



# Cambridge IGCSE™

---

**CO-ORDINATED SCIENCES**

**0654/33**

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.

---

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.

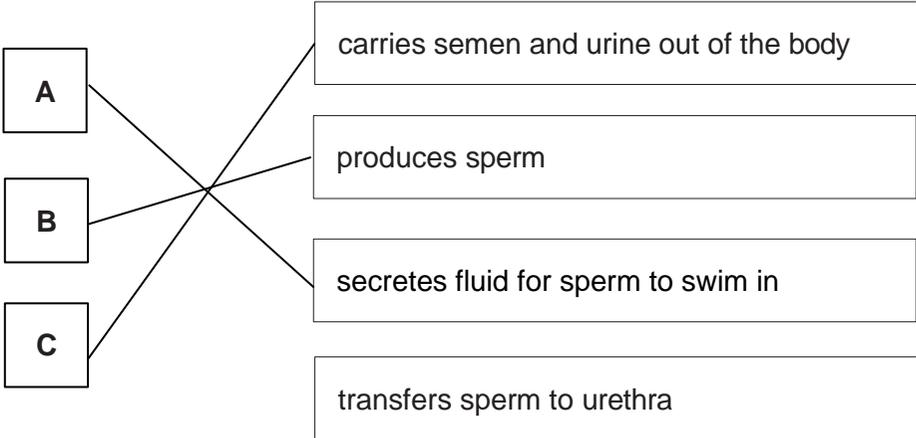
For answers given in standard form (e.g.  $a \times 10^n$ ) in which the convention of restricting the value of the coefficient ( $a$ ) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

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.

Question	Answer	Marks
1(a)	organism ;	1
1(b)	 <p>1 mark for each line ;;;</p>	3
1(c)	nucleus correctly labelled labelling correct structure ; correct name ;	2
1(d)	<i>any two from:</i> chloroplast ; cell wall ; (permanent) vacuole ;	2

Question	Answer	Marks
2(a)(i)	<p style="text-align: center;"> <span style="margin-right: 100px;"><b>method of separation</b></span> <span style="margin-right: 100px;"><b>substance</b></span> <span><b>mixture</b></span> </p> <p> <span style="border: 1px solid black; padding: 2px; display: inline-block; width: 100px; height: 30px; margin-bottom: 5px;">chromatography</span> <span style="border: 1px solid black; padding: 2px; display: inline-block; width: 100px; height: 30px; margin-left: 100px; margin-bottom: 5px;">bitumen</span> <span style="border: 1px solid black; padding: 2px; display: inline-block; width: 130px; height: 30px; margin-left: 100px; margin-bottom: 5px;">aqueous copper sulfate</span> </p> <p> <span style="border: 1px solid black; padding: 2px; display: inline-block; width: 100px; height: 30px; margin-bottom: 5px;">crystallisation</span> <span style="border: 1px solid black; padding: 2px; display: inline-block; width: 100px; height: 30px; margin-left: 100px; margin-bottom: 5px;">blue dye</span> <span style="border: 1px solid black; padding: 2px; display: inline-block; width: 130px; height: 30px; margin-left: 100px; margin-bottom: 5px;">aqueous potassium chloride</span> </p> <p> <span style="border: 1px solid black; padding: 2px; display: inline-block; width: 100px; height: 30px; margin-bottom: 5px;">distillation</span> <span style="border: 1px solid black; padding: 2px; display: inline-block; width: 100px; height: 30px; margin-left: 100px; margin-bottom: 5px;">copper sulfate</span> <span style="border: 1px solid black; padding: 2px; display: inline-block; width: 130px; height: 30px; margin-left: 100px; margin-bottom: 5px;">black ink</span> </p> <p> <span style="border: 1px solid black; padding: 2px; display: inline-block; width: 100px; height: 30px; margin-bottom: 5px;">fractional distillation</span> <span style="border: 1px solid black; padding: 2px; display: inline-block; width: 100px; height: 30px; margin-left: 100px; margin-bottom: 5px;">water</span> <span style="border: 1px solid black; padding: 2px; display: inline-block; width: 130px; height: 30px; margin-left: 100px; margin-bottom: 5px;">petroleum</span> </p> <p>           one pair of links correct ;            two pairs of links correct ;            three pairs of links correct ;         </p>	<b>3</b>
2(a)(ii)	water ;	<b>1</b>
2(a)(iii)	road surfaces ;	<b>1</b>
2(b)	filtration – removes solid particles ; chlorination – kills microbes / sterilises water ;	<b>2</b>
2(c)	electrolyte ; ions ; negative <b>and</b> positive (in that order) ; bromine <b>and</b> lead (in that order) ;	<b>4</b>

Question	Answer	Marks
3(a)(i)	ultraviolet ;	1
3(a)(ii)	ultraviolet (UV) written in box to the right of X-rays ;	1
3(b)	surface area of feet (in contact with sand) ; weight of man ;	2
3(c)	$g = \text{weight} \div \text{mass}$ ( <i>in any form</i> ) / $4.9 \div 0.50$ ; 9.8 ; N / kg ;	3
3(d)(i)	4(.0) (m) ;	1
3(d)(ii)	1(.0) (m) ;	1
3(e)(i)	three rays coming to a focus at <b>X</b> ;	1
3(e)(ii)	density = mass $\div$ volume ( <i>in any form</i> ) / $5.0 \div 2.0$ ; = 2.5 (g / cm <sup>3</sup> ) ;	2

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
4(a)(i)	27 000 and 11 000 ; $((27\,000 - 11\,000) / 27\,000 \times 100) (= 59.259)$ ; = 59 (%) ;	<b>3</b>
4(a)(ii)	increase in carbon dioxide concentration in the atmosphere ; <i>idea of less photosynthesis ;</i>	<b>2</b>
4(a)(iii)	<i>any three from:</i> habitat destruction ; extinction ; soil erosion ; flooding ; AVP ;	<b>3</b>
4(b)	<i>any two from:</i> feeding ; respiration ; AVP ;	<b>2</b>

Question	Answer	Marks																
5(a)	<table border="1" data-bbox="371 248 1151 501"> <thead> <tr> <th>element</th> <th>formula of molecules</th> <th>colour</th> <th>metal or non-metal?</th> </tr> </thead> <tbody> <tr> <td>bromine</td> <td><b>Br<sub>2</sub></b></td> <td>orange</td> <td>non-metal</td> </tr> <tr> <td>chlorine</td> <td><b>Cl<sub>2</sub></b></td> <td><b>(pale) green</b></td> <td><b>non-metal</b></td> </tr> <tr> <td>iodine</td> <td>I<sub>2</sub></td> <td>grey-black</td> <td><b>non-metal</b></td> </tr> </tbody> </table> <p>one mark for each column ;;;</p>	element	formula of molecules	colour	metal or non-metal?	bromine	<b>Br<sub>2</sub></b>	orange	non-metal	chlorine	<b>Cl<sub>2</sub></b>	<b>(pale) green</b>	<b>non-metal</b>	iodine	I <sub>2</sub>	grey-black	<b>non-metal</b>	<b>3</b>
element	formula of molecules	colour	metal or non-metal?															
bromine	<b>Br<sub>2</sub></b>	orange	non-metal															
chlorine	<b>Cl<sub>2</sub></b>	<b>(pale) green</b>	<b>non-metal</b>															
iodine	I <sub>2</sub>	grey-black	<b>non-metal</b>															
5(b)	halogens ;	<b>1</b>																
5(c)	<p>✓ no tick / x ✓ ✓</p> <p>3 ticks and 3 correct = 2 marks 4 ticks and 3 correct = 1 mark 3 ticks and 2 correct = 1 mark 2 ticks and 2 correct = 1 mark ;;</p>	<b>2</b>																
5(d)	potassium chloride – white precipitate ; potassium bromide – cream/off white precipitate ;	<b>2</b>																
5(e)	diffusion ; molecules move randomly from place to place / spread out / from high to low concentration ;	<b>2</b>																

Question	Answer	Marks
6(a)(i)	current = voltage $\div$ resistance ( <i>in any form</i> ) / $240 \div 40$ ; = 6 (A) ;	<b>2</b>
6(a)(ii)	parallel ;	<b>1</b>
6(a)(iii)	20 ( $\Omega$ ) ; combined resistance is less than either individual resistor ;	<b>2</b>
6(b)(i)	conduction ;	<b>1</b>
6(b)(ii)	arrows continue upwards and then go to left and / or right <b>and</b> then down ;	<b>1</b>
6(b)(iii)	surface ; energy ;	<b>2</b>
6(b)(iv)	100 ( $^{\circ}\text{C}$ ) ;	<b>1</b>
6(b)(v)	no change in temperature ;	<b>1</b>

Question	Answer	Marks										
7(a)	<b>A and D ;</b> <b>C ;</b> <b>B and C ;</b>	<b>3</b>										
7(b)	temperature / AVP ;	<b>1</b>										
7(c)	carbon, hydrogen, oxygen, nitrogen circled ;	<b>1</b>										
7(d)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">large nutrient molecule</td> <td style="width: 50%;">smaller molecules that nutrients are made from</td> </tr> <tr> <td>fats and oils</td> <td>fatty acids and <b>glycerol</b> ;</td> </tr> <tr> <td>proteins</td> <td><b>amino acids</b> ;</td> </tr> <tr> <td>1. starch 2. <b>glycogen</b> ;</td> <td><b>glucose</b> ;</td> </tr> </table>	large nutrient molecule	smaller molecules that nutrients are made from	fats and oils	fatty acids and <b>glycerol</b> ;	proteins	<b>amino acids</b> ;	1. starch 2. <b>glycogen</b> ;	<b>glucose</b> ;	<b>4</b>		
large nutrient molecule	smaller molecules that nutrients are made from											
fats and oils	fatty acids and <b>glycerol</b> ;											
proteins	<b>amino acids</b> ;											
1. starch 2. <b>glycogen</b> ;	<b>glucose</b> ;											
7(e)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 80%;">involves the breakdown of insoluble molecules to soluble molecules</td> <td style="width: 20%;"></td> </tr> <tr> <td>involves movement of digested food molecules into the blood</td> <td style="text-align: center;">✓</td> </tr> <tr> <td>involves movement of insoluble food molecules into cells</td> <td></td> </tr> <tr> <td>occurs across the wall of the liver</td> <td></td> </tr> <tr> <td>occurs across the wall of the intestine</td> <td style="text-align: center;">✓</td> </tr> </table> <p>∴                      3 ticks and 2 correct = 1 mark                      3 ticks and 1 correct = 0 marks                      4 or more ticks = 0 marks</p>	involves the breakdown of insoluble molecules to soluble molecules		involves movement of digested food molecules into the blood	✓	involves movement of insoluble food molecules into cells		occurs across the wall of the liver		occurs across the wall of the intestine	✓	<b>2</b>
involves the breakdown of insoluble molecules to soluble molecules												
involves movement of digested food molecules into the blood	✓											
involves movement of insoluble food molecules into cells												
occurs across the wall of the liver												
occurs across the wall of the intestine	✓											

Question	Answer	Marks
8(a)(i)	magnesium + hydrochloric acid → magnesium chloride + hydrogen ;	<b>2</b>
8(a)(ii)	<i>any two from:</i> increase temperature (of acid) ; increase concentration (of acid) ; decrease particle size / increase surface area of magnesium ;	<b>2</b>
8(a)(iii)	releases thermal energy ;	<b>1</b>
8(a)(iv)	calcium magnesium iron copper ;	<b>1</b>
8(b)(i)	89 (%) ;	<b>1</b>
8(b)(ii)	1.8 (kg) ;	<b>1</b>
8(b)(iii)	stronger ;	<b>1</b>

Question	Answer	Marks										
9(a)	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%; text-align: left;">energy source</th> <th style="width: 50%; text-align: left;">description</th> </tr> </thead> <tbody> <tr> <td style="border: 1px solid black; padding: 2px;">geothermal</td> <td style="border: 1px solid black; padding: 2px;">produces dangerous waste</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">hydroelectric (HEP)</td> <td style="border: 1px solid black; padding: 2px;">unreliable</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">nuclear</td> <td style="border: 1px solid black; padding: 2px;">uses energy from falling water</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">wind</td> <td style="border: 1px solid black; padding: 2px;">uses energy from inside the Earth</td> </tr> </tbody> </table> <p style="margin-top: 10px;">1 correct ; 2 or 3 correct ; 4 correct ;</p>	energy source	description	geothermal	produces dangerous waste	hydroelectric (HEP)	unreliable	nuclear	uses energy from falling water	wind	uses energy from inside the Earth	<b>3</b>
energy source	description											
geothermal	produces dangerous waste											
hydroelectric (HEP)	unreliable											
nuclear	uses energy from falling water											
wind	uses energy from inside the Earth											
9(b)	(nuclear) fission ;	<b>1</b>										
9(c)	145 ;	<b>1</b>										
9(d)(i)	plutonium-239 → uranium-235 + alpha particle ;	<b>1</b>										
9(d)(ii)	helium nucleus / 2 protons and 2 neutrons	<b>1</b>										
9(e)	most ionising – alpha beta gamma – least ionising ;	<b>1</b>										

Question	Answer	Marks
10(a)(i)	<b>X</b> – (upper) epidermis ; <b>Y</b> – spongy mesophyll ;	<b>2</b>
10(a)(ii)	arrow drawn from leaf going out of stoma ;	<b>1</b>
10(b)	axis labels ; negative correlation ;	<b>2</b>
10(c)	root hair (cell) ;	<b>1</b>
10(d)	xylem ;	<b>1</b>
10(e)	some used in, photosynthesis / support ;	<b>1</b>
10(f)(i)	phagocytosis / production of antibodies ;	<b>1</b>
10(f)(ii)	<i>any two from:</i> red blood cells ; plasma ; platelets ;	<b>2</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
11(a)	non-metals form acidic oxides and metals form basic oxides ;	<b>1</b>
11(b)	(solid) closer together / (gas) further apart) ; (solid) vibrating about a fixed point / (gas) free to move / faster ;	<b>2</b>
11(c)	giant ; covalent ;	<b>2</b>
11(d)(i)	<b>2 Na and 2 NaCl ;</b>	<b>1</b>
11(d)(ii)	2, 8, 1 ; 2, 8, 7 ;	<b>2</b>
11(d)(iii)	lithium reacts less rapidly / quickly ; (metal) reactivity increases down group ;	<b>2</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
12(a)(i)	20 (s) ;	<b>1</b>
12(a)(ii)	speed = distance / time or formula or $1000 / 120$ ; = 8.3 <b>or</b> 8.33 (m / s) ;	<b>2</b>
12(a)(iii)	constant gradient ;	<b>1</b>
12(b)(i)	chemical (potential) ; kinetic ;	<b>2</b>
12(b)(ii)	molecules move faster ;	<b>1</b>
12(c)	<b>X</b> is longer ; so greater moment ;	<b>2</b>