Cambridge Assessment International Education

Cambridge IGCSE™

CO-ORDINATED SCIENCES **0654/42**

Paper 4 Extended Theory **February/March 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 February/March 2023 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

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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.

Acronyms and shorthand in the mark scheme

acronym/shorthand	**explanation**
AW	Alternative wording
Brackets ( )	Words not explicitly needed in an answer, however if a contradictory word/phrase/unit to that in the brackets is seen the mark is not awarded.
Underlining	The underlined word (or a synonym) must be present for the mark to be scored. If the word is a technical scientific term, the word must be there.
/ or **OR**	Alternative answers any one of which gains the credit for that mark.
owtte	Or words to that effect.
ecf [question part]	Indicates that a candidate using an erroneous value from the stated question part must be given credit here if the erroneous value is used correctly here.
cao	correct answer only

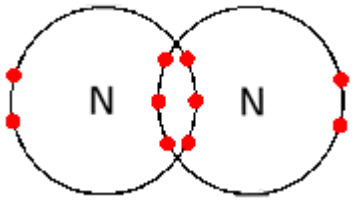
Question	Answer	Marks
1(a)(i)	label line drawn to anther ; labelled as anther ;	2
1(a)(ii)	X placed on ovary ;	1
1(a)(iii)	*any two from:* feathery ; hangs outside of flower ; large ;	2
1(a)(iv)	*any two from:* larger ; stickier ; rougher surface ; heavier ;	2
1(b)	*any three from:* no / less, (genetic) variation ; plants will only be adapted to one environment / less likely to adapt to any change in environment ; a disease might cause extinction ; any disadvantageous traits will be inherited by offspring ; **AVP** ;	3

Question	Answer	Marks
2(a)	evidence of (GPE =) mgh (in any form) or 225 × 10 × 5.2 ; (GPE =) 11 700 (J) ;	2
2(b)(i)	evidence of (I =) Q / t (in any form) or 6000 / 0.20 ; (I =) 30 000 (A) ;	2
2(b)(ii)	light travels faster than sound ; both waves travel the same distance / over a large distance the difference in time is noticeable ;	2
2(c)(i)	electrons ;	1

Question	Answer	Marks
2(c)(ii)	a region in which charged particles experience a force ;	1
2(d)	the same as ; less than AND less than ;	2
2(e)	(volume) increases / expands ; molecules, have more (kinetic) energy / move faster or molecules move further apart ;	2

Question	Answer	Marks
3(a)	100 (cm^3) ;	1
3(b)(i)	rate of reaction decreases ; as the reaction proceeds there are less particles in the same volume / less crowded particles ; therefore less collisions per second ;	3
3(b)(ii)	particles move faster / particles have more (kinetic) energy ; more (successful) collisions per second / owtte ;	2
3(c)(i)	acid is very dilute / marble is in large pieces or has a small surface area ;	1
3(c)(ii)	combustion of fossil fuels (which contain sulfur compounds) / AVP ;	1
3(d)	$CaCO_3 + 2\,HCl \rightarrow CaCl_2 + H_2O + CO_2$;;	2

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(a)</td><td>31 ;
blood ;
muscles ;
aerobic respiration ;</td><td>4</td></tr>
<tr><td>4(b)(i)</td><td>any two from:
shorter cilia less effective at moving mucus ;
increased risk of, (bacterial) infection / breathing difficulties / coughing ;
less efficient gas exchange ;</td><td>2</td></tr>
<tr><td>4(b)(ii)</td><td>any two from:
trachea ;
bronchi / bronchus ;
bronchioles ;</td><td>2</td></tr>
<tr><td>4(c)(i)</td><td><table><tr><td>There is a strong correlation between the number of cigarettes smoked and the number of deaths caused by lung cancer.</td><td>✓</td></tr><tr><td>The decrease in the number of cigarettes smoked and the decrease in deaths caused by lung cancer occur in the same year</td><td></td></tr><tr><td>There is a time delay between the increase in the number of cigarettes smoked and the increase in the number of deaths caused by lung cancer.</td><td>✓</td></tr><tr><td>The maximum number of cigarettes smoked and the maximum number of deaths caused by lung cancer is approximately the same.</td><td></td></tr><tr><td>The only factor influencing deaths caused by lung cancer is the number of cigarettes smoked.</td><td></td></tr></table>;;</td><td>2</td></tr>
<tr><td>4(c)(ii)</td><td>tar ;</td><td>1</td></tr>
<tr><td>4(c)(iii)</td><td>COPD / coronary heart disease / CHD / AVP ;</td><td>1</td></tr>
</table>

Question	Answer	Marks
5(a)	an atom that gains electrons to get a full outer shell and become stable. ☐ an atom that shares electrons to get a full outer shell and become stable ☐ an atom that loses electrons to get a full outer shell and become stable. ✓	1
5(b)	negative ; chlorine ; strong ; opposite ; lattice ;	5
5(c)(i)	covalent ;	1
5(c)(ii)		2
5(c)(iii)	(water and nitrogen) have weak intermolecular forces / weak attractions between molecules ; idea that (weak intermolecular forces) take little energy to break ;	2

Question	Answer	Marks
6(a)(i)	evidence of (speed =) distance/time (in any form) or 1.5 / 0.68 ; (speed =) 2.2 (m / s) ;	2
6(a)(ii)	evidence of (a =) Δv / t (in any form) or 5.2 / 0.61 ; (a =) 8.5 (m / s^2) ;	2
6(a)(iii)	reference to air resistance ; (air resistance) acts in opposite direction to weight / upwards ;	2
6(b)(i)	place shape in water ; measure the volume of water displaced ;	2
6(b)(ii)	evidence of (density =) m / V (in any form) or 135 / 75; (density =) 1.8 (g / cm^3)	2

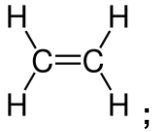
Question	Answer	Marks
7(a)(i)	receptor – retina ; effector – circular or radial muscles in the iris ;	2
7(a)(ii)	adrenaline ;	1
7(a)(iii)	it is automatic / requires no conscious thought ; it is rapid ;	2
7(b)	eating ticked **and** talking ticked only ;	1
7(c)	longer lasting ; slower ;	2
7(d)	insulin / glucagon ;	1

Question	Answer	Marks
8(a)	increased crop yield / increased growth rate / idea of better-quality crops / idea of replacing or adding nutrients or minerals / for synthesis of amino acids **or** proteins **;**	**1**
8(b)	$(NH_4)_2SO_4$ **;**	**1**
8(c)	relative formula mass of KOH =56 **and** of K_2SO_4 = 174 **;** moles of KOH = $\frac{28}{56}$ = 0.5 **;** (2:1 ratio so) mass of potassium sulfate = 0.25 × 174 = 43.5 g **;**	**3**
8(d)(i)	increases / owtte **;**	**1**
8(d)(ii)	*position of equilibrium* low temperature or 200 °C moves (position of) equilibrium to RHS / ORA ; *rate of reaction* reaction slow at low temperatures / ORA **;**	**2**

Question	Answer	Marks
9(a)	resistance of thermistor decreases**;** current / potential difference, of the heater increases **;** power output increases **;**	**3**
9(b)	evidence of unit conversion or 336 000 (J) evidence of (t =) E / P (in any form) or 336 000 / 3000 **;** (t =) 112 (s) **;**	**3**
9(c)	white (cup) **and** white emits less, (IR) radiation / thermal energy, than black **;** white / A, cools down more slowly (in 15 minutes) **;**	**2**
9(d)	a real image can be formed on a screen / is formed from real rays of light / is formed from converging rays / AVP **;**	**1**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>10(a)(i)</td><td>8 ;</td><td>1</td></tr>
<tr><td>10(a)(ii)</td><td>(no activity at pH2)
enzymes are denatured ;
(low / acidic, pH) causes <u>shape</u> of <u>active site</u> to change ;
substrate is no longer complementary to the, active site or enzyme ;</td><td>3</td></tr>
<tr><td>10(b)</td><td>amylase ;</td><td>1</td></tr>
<tr><td>10(c)</td><td>pH 1–3 ;</td><td>1</td></tr>
<tr><td>10(d)</td><td>
<table>
<tr><th>large food molecule</th><th>smaller molecules they are made from</th><th>chemical test for presence of large food molecule</th></tr>
<tr><td><s>fats and</s> oils</td><td>fatty acids and glycerol</td><td>ethanol emulsion</td></tr>
<tr><td>protein</td><td>amino acids</td><td>biuret (solution)</td></tr>
<tr><td>starch</td><td>glucose</td><td>iodine solution</td></tr>
</table>
;;;
</td><td>3</td></tr>
</table>

Question	Answer	Marks
11(a)	C ;	**1**
11(b)	bromine ;	**1**
11(c)	ethanol ;	**1**
11(d)(i)	long chain ; monomers ;	**2**

Question	Answer	Marks
11(d)(ii)	 ;	**1**
11(e)(i)	idea that products have less energy than the reactants ;	**1**
11(e)(ii)	exothermic ;	**1**
11(e)(iii)	bond breaking is endothermic / owtte ; bond making is exothermic / owtte ; more energy is given out (in bond making) than is taken in (in bond breaking) ;	**3**

Question	Answer	Marks
12(a)(i)	the wire experiences a changing magnetic field ; an emf is induced in the wire ;	**2**
12(a)(ii)	;;	**2**

	ammeter reading			
the wire in **(a)(i)** is:	becomes zero	increases	decreases	becomes negative
moved faster		✓		
moved right to left				✓
kept stationary	✓			
replaced with a wire with a lower resistance		✓		

Question	Answer	Marks
12(b)(i)	(P:) beta AND (Q:) gamma ;	1
12(b)(ii)	$^{241}_{95}Am \rightarrow {}^{237}_{93}Np + {}^{4}_{2}\alpha$;;	2
12(b)(iii)	least penetrating / short range ; easily stopped by smoke ; AVP ;	2