Cambridge Assessment International Education

Cambridge IGCSE™

CO-ORDINATED SCIENCES **0654/43**

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.

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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.

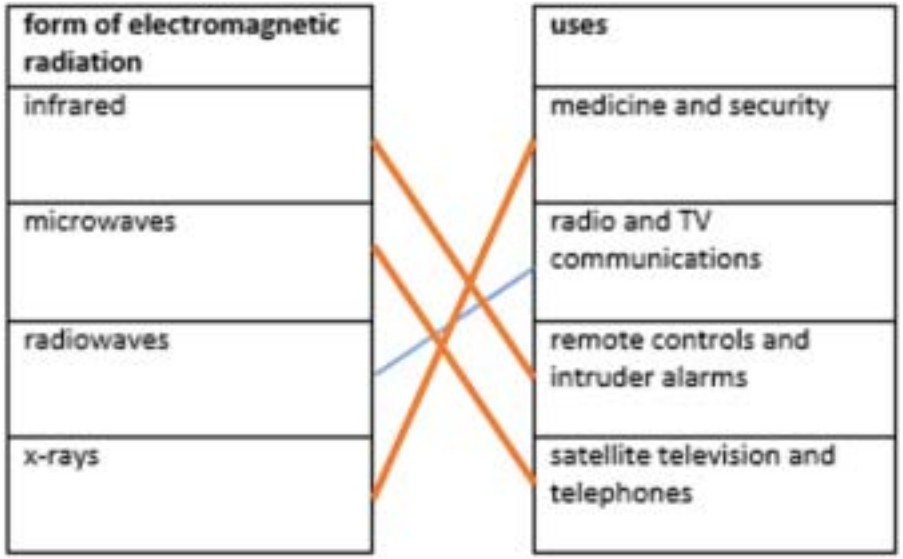
7 Guidance for chemical equations

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)	(+) 3.0 ;	**1**
1(b)	any figure between > 0.6 and < 0.8 (mol dm^{-3}) ;	**1**
1(c)	higher ; osmosis ; high and low ; partially permeable / cell ;	**4**
1(d)(i)	ref to plasmolysis / the cell membrane has come away from the cell wall / cytoplasm has shrunk ; because water has left the cell (by osmosis) ;	**2**
1(d)(ii)	0.8 / 1.0 (mol dm^{-3}) ;	**1**
1(e)	*any two from:* support / keeps cells turgid ; photosynthesis ; transport ; solvent ;	**2**

Question	Answer	Marks
2(a)	potassium chloride ; bromine ;	**2**
2(b)(i)	hydrogen chloride has weak intermolecular forces / weak attractions between (hydrogen chloride) molecules ; (weak intermolecular forces) take little energy to break / owtte ;	**2**
2(b)(ii)	litmus paper turns red ;	**1**
2(b)(iii)	H^+ ;	**1**
2(c)	mass of HCl in 250 cm^3 = $\frac{73 \times 250}{1000}$ **OR** 73×0.25 **OR** $73 \div 4$; 18.25 (g) ;	**2**
2(d)(i)	both C-Br bonds circled ;	**1**
2(d)(ii)	bond breaking is endothermic / takes in energy **and** bond making is exothermic / gives out energy ; more energy is given out (during bond making) than is taken in (during bond breaking) / energy stored in product is less than energy stored in reactant ;	**2**

Question	Answer	Marks
3(a)	same proton number and different neutron number ;	**1**
3(b)	$^{14}_{7}N$; $^{0}_{-1}\beta$;	**2**
3(c)	use of graph ; 6000 years ;	**2**
3(d)(i)	gamma in left box ;	**1**
3(d)(ii)	3×10^8 m / s ;	**1**
3(d)(iii)	(f=) v / λ **or** $3x10^8 / 2.0x10^{-11}$; 1.5×10^{19} ; Hz ;	**3**
3(d)(iv)	 ;;	**2**
3(e)	transverse vibrations are perpendicular to energy transfer / longitudinal vibrations are parallel to energy transfer ;	**1**

Question	Answer	Marks
4(a)	organisms ; interacting ;	**2**
4(b)(i)	4 ;	**1**
4(b)(ii)	producers ;	**1**
4(b)(iii)	blackbirds ;	**1**
4(b)(iv)	*any three from:* energy is lost between the trophic levels ; energy lost by, respiration / movement / heat / excretion ; not all the organism, is eaten / digested ; not enough energy for larger number of organisms ;	**3**
4(c)	4 3 5 (1) 2 ;	**1**
4(d)	*any two from:* 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 ;	**2**

Question	Answer	Marks
5(a)	*any two from:* high density ; high melting point ; form coloured compounds ; act as catalysts ;	**2**
5(b)(i)	carbon monoxide is poisonous / toxic ;	**1**
5(b)(ii)	iron(III) ions gain electrons ;	**1**
5(b)(iii)	$Fe^{3+} + 3e^- \rightarrow Fe$ correct formulae ; correct balancing ;	**2**
5(b)(iv)	M_r of Fe_2O_3 = 160 **and** M_r of CO = 28 ; (moles of Fe_2O_3 = 32,000 ÷ 160 =) 200 ; (moles of CO = 17,500 ÷ 28 =) 625 ; Fe_2O_3 is the limiting reactant because there is less than 1/3 of the number of moles of CO ;	**4**

Question	Answer	Marks
6(a)	coal ; natural gas ;	**2**
6(b)(i)	(efficiency =) $\frac{\text{useful output}}{\text{total input}} \times 100\%$ **OR** $\frac{0.72}{6.0} \times 100\%$; 12% ;	**2**
6(b)(ii)	does not release greenhouse gases / carbon dioxide / cause global warming / climate change / AVP ;	**1**
6(c)(i)	energy supplied by a source in driving charge around a complete circuit ;	**1**
6(c)(ii)	coil cuts magnetic field / experiences a changing magnetic field ; direction of induced current / emf changes every half turn ;	**2**
6(c)(iii)	slip-ring(s) ; to prevent wires tangling ; to maintain electrical contact ;	**3**

Question	Answer	Marks
7(a)(i)	cell membrane ;	**1**
7(a)(ii)	(relative size) small and large ; (motility) motile and non-motile ; (relative number released at a time) many and few ;	**3**
7(a)(iii)	jelly coat / energy stores ;	**1**
7(b)	are haploid ; contain unpaired chromosomes ; contain 23 chromosomes ;	**3**
7(c)	zygote ;	**1**

Question	Answer	Marks
8(a)	alkenes are unsaturated hydrocarbons ticked ;	**1**
8(b)	test: aqueous bromine ; result with propane: no change / aqueous bromine stays orange or yellow ; result with propene: aqueous bromine is decolourised / aqueous bromine changes from orange or yellow to colourless ;	**3**
8(c)	C=C in propene ; C—C in poly(propene) ; all else correct ;	**3**
8(d)	addition polymerisation requires one monomer / condensation polymerisation requires two monomers ; addition polymerisation produces a polymer only / condensation polymerisation produces a polymer molecule and a small molecule ;	**2**

Question	Answer	Marks
9(a)(i)	horizontal line drawn at 12 m/s for 15 s ; straight line drawn from 12 m/s to 0 m/s taking 25 s ;	**2**
9(a)(ii)	(a =) 12 / 25 (= 0.48 m/s^2) ;	**1**
9(a)(iii)	(F =) ma **or** 1200 $\times$ 0.48 ; 576 (N) ;	**2**
9(a)(iv)	(W =) f $\times$ d **or** 576 $\times$ 150 ; 86 400 (J) ;	**2**
9(b)	kinetic; thermal ;	**2**

Question	Answer	Marks
10(a)(i)	*any three from:* (pulse rate during exercise increases because:) heart pumps, more blood / blood faster ; increase in muscle contraction **;** muscles need more energy **;** increase in the rate of respiration **;** increase in pulse rate to transfer more oxygen / glucose to the muscles **/** body **;**	**3**
10(a)(ii)	muscular contraction ; of the, ventricles / atria ;	**2**
10(a)(iii)	valves ;	**1**
10(b)(i)	artery ;	**1**
10(b)(ii)	*thick wall* – withstands high pressure of the blood ; *narrow lumen* – maintains the blood pressure ;	**2**

Question	Answer	Marks
11(a)	$Zn + 2HCl \rightarrow ZnCl_2 + H_2$ correct formulae ; correct balancing ;	**2**
11(b)(i)	2 :	**1**
11(b)(ii)	*explanation for experiment 2:* used a lower temperature ; *any two from:* particles move slower or particles have less energy ; less frequent collisions / less collisions per second ; less particles with the activation energy / enough energy to react ;	**3**
11(b)(iii)	0.5 (g) ;	**1**
11(c)	D ;	**1**
11(d)	reference to sea of electrons ; electrons can move through the structure / flow / carry charge ;	**2**

Question	Answer	Marks
12(a)(i)	collisions between molecules and wall of container / jar ; causes a force ;	**2**
12(a)(ii)	(v =) $\sqrt{\frac{2E}{m}}$ **or** $\sqrt{\frac{2\times 2.67\times 10^{-22}}{5.34\times 10^{-26}}}$; 100 (m/s) ;	**2**
12(b)(i)	pressure increases as temperature increases ; at a uniform / linear rate / proportionally;	**2**
12(b)(ii)	volume would not be constant ;	**1**