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Cambridge IGCSE™

CO-ORDINATED SCIENCES **0654/43**

Paper 4 Theory (Extended) **October/November 2022**

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 2022 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

This document consists of **14** printed pages.

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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.

Question	Answer	Marks
1(a)	*any two from:* large surface area ; thin (surface) ; good blood supply ; *any valid point* ;	**2**
1(b)(i)	5 (%) ;	**1**
1(b)(ii)	oxygen is required for (aerobic) respiration ; to release energy (for metabolic processes) ;	**2**
1(b)(iii)	greater percentage of water (vapour) in expired air ;	**1**
1(c)	*any two from:* large surface area / biconcave shape ; contain haemoglobin ; no nucleus ;	**2**
1(d)(i)	COPD ticked ; CHD ticked ;	**2**
1(d)(ii)	tar ;	**1**
1(d)(iii)	goblet cells produce mucus ; mucus traps particles/pathogens ; cilia move mucus/particles/pathogens (away from gas exchange surface) ;	**3**

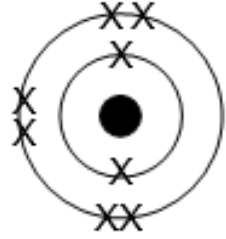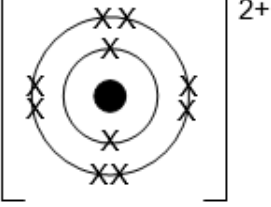| Question	Answer	Marks
2(a)(i)	(B) because the temperature change is greatest / 18 is greater than 9 / end temperature is highest (and starting temperature is the same) ;	**1**
2(a)(ii)	more energy is given out during bond making than is taken in during bond breaking ticked ;	**1**

Question	Answer	Marks
2(b)(i)	100 (kJ) ;	**1**
2(b)(ii)	50 (kJ) ;	**1**
2(c)(i)	$C_2H_4 + H_2O \rightarrow C_2H_5OH$;;	**2**
2(c)(ii)	reference to yeast *;* (uses) glucose / (named) sugar (solution) ; absence of air or oxygen / anaerobic conditions / anaerobic respiration ;	**3**

Question	Answer	Marks
3(a)(i)	(KE =) ½ mv^2 or ½ × 120 × 4^2 ; 960 (J) ;	**2**
3(a)(ii)	(Δv =) 3.5 (m / s) ; (a =) Δv / t or 3.5 / 5.0 ; 0.7 (m / s^2) ;	**3**
3(a)(iii)		**1**

Question	Answer	Marks
3(b)	(W =) mg or 120 × 10 or 1200 (N) ; (A =) W / P or 1200 / 500 ; 2.4 (m^2) ;	**3**
3(c)(i)	correct arrow showing one complete wavelength ;	**1**
3(c)(ii)	energy AND matter ; transverse AND perpendicular ;	**2**

Question	Answer	Marks
4(a)(i)	as light intensity increases the rate of photosynthesis increases / *or reverse argument* ; then rate levels off at 20 cm / 37 bubbles per minute ;	**2**
4(a)(ii)	(carbon dioxide is required) for photosynthesis ;	**1**
4(b)	chlorophyll ; chemical ; yellow ;	**3**
4(c)	protein ;	**1**

Question	Answer	Marks
5(a)(i)	B ;	**1**
5(a)(ii)	lilac / purple, (flame) ;	**1**
5(b)(i)	green ;	**1**
5(b)(ii)	$Fe^{2+}(aq) + 2OH^-(aq) \rightarrow Fe(OH)_2(s)$;;	**2**

Question	Answer	Marks
5(c)(i)	;	1
5(c)(ii)	;;	2
5(c)(iii)	strong attraction between (positive and negative) <u>ions</u> / strong electrostatic attraction / strong ionic bond ; so large amount of energy needed to overcome the attraction / owtte ;	2
5(d)	K_2O ;	1

Question	Answer	Marks
6(a)(i)	(V =) $0.16 \times 0.20 \times 0.90$ or 0.0288 (m^3) ; (ρ =) m / V or 72 / 0.0288 ; 2500 (kg / m^3) ;	3
6(a)(ii)	decreases ;	1
6(a)(iii)	particles move further apart ;	1
6(b)(i)	(conduction is) caused by particle vibrations ; vibrations passed from one particle to the next ;	2

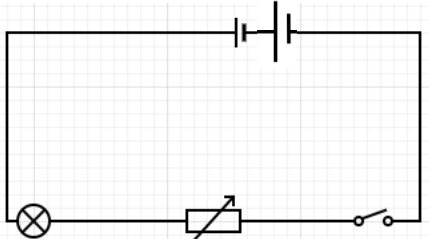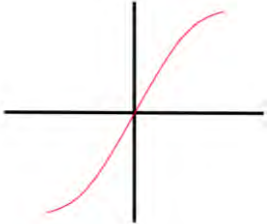| Question	Answer	Marks
6(b)(ii)	thermal energy is moved away from the hand / surface ;	1

Question	Answer	Marks
7(a)(i)	3 ;	1
7(a)(ii)	glucose has been used up / AW ; glucose is a requirement for (anaerobic) respiration (which produces carbon dioxide) ; *any valid point* ;;	2
7(b)	ref to, denatured / denaturation ; active site / enzyme, changes shape ; <u>active site</u> no longer complementary to substrate / substrate no longer fits into <u>active site</u> ;	3
7(c)	<table><tr><td>type of respiration</td><td>carbon dioxide</td><td>water</td><td>lactic acid</td></tr><tr><td>aerobic in humans</td><td>✓</td><td>✓</td><td></td></tr><tr><td>anaerobic in humans</td><td></td><td></td><td>✓</td></tr><tr><td>anaerobic in yeast</td><td>(✓)</td><td></td><td></td></tr></table> *1 mark for each column* ;;;	3
7(d)	total circled ; up circled ;	2

Question	Answer	Marks
8(a)	filtration – traps finer particles using sand ; chlorination – kills microbes ;	2
8(b)	(no because) bromide ions give a cream precipitate with silver nitrate solution / chloride ions give a white precipitate with silver nitrate solution ; *idea that* sample does contain sulfate ions as there is a white precipitate with barium chloride solution ;	2
8(c)	$BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$;;	2
8(d)	any pH above 3 and less than 7 ;	1
8(e)(i)	C ;	1
8(e)(ii)	covalent ;	1
8(f)	greenhouse ; climate change ;	2

Question	Answer	Marks
9(a)(i)	as distance increases, count rate decreases ; largest decrease at shortest distances / owtte ;	**2**
9(a)(ii)	beta particles, are ionising/can cause cancer/damages cells/damages DNA or genetic material ; beta particles travel less than 2 m in air / count rate at 2 m is (almost) zero / very few (beta particles) after 50 cm ;	**2**
9(a)(iii)	correct shape starting at 200 counts per min ; (curve) drawn lower than beta ;	**2**
9(b)(i)	(power output =) 65 × 0.8 ; 52 (W) ;	**2**
9(b)(ii)	(step-down) transformer ;	**1**

Question	Answer	Marks
10(a)	Person P and Person Q matched to statements: has a heterozygous genotype; has albinism; has a homozygous recessive genotype; has the genotype AA; is male; is female without albinism ;;;;	4
10(b)(i)	egg cell / ovum ;	1
10(b)(ii)	23 ;	1
10(b)(iii)	2 ;	1
10(b)(iv)	1 ;	1

PMT

Question	Answer	Marks
11(a)(i)	graphite ;	1
11(a)(ii)	(diamond is) hard ;	1
11(b)	covalent bonding (between the atoms) ; *any one from:* (silicon dioxide has a) macromolecular / giant structure ; each silicon atoms bonds to 4 oxygen atoms and each oxygen atom bonds to 2 silicon atoms ;	2
11(c)	<table><tr><td></td><td>number of protons</td><td>number of neutrons</td><td>number of electrons</td></tr><tr><td>carbon-12</td><td>6</td><td>6</td><td>6</td></tr><tr><td>carbon-14</td><td>**6**</td><td>**8**</td><td>**6**</td></tr></table> ;	1
11(d)	average ; element ; mass ;	3
11(e)	(moles = 0.6 ÷ 12 =) 0.05 ;	1

Question	Answer	Marks
12(a)(i)	$1 / R_T = 1 / R_1 + 1 / R_2$ or $1 / 12.0 + 1 / 6.0$; $R_T = 4.0 \ (\Omega)$;	**2**
12(a)(ii)	$(I =) V / R$ or $9.0 / 6.0$; $1.5 \ (A)$;	**2**
12(b)(i)	 correct symbols and quantities ; in series ;	**2**
12(b)(ii)	 ;	**1**
12(c)(i)	(ammeter) increases AND (voltmeter) decreases ;	**1**
12(c)(ii)	the resistance of the thermistor decreases ; the current / pd across the bulb increases ; the bulb receives / converts more energy ;	**3**