter cells;	2
3(d)(i)	 correct labelling of any one anther = 1 mark ;	1
3(d)(ii)	pollen ; diploid ; different ; fertilisation ;	4

Question	Answer	Marks
3(d)(iii)	any **one** from: produces (genetic) variation ; able to adapt to change in environment ; spreads offspring through dispersal of pollen / seeds ;	**1**

Question	Answer	Marks
4(a)	grasshopper frog python primary secondary tertiary **or apex** **consumer** **consumer** **consumer** **predator** ;;	**2**
4(b)	energy is lost between trophic levels / idea that less energy will be lost ; example of energy loss ; monkeys are primary consumers / frogs are higher along the food chain / idea of fewer trophic levels ;	**3**

Question	Answer	Marks
4(c)	<table><tr><td>*Effect (max. **two**)*</td><td>*Explanation*</td></tr><tr><td>soil erosion / loss of soil / soil less fertile / landslides / flooding ;</td><td>lack of roots which hold soil in place ;</td></tr><tr><td>flooding ;</td><td>silting up of rivers / rain not dispersed by roots / vegetation not there to slow flow ;</td></tr><tr><td>loss of soil quality ;</td><td>disruption of nutrient cycles / lack of humus ;</td></tr><tr><td>reduced rainfall ;</td><td>decreased transpiration from leaves ;</td></tr><tr><td>increase of CO_2 in atmosphere / global warming / climate change ;</td><td>reduced photosynthesis / less trees to absorb CO2 / burning of trees ;</td></tr><tr><td>increased air pollution ;</td><td>burning of trees ;</td></tr><tr><td>extinction ;</td><td>loss of habitat/foods sources / shelter / breeding grounds ;</td></tr><tr><td>eutrophication ;</td><td>soil erosion and runoff (of minerals / nutrients) ;</td></tr></table>	4

Question	Answer	Marks
5(a)	gas ;	**1**
5(b)	any **two** from : idea that the movement changes from vibrating about fixed positions ; to moving around each other ; particles move faster ;	**2**
5(c)(i)		**1**
5(c)(ii)	any **one** from : idea that there is a <u>horizontal</u> part to the graph ; (pure substance) melting occurs at one temperature / a mixture melts at more than one temperature ;	**1**

Question	Answer	Marks
5(d)	 ;;	2
5(e)(i)	 ;;	2
5(e)(ii)	idea that pure water does not contain any free (moving) electrons / ions ;	1

Question	Answer	Marks
6(a)	<table><tr><td rowspan="2">atomic number</td><td rowspan="2">mass number</td><td colspan="3">number of</td></tr><tr><td>protons</td><td>neutrons</td><td>electrons</td></tr><tr><td>**11** ;</td><td>23</td><td>**11**</td><td>**12** ;</td><td>11</td></tr></table>	2
6(b)	2.8.2 ✓ ;	1

Question	Answer	Marks
6(c)	(the isotopes have) the same number of electrons / the same electronic configuration ;	1
6(d)	acidic (oxide) ;	1
6(e)	reflected ; absorbed ; absorbed / stored ;	3
6(f)	M_r of CO_2 = 44 ; moles of CO_2 = 11000 ÷ 44 = 250 ; volume of CO_2 = 250 × 24 = 6000 dm³ ;	3

Question	Answer	Marks
7(a)	exothermic ;	1
7(b)	reduction ;	1
7(c)	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$;;	2
7(d)	M_r of $CaCO_3$ = 100 **and** M_r of CaO = 56 ; $\dfrac{100 \times 7}{56}$ = 12.5 (tonnes) ;	2
7(e)	zinc is more reactive than iron / ORA ; zinc loses <u>electrons</u> more easily than iron / ORA ;	2

Question	Answer	Marks
7(f)	electrostatic attraction ; between <u>positive</u> (zinc / metal) ions and (a 'sea' of) delocalised electrons ;	2

| Question	Answer	Marks
8(a)	(chain length) decreases / AW ; (boiling point) decreases / AW ;	2
8(b)(i)	cracking ; (use of a) high temperature / catalyst ;	2
8(b)(ii)	C_4H_{10} ; $C_{18}H_{36}$;	2
8(c)	moles of ethene = $5.6 \div 28 = 0.2$ (mol) ; moles of steam = $5.4 \div 18 = 0.3$ (mol) ; (there are less moles of ethene) so ethene is the limiting reactant ;	3

Question	Answer	Marks
9(a)(i)	hydrogen ; helium ;	2
9(a)(ii)	decreases ; decreases ;	2

Question	Answer	Marks
9(b)	evidence of 1 year = $60 \times 60 \times 24 \times 365$ or 1 year = 31 536 000 s ; $v = 2\pi r / T$ (in any form) or $2 \times \pi \times 1.5 \times 10^{11} / 31\,536\,000$; 30 000 m / s ;	3
9(c)	red **super**giant ; supernova ; black hole ;	3
9(d)	fusion is joining of (small) nucle<u>i</u> (to form a larger nucleus) ; fission is splitting of (large) nucleus (into smaller nuclei) ;	2

Question	Answer	Marks
10(a)(i)	changing / increasing acceleration ;	1
10(a)(ii)	evidence of substitution into $\Delta v/\Delta t$ or 300 / 30 ; 10 ; m / s² ;	3
10(a)(iii)	evidence of area or $0.5 \times 200 \times 20$; 2000 m ;	2
10(a)(iv)	50 (s) ;	1
10(b)	driving force AND drag / air resistance / friction ; equal (magnitude) and opposite (direction) ;	2

Question	Answer	Marks
11(a)(i)	similarity both are liquid to gas ; *any two from:* differences boiling occurs at the boiling point and evaporation occurs below the boiling point ; boiling occurs within the liquid and evaporation occurs at the surface of the liquid ; boiling is a fast(er) process and evaporation is a slow(er) process ; boiling forms bubbles and evaporation does not form bubbles ;	3
11(a)(ii)	increased temperature ; increased surface area ; increased air movement (over liquid surface) ;	3
11(b)	heated water becomes less dense ; and rises ; cold / more dense water sinks;	3

Question	Answer	Marks
12(a)(i)	(0.32 − 0.18 =) 0.14 (A) ;	1
12(a)(ii)	1.8 (V) ;	1
12(b)	evidence of R = 40 × 20 / (40 +20) or 1 / R = 1 / 40 + 1 / 20 ; 13 (Ω) ;	2
12(c)(i)	I = P / V (in any form) or 750 / 230 ; 3.3 (A) ;	2

Question	Answer	Marks
12(c)(ii)		3
12(c)(iii)	magnifying glass ;	1