Cambridge Assessment International Education

Cambridge IGCSE™

CO-ORDINATED SCIENCES **0654/42**

Paper 4 Theory (Extended) **March 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 March 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.

Examples of how to apply the list rule

State **three** reasons…. [3]

A

1. Correct	✓	**2**
2. Correct	✓	
3. Wrong	×	

B (4 responses)

1. Correct, Correct	✓, ✓	**3**
2. Correct	✓	
3. Wrong	ignore	

C (4 responses)

1. Correct	✓	**2**
2. Correct, Wrong	✓, ×	
3. Correct	ignore	

D (4 responses)

1. Correct	✓	**2**
2. Correct, CON (of 2.)	×, (discount 2)	
3. Correct	✓	

E (4 responses)

1. Correct	✓	**3**
2. Correct	✓	
3. Correct, Wrong	✓	

F (4 responses)

1. Correct	✓	**2**
2. Correct	✓	
3. Correct CON (of 3.)	× (discount 3)	

G (5 responses)

1. Correct	✓	**3**
2. Correct	✓	
3. Correct Correct CON (of 4.)	✓ ignore ignore	

H (4 responses)

1. Correct	✓	**2**
2. Correct	×	
3. CON (of 2.) Correct	(discount 2) ✓	

I (4 responses)

1. Correct	✓	**2**
2. Correct	×	
3. Correct CON (of 2.)	✓ (discount 2)	

Question	Answer	Marks
1(a)	$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$;;	2
1(b)(i)	25 (°C) ;	1
1(b)(ii)	the kinetic energy of the particles increases ticked ; there are more frequent collisions between the substrate and enzyme ticked ;	2
1(b)(iii)	*any three from:* photosynthesis has stopped ; the enzymes have become denatured ; the active site has changed shape / the shape of the active site is no longer complementary to the substrate ; substrate no longer fits into, enzyme / active site ;	3
1(b)(iv)	a change in light intensity will affect the results ; only the effect of temperature is being investigated / all other variables should be kept constant ;	2

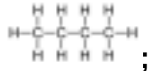
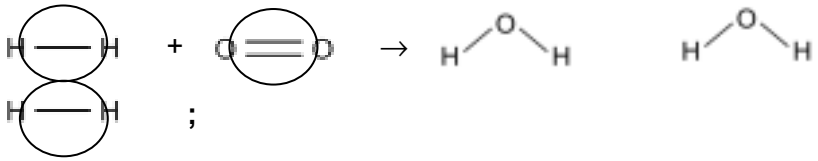
Question	Answer	Marks
2(a)	(particle **A**) – proton ; (particle **B**) – neutron ; (particle **C**) – electron ;	3
2(b)(i)	*proton number of 12 because* (magnesium) has 12 protons ; *nucleon number of 24 because* (magnesium) has 12 protons and 12 neutrons ;	2
2(b)(ii)	2.8.2 ;	1

Question	Answer	Marks
2(c)	magnesium oxide has strong (electrostatic) forces of attraction between oppositely charged magnesium ions and oxide ions ; water has weak intermolecular forces / weak attraction between (water) molecules ; strong (electrostatic) forces of attraction take more energy to break than weak intermolecular forces / ORA ;	3
2(d)	relative molecular mass of MgO = 40 **and** of $MgCl_2$ = 95 ; $\frac{2.0 \times 95}{40}$ **or** $\frac{95}{20}$ = 4.75 (g) ;	2

Question	Answer	Marks
3(a)(i)	m = 0.05625 kg ; (KE=) ½ mv^2 / $0.5 \times 0.05625 \times 8.0^2$; 1.8 (J) ;	3
3(a)(ii)	gravitational potential energy ;	1
3(b)	(f =) ma / 0.05625×1600 ; 90 (N) ;	2
3(c)(i)	33 (N) ;	1
3(c)(ii)	extension is directly proportional to the force applied ;	1
3(c)(iii)	the graph is, a curve / not a straight line ; force is not directly proportional to extension ;	2

Question	Answer	Marks
4(a)(i)	3 ;	1
4(a)(ii)	pancreas ; liver ; glycogen ;	3
4(b)	adrenaline ; glucagon ;	2
4(c)	negative feedback ;	1
4(d)(i)	movement of digested food molecules ; across the (wall of the) small intestine / into the blood ;	2
4(d)(ii)	presence of villi ; large surface area for absorption ; AVP	2

Question	Answer	Marks
5(a)	substances have different boiling points ;	1
5(b)	<table><tr><th>fraction</th><th>use</th></tr><tr><td>refinery gas</td><td>bottled gas for heating</td></tr><tr><td>gasoline</td><td>fuel (petrol) in cars</td></tr><tr><td>naphtha</td><td>feedstock for making chemicals ;</td></tr><tr><td>diesel oil</td><td>fuel in diesel engines ;</td></tr><tr><td>bitumen</td><td>road surfaces ;</td></tr></table>	3

Question	Answer	Marks
5(c)	 ;;	2
5(d)	$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$;;	2
5(e)	reaction in which thermal energy is given out ;	1
5(f)(i)	 ;	1
5(f)(ii)	bond breaking is endothermic / owtte **AND** bond making is exothermic / owtte ; more energy is given out in bond making than is taken in in bond breaking ;	2

Question	Answer	Marks
6(a)(i)	fossil fuels ;	1
6(a)(ii)	geothermal **and** tidal ;	1
6(b)	*any three from:* particles are free to move / particle movement is random ; rapid movement of particles / high kinetic energy of particles ; particles are far apart / low particle density ; forces between molecules are, weak / zero ;	3

Question	Answer	Marks
6(c)(i)	*any two from:* the coil turns ; in a magnetic field / cuts a magnetic field / experiences a changing magnetic flux ; induces emf ; *plus:* changes direction every half turn ;	3
6(c)(ii)	sine wave ;	1

Question	Answer	Marks
7(a)	**E** ; **A** ; **C** ;	3
7(b)	**X** on one of the spongy mesophyll cells ;	1
7(c)(i)	phloem ;	1
7(c)(ii)	sucrose ; amino acids ;	2
7(d)	<table><tr><th></th><th>transpiration</th><th>translocation</th></tr><tr><td>transports substances to regions of storage</td><td></td><td>✓</td></tr><tr><td>transports water</td><td>✓</td><td></td></tr><tr><td>movement of substances is in one direction only</td><td>✓</td><td></td></tr><tr><td>transport is from source to sink</td><td></td><td>✓</td></tr></table>;;	2

Question	Answer	Marks
8(a)(i)	0.3 (g) ;	1
8(a)(ii)	156 (seconds) ;	1
8(b)	less particles per unit volume / less particles per cm^3 / less particle density ; less frequent collisions / less collisions per second ;	2
8(c)	limewater ; turns, milky / cloudy ;	2
8(d)	M_r of CO_2 = 44 ; moles of CO_2 = 0.47 ÷ 44 = 0.0107 ; volume of CO_2 = 0.0107 × 24 = 0.26 (dm^3) **OR** volume of CO_2 = 0.0107 × 24 = 0.26 (dm^3) ;	3

Question	Answer	Marks
9(a)	vibrations / oscillations, are perpendicular to direction of energy transfer ;	1
9(b)(i)	ray moves towards the normal inside glass block ; ray emerges parallel to incidence ray ;	2
9(b)(ii)	refraction ;	1
9(b)(iii)	change of speed / caused by change in density of medium ;	1
9(c)	(P=) IV / 1.8 × 3.0 ; 5.4 (W) ;	2
9(d)(i)	1.3 (A) ;	1

Question	Answer	Marks
9(d)(ii)	(Q =) It / 1.3 × 30 ; 39 ; C / Coulombs ;	3

Question	Answer	Marks
10(a)(i)	100 ;	1
10(a)(ii)	limited number of phenotypes ; no intermediates ;	2
10(a)(iii)	genes ;	1
10(a)(iv)	height / AVP ;	1
10(b)	plasma – antibody production platelets – blood clotting red blood cell – transport of ions, soluble nutrients and hormones white blood cell – transport of oxygen ;;;	3
10(c)	*any two from:* no nucleus ; contains haemoglobin ; biconcave shape / large surface area ;	2

Question	Answer	Marks
11(a)	(sodium atom) loses one electron **and** (chlorine atom) gains one electron ;	**1**
11(b)	electrostatic attraction ; between oppositely charged ions ;	**2**
11(c)	$AlCl_3$;	**1**
11(d)	*any three from:* molten aluminium oxide / alumina, and cryolite ; cryolite lowers melting point of, aluminium oxide / alumina ; electrolysis / use of electricity ; high temperature to melt, aluminium oxide / alumina ;	**3**
11(e)	(species that) loses or donates electrons ;	**1**

Question	Answer	Marks
12(a)	using area under graph ; 500 (m) ;	**2**
12(b)	(a =) (v–u) ÷ t / 10÷100 ; 0.1 (m / s^2) ;	**2**
12(c)	constant acceleration initially ; non-uniform acceleration / rate of acceleration decreases, at 135 s ; then constant speed from 160s ;	**3**
12(d)(i)	2.60×10^4 (N) ;	**1**
12(d)(ii)	(m = W÷g / $1.96 \times 10^6 \div 10$ =) 1.96×10^5 (kg) ;	**1**
12(e)	white paint absorbs less thermal / infra-red radiation **or** reflects more thermal / infra-red radiation ;	**1**