

Cambridge IGCSE™

CO-ORDINATED SCIENCES**0654/43**

Paper 4 Theory (Extended)

May/June 2024

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 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

This document consists of **14** 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.

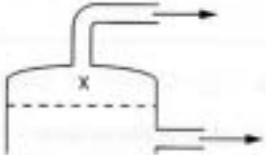
Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

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.

Question	Answer			Marks												
1(a)	<table border="1" data-bbox="338 220 1350 515"> <thead> <tr> <th data-bbox="338 220 629 320">name of part</th> <th data-bbox="629 220 786 320">letter in Fig. 1.1</th> <th data-bbox="786 220 1350 320">function</th> </tr> </thead> <tbody> <tr> <td data-bbox="338 320 629 384">lens</td> <td data-bbox="629 320 786 384">D</td> <td data-bbox="786 320 1350 384">focuses light</td> </tr> <tr> <td data-bbox="338 384 629 448">retina</td> <td data-bbox="629 384 786 448">A</td> <td data-bbox="786 384 1350 448">contains light receptors</td> </tr> <tr> <td data-bbox="338 448 629 515">optic nerve</td> <td data-bbox="629 448 786 515">B</td> <td data-bbox="786 448 1350 515">carries impulses (to brain)</td> </tr> </tbody> </table> <p data-bbox="338 515 367 555">∴</p>			name of part	letter in Fig. 1.1	function	lens	D	focuses light	retina	A	contains light receptors	optic nerve	B	carries impulses (to brain)	3
name of part	letter in Fig. 1.1	function														
lens	D	focuses light														
retina	A	contains light receptors														
optic nerve	B	carries impulses (to brain)														
1(b)(i)	pupil reflex ;			1												
1(b)(ii)	<i>stimulus</i> (change in) light (intensity) ; <i>effector</i> circular muscles ;			2												
1(c)	<table border="1" data-bbox="338 783 882 1110"> <tbody> <tr> <td data-bbox="338 783 786 847">drinking</td> <td data-bbox="786 783 882 847"></td> </tr> <tr> <td data-bbox="338 847 786 911">heart beating</td> <td data-bbox="786 847 882 911">✓</td> </tr> <tr> <td data-bbox="338 911 786 975">running</td> <td data-bbox="786 911 882 975"></td> </tr> <tr> <td data-bbox="338 975 786 1038">sneezing</td> <td data-bbox="786 975 882 1038">✓</td> </tr> <tr> <td data-bbox="338 1038 786 1110">talking</td> <td data-bbox="786 1038 882 1110"></td> </tr> </tbody> </table> <p data-bbox="338 1110 367 1150">∴</p>			drinking		heart beating	✓	running		sneezing	✓	talking		2		
drinking																
heart beating	✓															
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Question	Answer	Marks
2(a)	(compound containing) carbon and hydrogen (atoms) ; only ;	2
2(b)(i)	X inside the column, either inside the pipe or anywhere above the top dotted line ; e.g. 	1
2(b)(ii)	Any two from: boiling point / volatility / viscosity / flammability / density ;;	2
2(c)	$\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$;;	2
2(d)	Idea of thermal energy given out ;	1

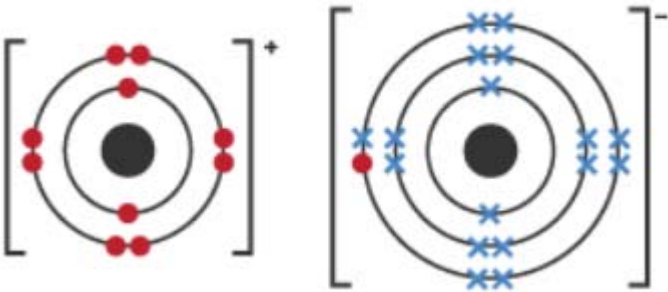
Question	Answer	Marks
3(a)(i)	(height \times length) \div 2 / (40 \times 12) \div 2 ; 240 (m) ;	2
3(a)(ii)	rate of change of velocity / change in velocity divided by time ;	1
3(a)(iii)	(m=) $2E_k / v^2$ OR $2 \times 10800 / 144$; (m=) 1500 (kg) ;	2

Question	Answer	Marks
3(b)	use of 3.0×10^8 (m / s) ; $(\lambda =) v / f$ OR $3.0 \times 10^8 \div 5.6 \times 10^{14}$; $(\lambda =) 5.4 \times 10^{-7}$ (m) ;	3

Question	Answer	Marks
4(a)(i)	D ;	1
4(a)(ii)	A (upper) epidermis ; B cuticle ;	2
4(a)(iii)	any two from: contain lots of chloroplasts ; located at the top of leaf ; tightly packed / column shaped ;	2
4(b)(i)	as sucrose ; by translocation ; in the phloem ;	3
4(b)(ii)	any two from: storage ; respiration ; growth ;	2

Question	Answer	Marks
4(c)	<i>any two from:</i> increased surface area ; increased temperature ; steeper concentration gradient ; shorter diffusion distance ;	2

Question	Answer	Marks
5(a)(i)	red-brown ;	1
5(a)(ii)	gas ;	1
5(a)(iii)	answer in range -189 to -272 ;	1
5(b)(i)	(sodium) has three (occupied) electron shells ;	1
5(b)(ii)	idea that protons are positive and electrons are negative ; same number of protons and electrons ;	2

Question	Answer	Marks
5(c)	 <p>sodium ion drawn with full outer shell or an empty one and a charge of +1 ;</p> <p>chloride ion drawn with 8 electrons in outer shell and a charge of -1 ;</p>	2
5(d)	Regular arrangement of alternating positive and negative ions ✓ ;	1

Question	Answer	Marks
6(a)	<p>weight = 1.5(N) OR resultant force = 0.6(N) ;</p> <p>upwards resultant force / 0.6 N upwards force ;</p> <p><u>accelerates</u> upwards ;</p>	3
6(b)(i)	<p>area = $\pi \times 0.035^2 / 3.848 \times 10^{-3}$;</p> <p>force = $P \times A / 180000 \times \text{area} / 180000 \times 3.848 \times 10^{-3}$;</p> <p>= 690 (N) ;</p>	3

Question	Answer	Marks
6(b)(ii)	one correct ray drawn ; second correct ray drawn ; image correctly drawn ;	3

Question	Answer	Marks
7(a)	(acidic environment) kills, bacteria / microorganisms / denatures enzymes in microorganisms or bacteria ; provides, optimum / suitable, pH for protease ;	2
7(b)	bile ;	1
7(c)	the breakdown of food into smaller pieces / AW ; without chemical change (to the food molecules) ;	2
7(d)(i)	ref to bacteria ; respiring (sugars) ;	2
7(d)(ii)	dissolving enamel or dentine / (dental) decay ;	1
7(e)(i)	<i>any two from:</i> carbohydrates ; fats ; protein ; fibre ; water ;	2

Question	Answer	Marks
7(e)(ii)	scurvy ;	1

Question	Answer	Marks
8(a)(i)	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$;;	2
8(a)(ii)	loss of electrons / AW ;	1
8(b)	M_r of $\text{O}_2 = 32$; moles of $\text{O}_2 = 40 \div 32 = 1.25$; volume of $\text{O}_2 = 1.25 \times 24 = 30 \text{ dm}^3$;	3
8(c)	weak intermolecular forces / weak forces between molecules ; (weak forces) which require little energy to break ;	2
8(d)	giant covalent OR covalent lattice ; each oxygen atom forms bonds with 2 silicon atoms / each silicon atoms forms bonds with 4 oxygen atoms ;	2
8(e)		2

Question	Answer	Marks
9(a)(i)	$I_1 = I_2$ / they are the same/equal ;	1
9(a)(ii)	$V = V_1 + V_2 + V_3$;	1
9(a)(iii)	7.5 (Ω) ;	1
9(a)(iv)	(I=) V / R / 1.5 / 7.5 ; (I=) 0.20 ; A / amp / amps / amperes ;	3
9(b)(i)	(ammeter:) decreases because the resistance of the thermistor increases ; (voltmeter:) stays the same because it receives the full voltage / owtte ;	2
9(b)(ii)	(arrangement:) solid is regular and liquid is random ; (motion:) solid molecules vibrate about a fixed point and liquid molecules can move / slide (past each other) ;	2

Question	Answer	Marks
10(a)(i)	cactus → kangaroo rat → spider → snake → falcon ; ;	2
10(a)(ii)	5 ;	1
10(a)(iii)	cactus ;	1
10(b)(i)	speed / desirable features ; offspring ; repeated ;	3

Question	Answer	Marks
10(b)(ii)	changes are not caused by natural selection ; population is not more suited to its environment / no change in <u>adaptive features</u> ;	2

Question	Answer	Marks
11(a)	gas syringe / measuring cylinder over water ;	1
11(b)	Any 3 from particles have more kinetic energy / molecules move faster ; more particles with activation energy ; more successful collisions ; frequency of collision (of particles) is higher / more collisions per second ;	3
11(c)	relative molecular mass of $\text{CaCO}_3 = 100$ <u>and</u> $\text{CaCl}_2 = 111$ / $\frac{111 \times 20}{100} = 22.2$ (g) ;;	2
11(d)(i)	carbon is more reactive than iron / ORA ;	1
11(d)(ii)	aluminium ;	1
11(d)(iii)	CO_2 ; SiO_2 ;	2
11(e)	zinc loses electrons more readily than iron / ORA ;	1

Question	Answer	Marks
12(a)(i)	beta curves to left ; gamma moves straight through ;	2
12(a)(ii)	has a relative mass of 4 ; has a relative charge of +2 ; has a high ionising ability and has a low penetrating ability ;	3
12(b)(i)	(useful energy output =) $89 \times 6.7 \times 10^6 / 100 / 5.96 \times 10^6$ J per day ; (useful energy output =) $5.96 \times 10^6 \times 365$; (useful energy output =) 2.2×10^9 (J) ;	3
12(b)(ii)	does not release carbon dioxide / contribute to global warming / climate change ;	1
12(b)(iii)	coil rotates ; coil cuts magnetic field / experiences a changing magnetic field ; emf / current is induced in the coil ; slip rings maintain electrical contact / prevent wires from tangling / ;	4