



# Cambridge IGCSE™

---

**COMBINED SCIENCE**

**0653/42**

Paper 4 Theory (Extended)

**October/November 2021**

**MARK SCHEME**

Maximum Mark: 80

---

**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 2021 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

---

This document consists of **12** 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 '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.

**Mark scheme abbreviations**

- ; separates marking points
- / alternative responses for the same marking point
- ecf error carried forward
- AVP any valid point
- ORA or reverse argument
- AW alternative wording
- underline actual word given must be used by candidate (grammatical variants accepted)
- ( ) the word / phrase in brackets is not required but sets the context

Question	Answer	Marks								
1(a)	 <p>cervix labelled anywhere in shaded area ;</p>	1								
1(b)(i)	respiration ;	1								
1(b)(ii)	amino acids come from mother's blood ;  <i>plus any one from:</i> cross the placenta ; brought to fetus by umbilical cord ; via diffusion ;	2								
1(c)	idea that fetus needs some of the iron ; reference to any named iron deficiency symptom (in mother) / iron is needed for haemoglobin production ;	2								
1(d)	<table border="1" data-bbox="338 890 1285 1157"> <thead> <tr> <th data-bbox="338 890 584 959">organ</th> <th data-bbox="584 890 1285 959">function</th> </tr> </thead> <tbody> <tr> <td data-bbox="338 959 584 1027">mouth ;</td> <td data-bbox="584 959 1285 1027">(uses teeth to breakdown food into smaller pieces)</td> </tr> <tr> <td data-bbox="338 1027 584 1096">(large intestine)</td> <td data-bbox="584 1027 1285 1096">absorbs water ;</td> </tr> <tr> <td data-bbox="338 1096 584 1157">anus ;</td> <td data-bbox="584 1096 1285 1157">(egestion)</td> </tr> </tbody> </table>	organ	function	mouth ;	(uses teeth to breakdown food into smaller pieces)	(large intestine)	absorbs water ;	anus ;	(egestion)	3
organ	function									
mouth ;	(uses teeth to breakdown food into smaller pieces)									
(large intestine)	absorbs water ;									
anus ;	(egestion)									

Question	Answer	Marks									
2(a)(i)	does not react (with the solution) ;	1									
2(a)(ii)	<table border="1" data-bbox="338 316 1756 544"> <thead> <tr> <th data-bbox="338 316 898 411">(solution)</th> <th data-bbox="898 316 1326 411">(name of gas formed at positive electrode)</th> <th data-bbox="1326 316 1756 411">(name of gas formed at negative electrode)</th> </tr> </thead> <tbody> <tr> <td data-bbox="338 411 898 480">(dilute aqueous sodium chloride)</td> <td data-bbox="898 411 1326 480">oxygen</td> <td data-bbox="1326 411 1756 480">hydrogen</td> </tr> <tr> <td data-bbox="338 480 898 544">(concentrated aqueous sodium chloride)</td> <td data-bbox="898 480 1326 544">chlorine</td> <td data-bbox="1326 480 1756 544">hydrogen</td> </tr> </tbody> </table> <p data-bbox="338 584 680 679">oxygen ; chlorine ; hydrogen AND hydrogen ;</p>	(solution)	(name of gas formed at positive electrode)	(name of gas formed at negative electrode)	(dilute aqueous sodium chloride)	oxygen	hydrogen	(concentrated aqueous sodium chloride)	chlorine	hydrogen	3
(solution)	(name of gas formed at positive electrode)	(name of gas formed at negative electrode)									
(dilute aqueous sodium chloride)	oxygen	hydrogen									
(concentrated aqueous sodium chloride)	chlorine	hydrogen									
2(a)(iii)	<i>positive</i> : anode AND <i>negative</i> : cathode ;	1									
2(b)	sodium ions are positive ; attracted to the, negative electrode / cathode ; where they gain, electrons / one electron each (to form sodium) ;	3									
2(c)	only sodium cations are present in molten sodium chloride / molten sodium chloride does not contain any hydrogen (ions) / hydrogen (ions) also present in aqueous sodium chloride ; sodium is more reactive than hydrogen / hydrogen ions (in aqueous solution) more easily discharged / AW ;	2									

Question	Answer	Marks
3(a)(i)	3 ;	1
3(a)(ii)	double-headed arrow between equilibrium position (mid-point) and any peak or trough ;	1
3(b)(i)	frequency = number of waves per second / 6 ÷ 40 ; 0.15 ; Hz ;	3
3(b)(ii)	$v = f\lambda$ in any form / $0.15 \times 18$ ; 2.7 (m / s) ;	2
3(c)	0.055 s AND sound travels faster through, water / liquids (than in, air / gases) ORA ;	1

Question	Answer	Marks
4(a)(i)	diaphragm ;	1
4(a)(ii)	larynx labelled ;	1
4(b)	<i>difference</i> : more carbon dioxide in expired air ; <i>explanation</i> : because produced in respiration ;	2
4(c)	<i>any three from</i> : cilia are, damaged / shorter ; (goblet cells make) more mucus ; pathogens / particles, trapped in the mucus ; idea that it is harder (for cilia) to move the mucus ; idea that, pathogens / particles, are not removed (easily) from the airways ;	3

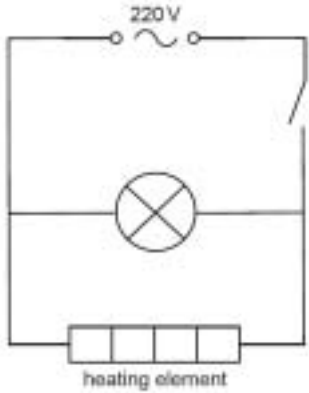
Question	Answer	Marks
5(a)	use universal indicator ; observe the colour ;	<b>2</b>
5(b)(i)	iron(III) chloride AND has the lowest pH ;	<b>1</b>
5(b)(ii)	copper(II) sulfate AND iron(III) chloride ;	<b>1</b>
5(c)	experiment 4 ; more particles, have / collide with, the (minimum) activation energy ;  <i>plus any two from:</i> higher temperature means higher, kinetic energy / speed ; small pieces have larger surface area ; reference to more frequent collisions ;	<b>4</b>



Question	Answer	Marks
6(a)(i)	force due to Earth's gravitational field accelerates meteorite / energy is transferred from GPE store to KE store ;	1
6(a)(ii)	$KE = \frac{1}{2}mv^2$ in any form / $\frac{1}{2} \times 45\,000 \times (1.7 \times 10^4)^2$ ; $6.5 \times 10^{12}$ (J) ;	2
6(b)(i)	(resultant opposing force of) air resistance / friction ;	1
6(b)(ii)	(opposing) force increases / atmosphere becomes denser ;	1
6(c)(i)	(volume = $3480 - 2500 =$ ) $980$ (cm <sup>3</sup> ) ;	1
6(c)(ii)	unit conversion / $980 \times 10^{-6}$ (m <sup>3</sup> ) ; density = $m \div V$ in any form / $4.52 \div 980 \times 10^{-6}$ ; $4610$ (kg / m <sup>3</sup> ) ; so must be stony-iron meteorite / identification of type of meteorite matched with density calculation ;	4

Question	Answer	Marks
7(a)(i)	0.2 ÷ 180 ; 0.001 (cm / s) ;	<b>2</b>
7(a)(ii)	as light intensity increases, the rate of photosynthesis increases ; idea that rate levels off (below 20 cm) ;	<b>2</b>
7(b)	<i>any three from:</i> 0 to 30 °C rate increases as enzymes gain more kinetic energy ; 0 to 30 °C rate increases as there are more (effective) collisions ; above 30 °C enzymes denature / shape of active site changes ; above 30 °C substrate no longer fits into active site ;	<b>3</b>
7(c)	phloem ; starch ;	<b>2</b>
7(d)(i)	phototropism ;	<b>1</b>
7(d)(ii)	auxin ;	<b>1</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
8(a)(i)	respiration / AVP ;	<b>1</b>
8(a)(ii)	combustion of fossil fuels / AVP ;	<b>1</b>
8(b)	causes <u>enhanced</u> greenhouse effect / global warming ; leads to, climate change / named harmful effect of climate change e.g. sea level rise ;	<b>2</b>
8(c)(i)	<i>solvent</i> : water ; <i>solute</i> : salts / gases ; <i>solution</i> : carbonic acid / sea (water) ;	<b>3</b>
8(c)(ii)	seas are becoming more acidic / acidification / named harmful effect ;	<b>1</b>

Question	Answer	Marks
9(a)	100 °C ;	1
9(b)	reference to (thermal) expansion (of metal) ; brass expands more (than steel causing the switch to bend / open) ;	2
9(c)(i)	conversion of kW to W / 2400 ; $P = IV$ in any form / $2400 \div 220$ ; 11 (A) ;	3
9(c)(ii)	 <p data-bbox="333 1011 1630 1110">correct symbols for lamp AND switch ; lamp in parallel with heating element ; switch controls both lamp and heater AND no short circuits, open circuits or additional components ;</p>	3