Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CO-ORDINATED SCIENCES **0654/41**

Paper 4 Theory (Extended) **October/November 2019**

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 2019 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

PUBLISHED

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.

Question	Answer	Marks
1(a)	chemical **;** energy **;** oxygen **;**	**3**
1(b)	release more energy (per glucose molecule) / does not produce lactic acid **;**	**1**
1(c)(i)	increased breathing rate or depth **;** increased respiration **;** increased need for energy **;** increased muscle contraction **;** **max 3**	**3**
1(c)(ii)	5 (minutes) **;**	**1**
1(c)(iii)	anaerobic respiration has taken place **;** needs to repay oxygen debt / to remove lactic acid **;**	**2**

Question	Answer	Marks
2(a)	oxygen: 21 **;** nitrogen: 78 **;**	**2**
2(b)(i)	3 bonding pairs **;** 2 lone pairs, all else correct **;**	**2**
2(b)(ii)	(molecule is unreactive because of) strong (covalent) bonding between atoms / triple bond **;** (atom is reactive because) atom has high tendency to gain electrons / has incomplete electron shell / does not have noble gas structure / owtte **;**	**2**
2(c)(i)	ionic bonds between metallic and non-metallic elements **;** covalent bonds between non-metallic elements / nitrogen is a non-metal (so covalently bonded) **;**	**2**
2(c)(ii)	attractive force between oppositely charged ions / strong force / bonds between ions / many forces / bonds between ions **;** more energy required to overcome force / break bond **;**	**2**
2(c)(iii)	Mg_3N_2 **;** idea of balanced charges **;**	**2**

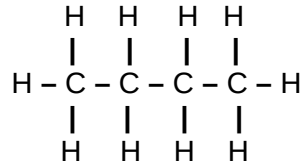
Question	Answer	Marks
3(a)(i)	arrow showing heated air rising **;**	**1**
3(a)(ii)	convection **;**	**1**
3(a)(iii)	particles vibrate more / gain energy **;** this vibration is passed through metal **;**	**2**
3(b)(i)	use of correct formula **;** evidence of correct working **;**	**2**
3(b)(ii)	30 Ω **;**	**1**
3(c)(i)	100 (°C) **;**	**1**
3(c)(ii)	stronger forces of attraction between water molecules in liquid **;** water molecules are closer together in liquid **;** water molecules have greater freedom of movement / collide less frequently in steam / owtte **;**	**3**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(a)</td><td>centre of the letter X drawn in correct position ;</td><td>1</td></tr>
<tr><td>4(b)</td><td>
<table>
<tr><th>part of the eye</th><th>letter on Fig. 4.1</th><th>function</th></tr>
<tr><td>cornea</td><td>D</td><td>refracts light entering the eye</td></tr>
<tr><td>iris</td><td>C</td><td>controls how much light enters, the eye / pupil</td></tr>
<tr><td>lens</td><td>B</td><td>focuses light (on retina)</td></tr>
<tr><td>optic nerve</td><td>H</td><td>carries impulse to brain</td></tr>
<tr><td>retina</td><td>A</td><td>contains light receptor cells</td></tr>
</table>
;;;;</td><td>4</td></tr>
<tr><td>4(c)</td><td>ciliary muscle relaxes ;
suspensory ligaments tighten / stretch ;
lens becomes thinner / is stretched / AW ;</td><td>3</td></tr>
</table>

Question	Answer	Marks
5(a)	reduces acidity **;**	**1**
5(b)	thermal **;** chemical **;**	**2**
5(c)(i)	→ salt + water **;**	**1**
5(c)(ii)	protons / H^+ transferred from acid to base **;**	**1**
5(d)	amphoteric **;** basic **;** neutral **;**	**3**
5(e)	$2CuO(s) + C(s) \rightarrow 2Cu(s) + CO_2(g)$ formulae **;** state symbols **;** balancing **;**	**3**
5(f)	calcium more reactive than carbon **;**	**1**

Question	Answer	Marks
6(a)	ref. to induced magnetism (in) nails **;** two nail heads / north poles / like poles, will repel each other **;**	**2**
6(b)(i)	atoms having same atomic number / proton number and different mass number / neutron number **;**	**1**
6(b)(ii)	$^{60}_{27}Co$ **;** $^{0}_{-1}e$ **;**	**2**
6(c)	evidence that resistance is halved by cross sectional area change **;** evidence that resistance is halved by length change **;** new resistance = $3.0 \times 10^{-4}\ \Omega$ **;**	**3**
6(d)	136 N **;** pressure = force / area **OR** 136 / 144 **;** 0.94 (N / cm^2) **;**	**3**

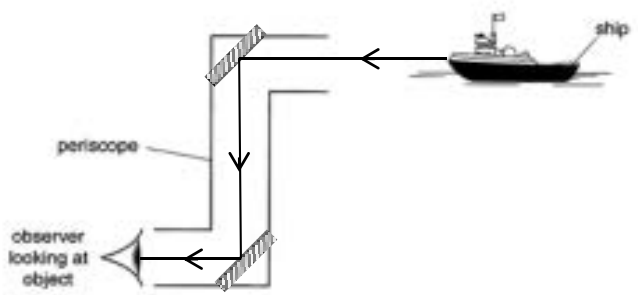
Question	Answer	Marks
7(a)(i)	to make the solution alkaline / so the solution changes colour (when acid is formed) **;**	**1**
7(a)(ii)	lipase breaks down the fat (in the milk) **;** into fatty acids (and glycerol) **;**	**2**
7(a)(iii)	the mixture would not become colourless **;** lipase / enzyme is denatured (at higher temperature) **;** fat is no longer broken down / fatty acids not produced **;**	**3**
7(b)(i)	*any two from* B, E, F **;** D **;**	**2**
7(b)(ii)	Kill microorganisms (in food) **;** acidic conditions needed for protein digestion **;**	**2**

Question	Answer	Marks
8(a)	carbon dioxide **;** water **;**	**2**
8(b)(i)	carbon dioxide **;**	**1**
8(b)(ii)	acid rain / named effect of acid rain / respiratory disease **;**	**1**
8(b)(iii)	minimum energy for particles / reactants to react **;**	**1**
8(c)(i)	same general formula **;** similar chemical properties **;**	**2**
8(c)(ii)	 chain of 4 C **;** all else correct **;**	**2**

Question	Answer	Marks
9(a)	$\frac{1}{2}mv^2$ **OR** $\frac{1}{2} \times 400000 \times 50 \times 50$ **;** = 500 000 (kJ) **;**	**2**
9(b)	velocity has direction but speed does not **;**	**1**
9(c)(i)	work done = force × distance (moved in direction of force) **;**	**1**
9(c)(ii)	2250 **;** J **;**	**2**

Question	Answer	Marks
10(a)(i)	4 (mm / min) **;**	**1**
10(a)(ii)	rate increasing **;** then levelling off / gradient reducing **;**	**2**
10(a)(iii)	increasing temperature causes (more) stomata to open (until other factors limit transpiration) **;** increasing rate of evaporation **;** increasing transpiration (pull) **;** **max 1**	**1**
10(b)	transpiration pull **;** difference in water potential / water potential gradient **;** draws up a column of water (molecules) **;** water (molecules) held together by cohesion **;** **max 3**	**3**
10(c)(i)	in the nucleus **;**	**1**
10(c)(ii)	identical **;**	**1**
10(d)	*any two from* replacement of cells **;** asexual reproduction **;** repair (of damaged tissue) **;** **max 2**	**2**
10(e)	they would contain half the number of chromosomes (in meiosis) **;**	**1**

Question	Answer	Marks
11(a)(i)	pale yellow / lighter than chlorine **;** gas **;** use of trend to predict property **;**	**3**
11(a)(ii)	fluorine is diatomic / formula is F_2 **;**	**1**
11(b)(i)	diffusion **;** molecules move from high concentration to low concentration / molecules move randomly **;**	**2**
11(b)(ii)	shorter times / greater rate of diffusion **;**	**1**

Question	Answer	Marks
12(a)(i)	distance travelled = speed × time **OR** 1.2 × 1500 / 1800 **;** depth = 1800 / 2 = 900 (m) **;**	**2**
12(a)(ii)	0.05 (m) **OR** 150 000 (cm / s) **;** (f =) 1500 / 0.05 **OR** 150 000 / 5 **;** (= 30 000 Hz)	**2**
12(a)(iii)	compression and rarefaction correctly identified **;**	**1**
12(b)	 two mirrors in correct places **;** two plane mirrors in correct places and correct orientations **;** correct reflections shown **;**	**3**
12(c)(i)	slip rings **;**	**1**
12(c)(ii)	coil cuts lines of magnetic field / coil moves in magnetic field / coil experiences changing magnetic field **;** e.m.f. / current <u>induced</u> **;** each side of coil moves upwards and then downwards (through field as it turns) owtte **;** current changes direction every half turn / flows in one direction and then the other **;** **max 3**	**3**