Cambridge Assessment International Education

Cambridge IGCSE™ (9–1)

CO-ORDINATED SCIENCES **0973/41**

Paper 4 Theory (Extended) **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.

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.

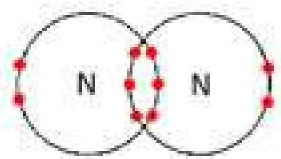
GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely 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	<u>‘List rule’ guidance</u> 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)	**A** trachea ; **B** intercostal muscle ; **C** diaphragm ;	**3**
1(a)(ii)	*any two from:* good blood supply ; thin ; large surface area ; ventilated ; AVP ;	**2**
1(b)	*any two from:* COPD increases with age ; more smokers have COPD than non-smokers ; more rapid increase of COPD with age in smokers ; comparative data quote ;	**3**
1(c)(i)	goblet cells produce mucus ; *and any two from:* mucus traps, pathogens / particles / bacteria ; cilia unable to remove, mucus / pathogens / bacteria ; bacteria, reproduce / multiply (causing infection) ;	**3**
1(c)(ii)	nicotine ;	**1**

Question	Answer	Marks
2(a)	idea of a reaction that goes both ways ;	**1**
2(b)	recycled / owtte ;	**1**
2(c)	**iron catalyst:** increases rate of reaction / owtte ; **high pressure:** increases the yield of ammonia / increases rate of reaction ; **450 °C:** idea of compromise of temperature to give high enough rate of reaction with reasonable yield ;	**3**
2(d)	 triple bond between N atoms ; lone pairs on N atoms ;	**2**
2(e)	M_r of NH_3 = 17 **and** M_r H_2SO_4 = 98 ; 2 moles of NH_3 needs 1 mole of H_2SO_4 ; $\frac{98 \times 68}{34}$ = 196 (g) ;	**3**

Question	Answer	Marks
3(a)	3×10^8 m / s ;	**1**
3(b)(i)	'visible light' placed in central box ;	**1**
3(b)(ii)	gamma ;	**1**
3(c)(i)	line drawn peak to peak / trough to trough / any identical points on adjacent waves ;	**1**
3(c)(ii)	$v = f\lambda$;	**1**
3(d)(i)	*any two from:* ray parallel to the principal axis passing through F on image side ; ray passing through F on object side made parallel to the principal axis ; ray passing through optical centre of lens not refracted ; **and** image of correct size and position ;	**3**
3(d)(ii)	can be formed on a screen / is formed from real rays of light / formed from converging rays ;	**1**
3(d)(iii)	magnifying glass ; AVP ;	**max1**

Question	Answer	Marks
4(a)(i)	D ;	**1**
4(a)(ii)	C ;	**1**
4(b)(i)	chromosome / gene ; reproduce / AW ; allele ;	**3**
4(b)(ii)	traits / characteristics, are selected by humans (in artificial selection) / traits are selected by the environment in natural selection ; traits / characteristics, are usually chosen for economic reasons (in artificial selection) / traits are beneficial for survival in natural selection ; faster results (from artificial selection) / ORA ; (artificial selection only) takes place in selected individuals / natural selection takes place in whole populations ; (artificial selection) does not lead to <u>evolution</u> / ORA ; (artificial selection) results in decreased (genetic) variation / diversity / ORA ; (artificial selection) leads to increased likelihood of inherited / genetic disease ; AVP ;	**max1**
4(c)	**advantages:** no mates required / rapid / AVP ; **disadvantages** no (genetic) diversity / no evolution / extinction more likely ;	**2**

Question	Answer	Marks
5(a)	$MgCO_3 + 2HCl \rightarrow MgCl_2 + CO_2 + H_2O$ correct formulae ; correct balancing ;	**2**
5(b)(i)	30 (seconds) ;	**1**
5(b)(ii)	(student used) same mass of magnesium carbonate;	**1**
5(b)(iii)	limewater ; turns milky / cloudy ;	**2**
5(b)(iv)	moles of CO_2 = 48 ÷ 24 000 or 0.048 ÷ 24 or 0.0020 ; M_r of CO_2 = 44 ; (mass of CO_2 = 0.0020 × 44 =) 0.088 (g) ;	**3**
5(c)	rate of reaction increases / owtte ; particles are more crowded / more particles per unit volume / more particles per cm^3 ; more frequent collisions / more collisions per second ;	**3**

Question	Answer	Marks
6(a)	no resultant force <u>and</u> no resultant turning effect ;	**1**
6(b)(i)	0.02 **or** 20×10^{-3} (kg) ; (W =) mg or 0.02 × 10 ; 0.2 (N) ;	**3**
6(b)(ii)	clockwise moment = force × distance **or** 0.2 × 0.25 **or** 0.05 ; anti-clockwise moment = clockwise moment ; F = 0.05 ÷ 0.19 **or** 0.263 / m = 0.263 ÷ 10 **or** 0.026 (kg) **or** 26 (g) ; g / kg ;	**4**
6(c)	immerse in water ; measure volume of displaced water ;	**2**

Question	Answer	Marks
7(a)(i)	<table><tr><th>name</th><th>letter in Fig. 3.1</th><th>function</th><th></th></tr><tr><td>lacteal</td><td>X</td><td>absorption of fats</td><td>;</td></tr><tr><td>epithelial cell</td><td>Y</td><td>contain microvilli</td><td>;</td></tr><tr><td>capillary</td><td>Z</td><td>transport of nutrients around the body</td><td>;</td></tr></table>	3
7(a)(ii)	increases surface area ; for more absorption ;	2
7(b)(i)	F ; H ; A ;	3
7(b)(ii)	bacteria ;	1
7(c)	increases ;	1

Question	Answer	Marks
8(a)(i)	cathode ;	**1**
8(a)(ii)	chlorine ;	**1**
8(a)(iii)	**test:** universal indicator / (red) litmus / pH meter ; **result:** universal indicator would turn blue or purple / pH greater than 7 / red litmus turns blue / pH meter or pH probe gives pH greater than 7 ;	**2**
8(b)	$2H^+ + 2e^- \rightarrow H_2$ correct formulae ; correct balancing ;	**2**
8(c)	sodium chloride has strong (attractive) forces between (oppositely charged sodium ions and chloride) ions ; hydrogen has weak intermolecular forces / weak (attractive) forces between molecules ; strong (electrostatic) attractive forces take more energy to overcome than weak (intermolecular) forces / ORA ;	**3**

Question	Answer	Marks
9(a)(i)	collisions of molecules with walls / raft ; produces a force ;	**2**
9(a)(ii)	molecules move faster / have more (kinetic) energy ; molecules collide more often / more frequently with walls ; larger force exerted on walls ;	**3**
9(b)(i)	(A =) F ÷ P or 1100 ÷ 500 ; 2.2 (m^2) ;	**2**
9(b)(ii)	(mass =) 110 kg ; (KE =) $\frac{1}{2}mv^2$ / $\frac{1}{2} \times 110 \times 4^2$; 880 (J) ;	**3**
9(b)(iii)	the moon ;	**1**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>10(a)</td><td>plasma ;</td><td>1</td></tr>
<tr><td>10(b)</td><td>pancreas in boxes 2 and 6 ;
insulin in box 3 ;
glycogen in box 4 and 8 ;
liver in box 8 ;</td><td>4</td></tr>
<tr><td>10(c)</td><td>negative feedback ;</td><td>1</td></tr>
<tr><td>10(d)</td><td>adrenaline ;</td><td>1</td></tr>
<tr><td>10(e)</td><td>
<table>
<tr><th></th><th>hormonal control</th><th>nervous control</th><th></th></tr>
<tr><td>transmission method</td><td>in the blood</td><td>by neurones / electrical impulses</td><td>;</td></tr>
<tr><td>relative speed of transmission</td><td>slow</td><td>fast</td><td>;</td></tr>
<tr><td>relative length of effect</td><td>long lasting</td><td>short-lived</td><td>;</td></tr>
</table>
</td><td>3</td></tr>
</table>

Question	Answer	Marks
11(a)	<table><tr><th>particle</th><th>number</th><th></th></tr><tr><td>protons</td><td>**26**</td><td>;</td></tr><tr><td>neutrons</td><td>**30**</td><td>;</td></tr><tr><td>electrons</td><td>26</td><td></td></tr></table>	**2**
11(b)	(stainless steel) is more resistant to corrosion ;	**1**
11(c)	FeS_2 ;	**1**
11(d)	metal (atoms) lose electrons and non-metal (atoms) gain electrons ; metal (atoms) form positive ions and non-metal (atoms) form negative ions ; attraction between oppositely charged ions ;	**3**
11(e)	carbon is more reactive than iron / ORA ; carbon displaces iron / carbon removes oxygen (from iron oxide) ;	**2**

Question	Answer	Marks
12(a)(i)	core ;	**1**
12(a)(ii)	(soft) iron ;	**1**
12(b)(i)	(Vs =) Vp × Ns ÷ Np **or** 10 × 30÷ 5 ; 60 (V) ;	**2**
12(b)(ii)	increase secondary turns ; decrease primary turns ; increase primary voltage ;	**max 2**
12(c)	(A) D C B (E) ;;	**2**
12(d)	95% of the input power / energy is transferred to useful output / 5% of the input power / energy is wasted ;	**1**