



Cambridge IGCSE™

CO-ORDINATED SCIENCES

0654/31

Paper 3 Theory (Core)

October/November 2021

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 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.

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.

Question	Answer	Marks
1(a)(i)	0.12 (mm) ;	1
1(a)(ii)	A ;	1
1(a)(iii)	animal F is the biggest but does not have the longest length of sperm / animal D has the longest sperm but is not the biggest animal / avp ;	1
1(b)	<i>any two from:</i> cell membrane ; cytoplasm ; AVP ; e.g. ribosomes / mitochondria	2
1(c)		3
1(d)	diffusion ;	1
1(e)	respiration releases energy ; (energy is required) for muscle contraction / movement ;	2

Question	Answer	Marks												
2(a)(i)	calcium carbonate → calcium oxide + carbon dioxide ;	1												
2(a)(ii)	neutralizing acidic soil / building material / cement ;	1												
2(a)(iii)	3 ;	1												
2(a)(iv)	new substances produced ;	1												
2(a)(v)	(thermal) energy taken in ;	1												
2(b)(i)	an element contains only one type of atom ; a compound contains two or more elements chemically combined ;	2												
2(b)(ii)	<table border="1"> <thead> <tr> <th></th> <th>particles separation</th> <th>particle arrangement</th> <th>particle motion</th> </tr> </thead> <tbody> <tr> <td>solid</td> <td>close together</td> <td>regular</td> <td>vibrate about a fixed point</td> </tr> <tr> <td>gas</td> <td>far apart</td> <td>random</td> <td>move rapidly in all directions</td> </tr> </tbody> </table> <p>particle separation column ; particle arrangement column ;</p>		particles separation	particle arrangement	particle motion	solid	close together	regular	vibrate about a fixed point	gas	far apart	random	move rapidly in all directions	2
	particles separation	particle arrangement	particle motion											
solid	close together	regular	vibrate about a fixed point											
gas	far apart	random	move rapidly in all directions											
2(c)(i)	A ;	1												
2(c)(ii)	B ;	1												
2(c)(iii)	2 non-metal atoms bonding / electrons are shared ;	1												

Question	Answer	Marks
3(a)(i)	all symbols correct ; lamps in parallel ; both switches in correct place ;	3
3(a)(ii)	if one lamp fails the other will still light / so both lamps get the full battery voltage ;	1
3(b)(i)	conduction ;	1
3(b)(ii)	visible light / infrared ;	1
3(c)(i)	<i>i</i> positioned between incident ray and normal ; <i>r</i> positioned between refracted ray and normal ;	2
3(c)(ii)	change of speed ;	1

Question	Answer	Marks
4(a)	E ; C ; A ;	3
4(b)	ovary ;	1
4(c)	asexual sexual sexual ;;	2
4(d)	asexual offspring produced by only one parent ;	1

Question	Answer	Marks
4(e)	<i>any two from:</i> movement ; sensitivity ; growth ; excretion ; nutrition ;	2

Question	Answer	Marks
5(a)(i)	transition elements / transition metals ;	1
5(a)(ii)	26 ;	1
5(a)(iii)	iron oxide ; loses oxygen ;	2
5(b)(i)	mixture of metals / mixture of metal and other element ;	1
5(b)(ii)	stronger ;	1
5(b)(iii)	7% ;	1
5(c)	(tube X does not rust) – no water present ; (tube Y rusts) – oxygen (air) and water present ; (tube Z does not rust) – no air and water can reach nail ;	3

Question	Answer	Marks
6(a)(i)	reverse battery polarity / current ; reverse magnet polarity ;	2
6(a)(ii)	current ;	1
6(b)(i)	(radioactive decay is the process by which) an unstable (atomic) nucleus ; loses energy / emits radiation ; (isotopes are) – atoms of the same element that have same proton number and different nucleon number ;	3
6(b)(ii)	β particles are less ionising than α particles and α particles are less penetrating than β particles ;	1
6(c)(i)	loses electrons ;	1
6(c)(ii)	row 4 ;	1

Question	Answer	Marks				
7(a)(i)	homozygous ; recessive ;	2				
7(a)(ii)	GG and Gg ;	1				
7(b)(i)	<table border="1" style="display: inline-table; vertical-align: middle;"> <tbody> <tr> <td>GG</td> <td>Gg</td> </tr> <tr> <td>Gg</td> <td>gg</td> </tr> </tbody> </table> ;	GG	Gg	Gg	gg	1
GG	Gg					
Gg	gg					
7(b)(ii)	25(%) ;	1				
7(c)(i)	DNA, genes, chromosomes ;	1				
7(c)(ii)	female ;	1				

Question	Answer	Marks
8(a)(i)	coal / natural gas ;	1
8(a)(ii)	mixture ; distillation ;	2
8(a)(iii)	carbon dioxide ; water ;	2
8(b)(i)	contains a (carbon – carbon) double bond ;	1
8(b)(ii)	aqueous bromine ; decolourises ;	2
8(c)(i)	join together (into long chains) ;	1
8(c)(ii)	polyethene ;	1

Question	Answer	Marks
9(a)	convection ;	1
9(b)	mass = density \times volume or $0.00126 \times 210\,000$; = 265 g ;	2
9(c)(i)	mercury / alcohol ;	1
9(c)(ii)	volume ;	1
9(d)(i)	small amplitude ; low frequency ;	2
9(d)(ii)	hertz ;	1
9(e)(i)	9000 Ω ;	1

Question	Answer	Marks
9(e)(ii)	current = voltage / resistance or 240 / 9000 ; 0.027 (A) ;	2

Question	Answer	Marks								
10(a)	fossilisation ;	1								
10(b)(i)	<i>any two from:</i> habitat destruction ; extinction ; loss of soil ; flooding ; AVP ;	2								
10(b)(ii)	replant / plant more trees ; reduce, combustion of fossil fuels / emissions by industry ;	2								
10(c)	<table border="1" style="display: inline-table; vertical-align: middle;"> <tbody> <tr> <td></td> <td>✓</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>✓</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> ; ; ; ;		✓	✓	✓	✓				4
	✓	✓	✓							
✓										
10(d)(i)	xylem ;	1								
10(d)(ii)	leaves ; cells ; stomata ;	3								

Question	Answer	Marks
11(a)	45 (°C) to 90 (°C) ;	1
11(b)(i)	potassium ion 2.8.8. ; chloride ion 2.8.8 ;	2
11(b)(ii)	$2 (K + Cl_2 \rightarrow) 2 (KCl)$;	1
11(c)(i)	7 ;	1
11(c)(ii)	any value between 7 and 14 ; purple ;	2
11(c)(iii)	lithium reacts less violently / lithium is less reactive ;	1

Question	Answer	Marks
12(a)	7 000 000 N ;	1
12(b)(i)	electrical ; chemical potential ;	2
12(b)(ii)	waves / HEP / tides / geothermal / wind ;	1
12(c)	72 hours = 259 200 s ; speed = distance ÷ time or $386\,000 \div 259\,200$; 1.49 km/s ;	3
12(d)	mass is the actual amount of material contained in a body (measured in kg or g) ; OR weight is the force exerted by the gravity on that object;	1
12(e)(i)	radio waves in right hand box ;	1
12(e)(ii)	sound waves need a medium / cannot travel through a vacuum ;	1
12(e)(iii)	(double headed arrow from) peak to peak OR from trough to trough OR equivalent ;	1