Cambridge Assessment International Education

Cambridge IGCSE™

CO-ORDINATED SCIENCES **0654/42**

Paper 4 Theory (Extended) **May/June 2020**

MARK SCHEME

Maximum Mark: 120

Published

Students did not sit exam papers in the June 2020 series due to the Covid-19 global pandemic.

This mark scheme is published to support teachers and students and should be read together with the question paper. It shows the requirements of the exam. The answer column of the mark scheme shows the proposed basis on which Examiners would award marks for this exam. Where appropriate, this column also provides the most likely acceptable alternative responses expected from students. Examiners usually review the mark scheme after they have seen student responses and update the mark scheme if appropriate. In the June series, Examiners were unable to consider the acceptability of alternative responses, as there were no student responses to consider.

Mark schemes should usually be read together with the Principal Examiner Report for Teachers. However, because students did not sit exam papers, there is no Principal Examiner Report for Teachers for the June 2020 series.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the June 2020 series for most Cambridge IGCSE™ and Cambridge International A & AS Level components, and some Cambridge O Level components.

[Turn over

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 (see examples below)

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)	spiky (surface) ;	**1**
1(b)	stigma feathery ; stigma hangs outside flower ;	**2**
1(c)	fusion of nuclei ; ref to pollen **and** ovule ;	**2**
1(d)	9 ; 18 ;	**2**
1(e)	*advantage* fast / colonise areas quickly / only requires one parent ; *disadvantage* no variety / more prone to extinction / more susceptible to disease ;	**2**

Question	Answer	Marks
2(a)(i)	solid to liquid = melting ; gas to liquid = condensing ;	**2**
2(a)(ii)	(kinetic energy) decreases / owtte	**1**
2(b)(i)	(R_f =) distance travelled by substance ÷ distance travelled by solvent or 2.3 ÷ 5.8 ; = 0.4 ;	**2**
2(b)(ii)	dye B ; idea that the colours (in dye B) moved different distances up the paper from the colours in the ink sample ;	**2**
2(b)(iii)	a substance that can dissolve a solute (to form a solution)	**1**

Question	Answer	Marks
2(c)	(pure substance is **X**) no mark idea that pure substances have a specific melting point / ORA / idea that pure substances do not melt over a range (of temperatures) / ORA ;	**1**

Question	Answer	Marks
3(a)(i)	$R = V \div I$; $= 12 \div 5.0$; $(= 2.4\ \Omega)$	**2**
3(a)(ii)	$1/R_T = 1/R_1 + 1/R_2$ or $R_T = R_1 R_2 / R_1 + R_2$ or correct substitution; 1.2 (Ω);	**2**
3(a)(iii)	both lamps get full voltage; if one lamp fails the other will still work;	**1**
3(b)	$v = f \times \lambda$ or correct substitution; (speed of light =) 3×10^8 (m) seen; $= 5 \times 10^{-7}$ (m);	**3**
3(c)(i)	 rarefaction correctly labelled with the letter R;	**1**
3(c)(ii)	number of compressions per second;	**1**
3(d)	thermal energy transferred as (vibrational) energy of atoms ; vibrations passed from atom to atom ; delocalised electrons transfer energy ;	**max 2**

Question	Answer	Marks
4(a)(i)	$(62 \times 30) = 1860$;	**1**
4(a)(ii)	(increase in physical activity) increases need for energy (for muscle contraction) ; increase in respiration ; increase in requirement for oxygen ; increase on concentration of carbon dioxide in blood ;	**max 3**
4(a)(iii)	more oxygen ; less carbon dioxide ; less water vapour ;	**max 2**
4(b)(i)	any two from: thin ; ventilated ; large surface area ;	**2**
4(b)(ii)	thin (wall) / (wall) only one cell thick ; reduces diffusion distance ;	**2**

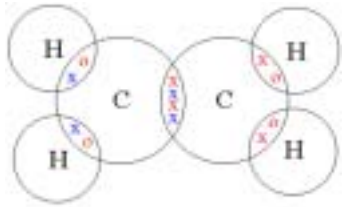
Question	Answer	Marks
5(a)	electrolysis;	**1**
5(b)	strong ; low density ;	**2**
5(c)(i)	order of reactivity (most to least): sodium magnesium zinc tin gold ;;	**2**

Question	Answer	Marks
5(c)(ii)	$Mg + 2HCl \rightarrow MgCl_2 + H_2$ correct formulae; correctly balanced;	**2**
5(c)(iii)	(aluminium) reacts with oxygen to form an oxide layer / aluminium oxide ; (oxide layer) adheres to the metal / does not flake off ;	**2**

Question	Answer	Marks
6(a)(i)	$^{239}_{94}Pu \rightarrow {}^{235}_{92}U + {}^{4}_{2}He$ uranium identified; 235 and 92; helium notation correct;	**3**
6(a)(ii)	five half-lives; 0.0625 (kg);	**2**
6(b)	formula or correct substitution; 37(%)	**2**
6(c)	$V_1/V_2 = N_1/N_2$ or correct substitution; 62 500 ;	**2**
6(d)	higher voltage means lower current; power loss increases with current / power loss is I^2R;	**2**

Question	Answer	Marks
7(a)(i)	pike ;	**1**
7(a)(ii)	6 ;	**1**

Question	Answer	Marks
7(a)(iii)	it has more than five trophic levels ; energy is lost between the trophic levels ; by respiration / excretion / movement / heat / not all animal is eaten ; there is not usually enough energy to sustain a sixth trophic level ;	**max 3**
7(b)	food web ; producer ; decomposer ;	**3**
7(c)(i)	tree roots stabilise soil ; (tree removal causes) soil to be exposed to wind / rain ; causing soil erosion ;	**max 2**
7(c)(ii)	photosynthesis produces oxygen ; fewer trees means less photosynthesis ; combustion (of trees) uses oxygen ;	**max 2**

Question	Answer	Marks
8(a)(i)	(diamond) has many strong bonds ; bonds are covalent bonds ; (diamond) is giant molecular / macromolecular / giant tetrahedral (lattice) ;	**max 2**
8(a)(ii)	(graphite has) electrons ; that can move / that are delocalised ;	**2**
8(b)	 double bond between C atoms ; single bonds between C and H ;	**2**

Question	Answer	Marks
8(c)	global warming / climate change ;	**1**
8(d)	(catalytic converter) changes carbon monoxide into carbon dioxide ; balanced symbol equation: $2CO + O_2 \rightarrow 2CO_2$ / $2CO + 2NO \rightarrow N_2 + 2CO_2$;; correct formulae; correctly balanced;	**3**

Question	Answer	Marks
9(a)(i)	0(°C);	**1**
9(a)(ii)	molecular motion – molecules in liquid water can move throughout but molecules in ice vibrate about a fixed point ; molecular arrangement – molecules in liquid water in random arrangement / molecules in ice in regular arrangement ;	**2**
9(b)	ultraviolet placed between X-rays and visible light;	**1**
9(c)(i)	a region in which an electric charge experiences a force;	**1**
9(c)(ii)	I = Q/t or correct substitution; 25 000 (A);	**2**

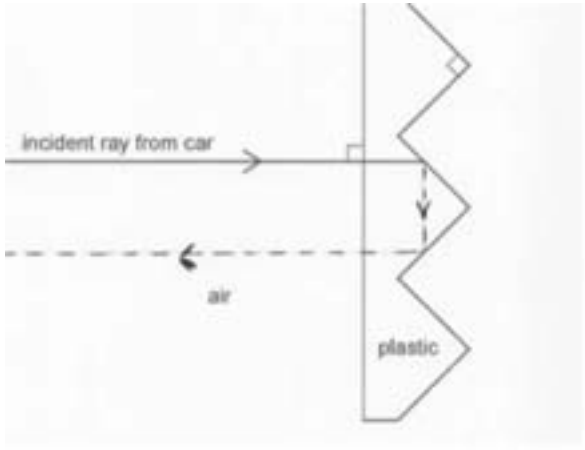
Question	Answer	Marks
10(a)(i)	increase in temperature (no mark) increase in kinetic energy of water molecules ; increased rate of evaporation ; increased loss of water (vapour) through stomata ;	**3**
10(a)(ii)	humidity ;	**1**

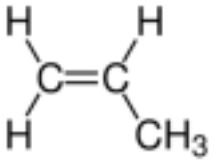
<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>10(b)</td><td>
<table>
<tr><td></td><td>transpiration</td><td>translocation</td></tr>
<tr><td>substances moved</td><td>water</td><td>1 sucrose
2 amino acids</td></tr>
<tr><td>direction of movement</td><td>from roots to leaves</td><td>from source to storage / sink</td></tr>
<tr><td>name of tissue used for transport</td><td>xylem</td><td>phloem</td></tr>
</table>
;;;

1 mark for each correct row</td><td>3</td></tr>
<tr><td>10(c)</td><td>$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

left hand side ;
right hand side ;</td><td>2</td></tr>
</table>

Question	Answer	Marks
11(a)	$(NH_4)_2SO_4$;	1
11(b)	to improve crop yield / idea of producing better quality crops ; fertilisers provide the essential elements for plant growth / owtte ; plants remove NPK (from soil), which needs to be replaced / owtte ;	max 2
11(c)(i)	idea that 450°C gives higher yield (than 800°C) / ORA ;	1
11(c)(ii)	idea that rate of reaction is faster at 450°C (than at 200°C) / ORA ;	1
11(c)(iii)	iron is a catalyst / iron increases the rate of the reaction ;	1

Question	Answer	Marks
12(a)(i)	change of speed or correct substitution (e.g. 1.55/2); 0.775 (m/s^2);	**2**
12(a)(ii)	F = ma or 80×0.775; 62 (N);	**2**
12(a)(iii)	max speed = 9 m/s; KE = ½mv^2 or $½ \times 80 \times 9 \times 9$; 3240 (J);	**3**
12(b)	 reflection only shown at first reflection; after second reflection ray emerges parallel to incident ray;	**2**
12(c)	spanner **B** is longer / gives a bigger, moment / turning force ;	**1**

Question	Answer	Marks
13(a)		1
13(b)	in addition polymerisation molecules react together to form one larger molecule ; in condensation polymerisation molecules react together to form one larger molecule and smaller molecules ;	2
13(c)	moles of ethene = 3.9 ÷ 28 = 0.14 OR moles of water = 4.0 ÷ 18 = 0.22 ; ethene is the limiting reactant ; explanation demonstrating understanding of the term ‘limiting reactant’;	3