

Cambridge IGCSE™

CO-ORDINATED SCIENCES**0654/42**

Paper 4 Theory (Extended)

October/November 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 October/November 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

This document consists of **17** 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 '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.

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
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
R	incorrect point or mark not awarded

Annotation	Meaning
LNK	two statements are linked
SEEN	point has been noted, but no credit has been given or blank page seen
	key point attempted / working towards marking point / incomplete answer / response seen but not credited / blank page seen
BP	blank page

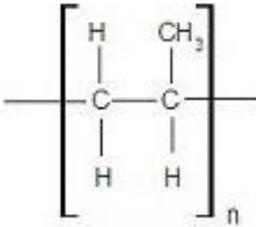
Question	Answer	Marks
2(a)(i)	(rate increases as) (wind) removes water <u>vapour</u> from around the leaf ; (wind) maintains steep concentration gradient ; increased <u>diffusion</u> (of water) from stomata ;	3
2(a)(ii)	(effect on distance) increases (for 25 °C) AND any two from (explanation): <ul style="list-style-type: none"> • increase in rate of transpiration ; • increased rate of water evaporating ; • increased rate of diffusion of water vapour ; 	2
2(b)(i)	mineral ions ;	1
2(b)(ii)	sucrose and amino acids ; phloem ;	2
2(c)(i)	(idea that) blood only goes through the heart once (each circuit) OR heart → gills → body ;	1
2(c)(ii)	any one from: allows faster metabolism ; high blood pressure around body / low blood pressure to lungs / allows different pressure to lungs / allows different pressure to body ; oxygenated blood and deoxygenated blood kept separate ;	1

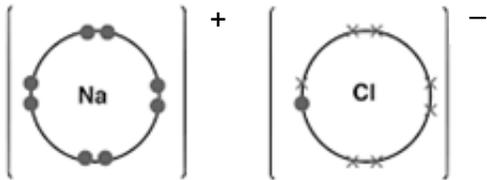
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Question	Answer	Marks
3(a)(i)	any two from: <ul style="list-style-type: none"> • salivary glands ; • pancreas ; • small intestine ; 	2
3(a)(ii)	(reducing) sugar(s) ;	1
3(b)(i)	(enzyme / substrate) have more kinetic energy ; increased frequency of (effective) collisions ; (the collisions are effective because) more <u>enzyme-substrate complexes</u> formed / increased rate of substrate entering <u>active site</u> (of the enzyme) ;	3
3(b)(ii)	any two from: <ul style="list-style-type: none"> • enzyme <u>denatured</u> ; • <u>active site</u> changes shape ; • no enzyme-substrate complexes formed / enzymes no longer complementary to substrate ; 	2
3(c)	any two from: <ul style="list-style-type: none"> • neutralises the acidic mixture (of food and gastric juices entering the duodenum from the stomach) ; • provides suitable pH for enzymes ; • emulsifies fats / emulsifies lipids ; • increases surface area for (chemical) digestion ; 	2

Question	Answer		Marks
4(a)	endocrine gland	hormone released from gland	2
	adrenal	adrenaline ;	
	pancreas	insulin / glucagon ;	
4(b)(i)	label line to sweat gland (with letter S) ;		1
4(b)(ii)	increased sweat / increased sweating ; vasodilation / description of vasodilation / <u>arterioles</u> widen ; hairs lie flat ;		3
4(c)(i)	relay ; effector ;		2
4(c)(ii)	brain and spinal cord ;		1
4(c)(iii)	49.0 ;		1

Question	Answer	Marks
5(a)(i)	C ₄ H ₁₀ ;	1
5(a)(ii)	<p>unsaturated (propene contains) a double carbon-carbon (covalent) bond / one of the carbon-carbon bonds is not a single bond ;</p> <p>hydrocarbon (propene contains) only hydrogen and carbon (atoms) ;</p>	2
5(a)(iii)	$ \begin{array}{ccccccc} & \text{H} & & \text{H} & & \text{H} & & \text{H} \\ & & & & & & & \\ \text{H} & - \text{C} & - & \text{C} & = & \text{C} & - & \text{C} & - \text{H} \\ & & & & & & & \\ & \text{H} & & & & & & \text{H} \end{array} $ <p>1 mark for double bond between carbon 2 and carbon 3 1 mark for rest of structure correct</p>	2
5(b)	turns colourless / decolourised ;	1
5(c)	<p>any three from:</p> <ul style="list-style-type: none"> • idea that (large) alkane molecules are broken down (into smaller molecules) ; • (idea that molecules are broken down) into alkene molecules ; <p>conditions</p> <ul style="list-style-type: none"> • high temperature ; • catalyst ; 	3

Question	Answer	Marks
5(d)	 <p>1 mark for single bond between carbon atoms 1 mark for rest of structure correct</p>	2

Question	Answer	Marks
6(a)(i)	Ar ;	1
6(a)(ii)	Na or K or Al ;	1
6(a)(iii)	Al ;	1
6(b)	 <p>1 mark for correct sodium ion with charge shown 1 mark for correct chloride ion with charge shown</p>	2
6(c)(i)	(carbon has) 2 (occupied) electron shells ;	1
6(c)(ii)	same electronic configuration ;	1
6(c)(iii)	(graphite has) <u>electrons</u> ; that can move ;	2

Question	Answer	Marks
6(c)(iv)	anode: oxygen ; cathode: copper ;	2

Question	Answer	Marks
7(a)	$\text{Fe}_2(\text{SO}_4)_3$;	1
7(b)(i)	red-brown ;	1
7(b)(ii)	$\text{Fe}^{3+}(\text{aq}) + 3\text{OH}^{-}(\text{aq}) \rightarrow \text{Fe}(\text{OH})_3(\text{s})$ 1 mark for formulae 1 mark for balancing 1 mark for state symbols	3
7(c)(i)	(reduced because) iron (III) oxide loses oxygen / Fe_2O_3 loses oxygen ;	1
7(c)(ii)	(M_r of Fe_2O_3 =) 160 ; (mass of Fe_2O_3 =) $\frac{160 \times 28000}{112}$; 40 000 (g) ; OR (moles of Fe = $28000 \div 56$ =) 500 ; (moles of Fe_2O_3 =) $500 \div 2$ or 250 or ratio of moles of Fe: Fe_2O_3 is 2:1 ; (mass of Fe_2O_3 = 250×160 =) 40000 (g) ;	3

Question	Answer	Marks
8(a)	(test) limewater ; (observation) white precipitate / (turns) milky ;	2
8(b)(i)	any value in the inclusive range 5.6–6 (minutes) ;	1
8(b)(ii)	$30 \div 2$; $= 15 \text{ (cm}^3\text{/ minute)}$;	2
8(b)(iii)	$\text{mol} = \text{volume} \div 24$ or $\text{mol} = 0.050 \div 24$; 0.0021 ;	2
8(c)	more particles per unit volume ; frequency of collision (of particles) is higher ;	2

Question	Answer	Marks
9(a)(i)	hot water / steam (from underground) ; turns turbine ; (turbine) turns generator ;	3
9(a)(ii)	nuclear ; tidal ;	2
9(b)(i)	efficiency = useful output power \div total input power OR $0.32 = \text{useful power output} \div 1400$; 450 (W) ;	2

Question	Answer	Marks
9(b)(ii)	2500 ÷ 450 ; 5.6 (m ²) ;	2
9(b)(iii)	($\Delta E_p =$) $mg\Delta h$ OR 8.4 × 9.8 × 6.0 ; 490 (J) ;	2

Question	Answer	Marks
10(a)(i)	any one from: <ul style="list-style-type: none"> • satellite TV ; • mobile phones ; • (microwave) ovens ; 	1
10(a)(ii)	vibrations / oscillations are perpendicular ; (vibrations / oscillations are perpendicular), to the direction of propagation / to the direction of travel / to the direction of energy transfer ;	2
10(b)(i)	evidence of $n = \sin i \div \sin r$ OR 1.25 = $\sin 48 \div \sin r$; $r = \sin^{-1} (\sin 48 \div 1.25)$; $r = 36 (^{\circ})$;	3

Question	Answer	Marks
10(b)(ii)	ray continued as a straight line drawn in top right ; ray drawn refracted towards the normal ;	2
10(c)	ray continued as a straight line drawn in bottom right ; with angle of incidence equal to angle of reflection ;	2

Question	Answer	Marks
11(a)(i)	evidence of $Q = It$ OR $0.25 \times 5.0 \times 60$; 75 (C) ;	2
11(a)(ii)	3 (.0 V) ;	1
11(a)(iii)	$(0.25 - 0.15 =) 0.1(0 \text{ A})$;	1
11(a)(iv)	evidence of $R = V \div I$ OR $3 \div 0.25$; 12 (Ω) ;	2
11(b)(i)	(current) decreases ; total resistance of circuit increased ;	2
11(b)(ii)	(current) unchanged ; same p.d. across resistor ;	2

Question	Answer	Marks
12(a)(i)	79 ;	1
12(a)(ii)	118 ;	1
12(a)(iii)	isotopes ;	1
12(b)(i)	${}_{79}^{198}\text{Au} \rightarrow {}_{80}^{198}\text{Hg} + {}_{-1}^0\beta$ <p>1 mark for beta completely correct 1 mark for Hg completely correct</p>	2
12(b)(ii)	(average) time taken ; for half the nuclei of the isotope in a sample to decay ;	2
12(b)(iii)	(8.1 ÷ 2.7 =) 3 half-lives ; (280 ÷ 2 ³ =) 35 (g) ;	2