

Cambridge IGCSE™

CO-ORDINATED SCIENCES**0654/43**

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
	benefit of the doubt given
	follow through
	response is too vague or there is insufficient detail in response
	error carried forward applied
	information missing or insufficient for credit
	unclear response
	incorrect or insufficient point ignored while marking the rest of the response
	incorrect point or mark not awarded

Annotation	Meaning
	two statements are linked
	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
	blank page

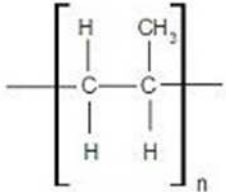
Question	Answer	Marks
1(a)	similar, any two from: • cell wall ; • cell membrane ; • ribosomes ; • DNA/genetic material ; • cytoplasm ; different, any two from: • plant has cellulose cell wall / bacterial has cell wall not made from cellulose OR bacteria has cell wall made of sugars and amino acids / peptidoglycan ; • plant cells have chloroplasts / bacterial cells do not have chloroplasts ; • plant cells have vacuole / bacterial cells do not have vacuole ; • plant cells have a nucleus / bacterial cells do not have a nucleus ; • plant cells have chromosomes / bacterial cells have circular DNA / bacterial cells have plasmids ;	4
1(b)(i)	chromosomes ;	1
1(b)(ii)	(advantage) (more) <u>genetic</u> variation ; (disadvantage) process of development takes longer / idea of offspring having to develop from fertilised egg taking longer ;	2
1(c)(i)	A – stigma ; B – style ;	2
1(c)(ii)	C – would not be colourful / dull (colour) / absent / small / have no smell / have no scent ; D – would be hanging outside the flower ;	2
1(d)	meiosis ;	1

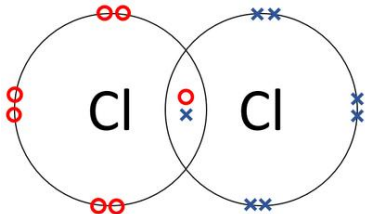
Question	Answer	Marks
2(a)(i)	the movement of particles (through a cell membrane) from a region of low(er) concentration to a region of high(er) concentration / the movement of particles (through a cell membrane) against a concentration gradient ; using energy (from respiration) ;	2
2(a)(ii)	(magnesium ions) production of <u>chlorophyll</u> ; (nitrate ions) production of amino acids / proteins / DNA / RNA / ATP ;	2
2(b)(i)	any three from: • <u>water</u> enters <u>cells</u> (of the carrot) ; • by <u>osmosis</u> ; • from a region of high(er) water potential to a region of low(er) water potential / water potential inside the cells is lower than the solution / water potential inside the carrot is lower than the solution / ORA ; • through a partially permeable membrane ;	3
2(b)(ii)	any two from: • smaller cell / smaller vacuole / flaccid / less turgid ; • plasmolysed ; • correct description of plasmolysed / cell membrane has pulled away from the cell wall ;	2

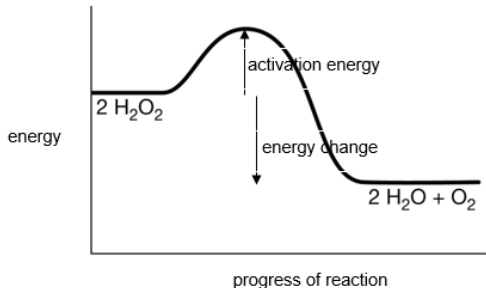
Question	Answer	Marks
3(a)(i)	septum labelled S ; any valve labelled V ;	2
3(a)(ii)	has a small lumen / has muscular wall / has thick muscle wall ; (to maintain or withstand the) high pressure of the blood ;	2
3(b)(i)	clots (blood) ; prevents entry of pathogens / seals wounds ;	2

Question	Answer	Marks
3(b)(ii)	any one from: - ions ; - nutrients ; - urea ; - hormones ; - carbon dioxide ; - antibodies ;	1
3(b)(iii)	any three from: (fewer) red blood cells ; - idea of insufficient (transport of) oxygen ; (idea oxygen is needed) for <u>aerobic</u> respiration ; - idea of less energy for muscle contraction / exercise ; - increase in lactic acid / oxygen debt ;	3
3(b)(iv)	(lymphocytes) <u>antibody</u> production ;	1

Question	Answer			Marks
4(a)	description	continuous	discontinuous	2
	limited number of phenotypes		✓	
	ABO blood groups is one example		✓	
	height is one example	✓		
	3 correct for 2 marks 2 correct for 1 mark			
4(b)	some bacteria <u>mutate</u> and become resistant (to antibiotics) ; (idea that these bacteria) survive and divide / reproduce ; pass on <u>alleles</u> (for antibiotic resistance to offspring) ;			3
4(c)(i)	an organism that gets its <u>energy</u> from dead or waste organic material ;			1
4(c)(ii)	any two from: • egestion / faeces / indigestible material ; • respiration / heat (loss) ; • movement / muscle contraction ; • (there are), inedible parts / bones / teeth ; • AVP ;			2

Question	Answer	Marks
5(a)	C ; (C) contains oxygen / (C) does not contain only carbon and hydrogen / hydrocarbons only contains hydrogen and carbon ;	2
5(b)	natural gas ;	1
5(c)	propane ;	1
5(d)(i)	 1 mark for single bond between carbon atoms 1 mark for rest of structure correct	2
5(d)(ii)	any two from: addition polymerisation - only occurs in unsaturated monomers / monomers that contain C = C bonds ; - idea that it involves the same type of <u>monomer/unit</u> ; - only forms the polymer molecule ; condensation polymerisation - idea that it involves different types of <u>monomers / units</u> ; - forms (the polymer molecule and one) water (molecule per linkage) ;	2
5(e)	$\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O} ;;$ 1 mark for correct formulae 1 mark for correct balanced equation	2

Question	Answer	Marks												
6(a)	<table border="1"> <thead> <tr> <th>particle</th><th>relative charge</th><th>relative mass</th></tr> </thead> <tbody> <tr> <td>electron</td><td>-1</td><td>0.0005</td></tr> <tr> <td>neutron</td><td>0</td><td>1</td></tr> <tr> <td>proton</td><td>+1</td><td>1</td></tr> </tbody> </table> 3 correct for 2 marks 1 or 2 correct for 1 mark	particle	relative charge	relative mass	electron	-1	0.0005	neutron	0	1	proton	+1	1	2
particle	relative charge	relative mass												
electron	-1	0.0005												
neutron	0	1												
proton	+1	1												
6(b)	10 electrons ; 12 neutrons ;	2												
6(c)	$^{35}_{18}\text{Cl}$;	1												
6(d)	 1 mark shared pair of electrons between chlorine atoms 1 mark for rest of structure correct	2												
6(e)	chlorine is covalent and sodium chloride is ionic ; chlorine has weak <u>intermolecular forces</u> ; sodium chloride has strong <u>electrostatic forces</u> / sodium chloride has strong forces <u>between oppositely charged ions</u> ;	3												

Question	Answer	Marks
7(a)	test: glowing splint ; result: relights ;	2
7(b)	(catalyst) decrease the activation energy (of the reaction) / (catalyst) decrease the E_a (of the reaction) ;	1
7(c)	(line A) the line is steeper / line has larger gradient ; higher rate of reaction / reaction is faster / the reaction finishes first / volume of gas increases faster ;	2
7(d)(i)	 reactants line drawn above products line ; arrow correctly labelled activation energy ; arrow correctly labelled energy change ;	3
7(d)(ii)	+56 kJ / mol ☐ +219 kJ / mol ☐ 0 kJ / mol ☐ -196 kJ / mol ☒	1

Question	Answer	Marks
8(a)	$2\text{Fe} + 3\text{CO}_2$ 1 mark for correct formulae 1 mark for correct balancing	2
8(b)(i)	(pure iron is an element because) it is made of only one type of <u>atom</u> ; (iron from the blast furnace is a mixture because) it contains two elements not chemically combined ;	2
8(b)(ii)	idea that atoms in iron from the blast furnace are different sizes / atoms in pure iron are all the same size ; idea that <u>layers</u> in iron from the blast furnace and cannot slide over each other / ORA ;	2
8(b)(iii)	idea that layers of atoms in pure iron slide / move / slip over each other ;	1
8(c)(i)	<u>thermal</u> decomposition ;	1
8(c)(ii)	$(M_r \text{ of CaO} =) \textbf{56 and } (M_r \text{ of SiO}_2 =) \textbf{60}$; $(\frac{720 \times 56}{60} =) \textbf{672}$ (tonnes) ; or moles of $\text{SiO}_2 = 720 \times 10^6 / 60 =) \textbf{1.2} \times \textbf{10}^7 \text{ g}$; $(1.2 \times 10^7 \text{ g} \times 56 = 6.72 \times 10^8 \text{ g} =) \textbf{672}$ (tonnes) ;	2
8(c)(iii)	giant covalent ;	1

Question	Answer	Marks
9(a)(i)	chemical ;	1
9(a)(ii)	(electrical) current / (electrical) work done ;	1
9(b)(i)	$(\Delta E_p =) mg\Delta h$ or $(E_p =) 0.56 \times 9.8 \times 9.4$; 52 (J) ;	2

Question	Answer	Marks
9(b)(ii)	$(E_k =) \frac{1}{2}mv^2$ (in any form) or $52 = 0.5 \times 0.56 \times v^2$; 14 (m / s) ;	2
9(c)(i)	work is done ; compressing ball / deforming ball / by ball on the ground ;	2
9(c)(ii)	evidence of efficiency = $\frac{\text{useful energy output}}{\text{total energy input}}$ or $\frac{8.2}{9.4}$ or 0.87 or $0.56 \times 9.8 \times 8.2$ or 45 ; 87(%) ;	2

Question	Answer	Marks
10(a)(i)	collisions ; between particles and walls (of syringe) ;	2
10(a)(ii)	increases ;	1
10(a)(iii)	more frequent collisions ; greater force ;	2
10(b)(i)	solid ;	1
10(b)(ii)	20 000 Hz / 20 kHz ;	1
10(b)(iii)	speed = distance / time or $v = s / t$ (in any form) or $1500 = \text{distance} / 8.0 \times 10^{-5}$; distance = 0.12 (m) ; depth = 0.060 (m) ;	3

Question	Answer	Marks
11(a)(i)	13.8 billion years ;	1
11(a)(ii)	expanded ; from a single point (of high temperature / high density) ;	2
11(b)	time = distance / speed or $t = s / v$ (in this form) or $5.6 \times 10^{10} / 3 \times 10^8$; 187 / 190 (s) ;	2
11(c)(i)	${}_{84}^{210}\text{Po} \rightarrow {}_{82}^{206}\text{Pb} + {}_2^4\alpha$ alpha completely correct ; Pb completely correct ;	2
11(c)(ii)	(12.4 / 3.1 =) 4 (half-lives) ; (560 / 2 ⁴ =) 35 (g) ;	2

Question	Answer	Marks
12(a)(i)	primary coil with fewer turns (than secondary) / ORA ; <u>soft iron</u> core ;	2
12(a)(ii)	$P = I^2 R$ or $500^2 \times 0.6$; 150 000 (W) ;	2
12(b)	(d.c.) electric charge (only) flows in one direction / current (only) flows in one direction OR (a.c.) electric charge <u>changes</u> / <u>reverses</u> direction (periodically) / current <u>changes</u> / <u>reverses</u> direction (periodically) ;	1
12(c)(i)	maintain a connection to each side of the coil ; so wires do not twist / so wires do not tangle ;	2
12(c)(ii)	sine wave with positive and negative e.m.f. ; constant amplitude and period ;	2
12(c)(iii)	<u>amplitude</u> doubles ; <u>period</u> halves or <u>frequency</u> doubles ;	2