



# Cambridge IGCSE™

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**CO-ORDINATED SCIENCES****0654/31**

Paper 3 Theory (Core)

**October/November 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 October/November 2023 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

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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 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	<p><u>'List rule' guidance</u></p> <p>For questions that require <i>n</i> responses (e.g. State <b>two</b> reasons ...):</p> <ul style="list-style-type: none"><li>• The response should be read as continuous prose, even when numbered answer spaces are provided.</li><li>• Any response marked <i>ignore</i> in the mark scheme should not count towards <i>n</i>.</li><li>• Incorrect responses should not be awarded credit but will still count towards <i>n</i>.</li><li>• Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should <b>not</b> 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.</li><li>• Non-contradictory responses after the first <i>n</i> responses may be ignored even if they include incorrect science.</li></ul>

**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.

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
1(a)	<b>B ; D ; A ;</b>	<b>3</b>
1(b)	female – ovum / egg ; male – sperm ;	<b>2</b>
1(c)	cell membrane drawn correctly and labelled ; nucleus drawn correctly and labelled ; space around nucleus inside of the cell membrane labelled cytoplasm ;	<b>3</b>
1(d)	a zygote ; an embryo ; uterus ;	<b>3</b>

Question	Answer	Marks
2(a)(i)	sample <b>A</b> (no mark) idea that proportion of gases (other than Nitrogen) is correct ;  ORA about sample <b>B</b>	<b>1</b>
2(a)(ii)	nitrogen ;	<b>1</b>
2(b)(i)	respiratory problems ;	<b>1</b>
2(b)(ii)	combustion of fossil fuels (containing sulfur) / volcanoes ;	<b>1</b>
2(b)(iii)	carbon monoxide / nitrogen oxides ;	<b>1</b>
2(b)(iv)	3-6 ;	<b>1</b>
2(b)(v)	lime(stone) / $\text{CaCO}_3$ / $\text{CaO}$ / $\text{Ca(OH)}_2$ ;	<b>1</b>
2(c)(i)	2 electrons in first shell <b>and</b> 8 electrons in 2nd shell <b>and</b> 6 electrons in 3rd shell ;	<b>1</b>
2(c)(ii)	2 ;	<b>1</b>

Question	Answer	Marks
3(a)(i)	weight ;	1
3(a)(ii)	equal ;	1
3(b)(i)	above 20 000 (Hz) ;	1
3(b)(ii)	distance = speed $\times$ time <b>or</b> formula <b>or</b> $1600 \times 1.4$ ; = 2200 or 2240 (m) ;	2
3(b)(iii)	(answer to 3(b)(ii) $\div$ 2) = 1100 <b>or</b> 1120 ;	1
3(c)(i)	atoms of the same element which have the same proton number but a different nucleon number ;	1
3(c)(ii)	splits ;	1
3(c)(iii)	<i>one from:</i> no CO <sub>2</sub> emissions ; reliability ; AVP ;	1



Question	Answer	Marks
4(a)(i)	yoga ;	1
4(a)(ii)	pulse rate at rest – 68 <b>and</b> pulse rate during running – 140 ; $((140 - 68) / 68) \times 100 = 106$ ;	2
4(b)(i)	glucose ; oxygen ;	2
4(b)(ii)	<i>any two from:</i> more energy is required ; for muscle contraction ; (aerobic) respiration releases energy ;	2
4(c)(i)	adrenaline ;	1
4(c)(ii)	plasma ;	1

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
5(a)(i)	<b>D</b> ;	<b>1</b>
5(a)(ii)	(aqueous) bromine ; saturated – stays orange ; unsaturated – goes colourless ;	<b>3</b>
5(b)(i)	carbon monoxide ; carbon dioxide ;	<b>2</b>
5(b)(ii)	ethanol ;	<b>1</b>
5(b)(iii)	poly(ethene) ;	<b>1</b>
5(b)(iv)	C–C single bond ; 3 hydrogens each attached to a different carbon atom ;	<b>2</b>
5(c)	carbon dioxide <b>and</b> methane ;	<b>1</b>

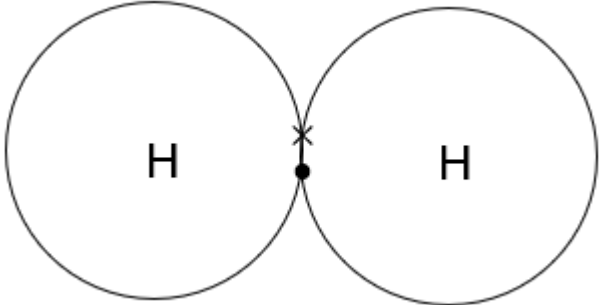
Question	Answer	Marks
6(a)(i)	ammeter in series with lamp <b>A</b> completing the circuit ; voltmeter across lamp <b>A</b> ; both symbols correct ;	<b>3</b>
6(a)(ii)	<u>variable</u> resistor ;	<b>1</b>
6(b)(i)	p.d. = current $\times$ resistance ( <i>in any form</i> ) <b>or</b> $1.2 \times 6.0$ ; = 7.2 (V) ;	<b>2</b>
6(b)(ii)	10.0 ( $\Omega$ ) ;	<b>1</b>
6(b)(iii)	2.4 ( $\Omega$ ) ; resistance is less than the value of either individual resistance ;	<b>2</b>
6(c)	<i>any two from:</i> if one fails the other will still light ; both lamps get full mains voltage ; independent switching ;	<b>2</b>

Question	Answer	Marks				
7(a)	animal that gets its <u>energy</u> ; from eating plants / AW ;	<b>2</b>				
7(b)(i)	<b>X</b> – premolars ; <b>Y</b> – incisors ;	<b>2</b>				
7(b)(ii)	canines ;	<b>1</b>				
7(b)(iii)	mechanical ;	<b>1</b>				
7(c)	<table border="1" data-bbox="338 547 1270 679"> <tbody> <tr> <td data-bbox="338 547 1171 612">food molecules cross the wall of the small intestine</td> <td data-bbox="1171 547 1270 612">✓</td> </tr> <tr> <td data-bbox="338 612 1171 679">food molecules enter the blood</td> <td data-bbox="1171 612 1270 679">✓</td> </tr> </tbody> </table> ;; 2 ticks and 2 correct = 2 marks 3 ticks and 2 correct = 1 mark otherwise 0 marks	food molecules cross the wall of the small intestine	✓	food molecules enter the blood	✓	<b>2</b>
food molecules cross the wall of the small intestine	✓					
food molecules enter the blood	✓					
7(d)	amino acids ; glycogen ; starch ; starch ;	<b>4</b>				

Question	Answer			Marks															
8(a)	<table border="1"> <thead> <tr> <th data-bbox="322 220 909 284">statement</th> <th data-bbox="909 220 1099 284">solid</th> <th data-bbox="1099 220 1272 284">gas</th> </tr> </thead> <tbody> <tr> <td data-bbox="322 284 909 347">molecules are closely packed</td> <td data-bbox="909 284 1099 347">✓</td> <td data-bbox="1099 284 1272 347"></td> </tr> <tr> <td data-bbox="322 347 909 411">molecules are free to move around</td> <td data-bbox="909 347 1099 411"></td> <td data-bbox="1099 347 1272 411">✓</td> </tr> <tr> <td data-bbox="322 411 909 475">molecules are widely separated</td> <td data-bbox="909 411 1099 475"></td> <td data-bbox="1099 411 1272 475">✓</td> </tr> <tr> <td data-bbox="322 475 909 544">molecules vibrate about a fixed position</td> <td data-bbox="909 475 1099 544">✓</td> <td data-bbox="1099 475 1272 544"></td> </tr> </tbody> </table>	statement	solid	gas	molecules are closely packed	✓		molecules are free to move around		✓	molecules are widely separated		✓	molecules vibrate about a fixed position	✓				2
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molecules are closely packed	✓																		
molecules are free to move around		✓																	
molecules are widely separated		✓																	
molecules vibrate about a fixed position	✓																		
8(b)(i)	ethanol / water ;			1															
8(b)(ii)	ethanol ; water ;			2															
8(b)(iii)	copper ;			1															
8(b)(iv)	chlorine ;			1															
8(b)(v)	chlorine / oxygen ;			1															

Question	Answer	Marks							
9(a)(i)	to allow for expansion ; so rails are not damaged / in hot weather ;	2							
9(a)(ii)	mass = density $\times$ volume ( <i>in any form</i> ) <b>or</b> $7900 \times 0.13$ ; 1000 (kg) <b>or</b> 1027 (kg) ;	2							
9(b)(i)	horizontal section correct ; slowing down section taking 100 s ;	2							
9(b)(ii)	$5 \times 10^9$ (J) ;	1							
9(c)(i)	cancer / radiation burns / AVP ;	1							
9(c)(ii)	lead lined container ;	1							
9(d)	<table border="1" data-bbox="336 718 1355 829"> <tr> <td>gamma radiation</td> <td>X-rays</td> <td>ultraviolet</td> <td>visible light</td> <td>infrared</td> <td>microwaves</td> <td>radio waves</td> </tr> </table> <p>three correct ; in correct order ;</p>	gamma radiation	X-rays	ultraviolet	visible light	infrared	microwaves	radio waves	2
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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
10(a)	<b>B</b> – seeds did not have, water / moisture ; <b>C</b> – seeds did not have oxygen ; <b>D</b> – seeds did not have, a suitable temperature / warmth ;	<b>3</b>
10(b)(i)	phototropism ;	<b>1</b>
10(b)(ii)	maximise exposure to light / increase light intensity / ref to requiring light → energy ; for photosynthesis ;	<b>2</b>
10(c)	cuticle ; palisade (mesophyll) ;	<b>2</b>

Question	Answer	Marks
11(a)(i)	<b>(sulfuric acid) + magnesium → hydrogen + magnesium sulfate</b>  magnesium and hydrogen ; magnesium sulfate ;	<b>2</b>
11(a)(ii)	gets hot / temperature increases ;  fizzing / bubbles / effervescence ;	<b>2</b>
11(a)(iii)	  2 hydrogen atoms ; 1 shared pair of electrons only ;	<b>2</b>
11(b)(i)	3 ;	<b>1</b>
11(b)(ii)	7 ;	<b>1</b>
11(c)(i)	<i>any two from:</i> good conductor of electricity ; good conductor of heat ; high melting / boiling point ; malleable ;	<b>2</b>
11(c)(ii)	<ul style="list-style-type: none"> <li>• 96 (%) seen ;</li> <li>• 48 (kg) ;</li> </ul>	<b>2</b>



Question	Answer	Marks
12(a)(i)	35.3 (s) ;	1
12(a)(ii)	molecules move <u>faster</u> ;	1
12(a)(iii)	gases <b>and</b> liquids both correct – 1 mark ;	1
12(b)(i)	arrow drawn going away from cyclist / towards driver ;	1
12(b)(ii)	angle of incidence correctly labelled ;	1
12(c)(i)	radiation ;	1
12(c)(ii)	conduction ;	1
12(c)(iii)	use a magnet ; steel will be attracted (to magnet) ; ORA	2