



COMBINED SCIENCE

0653/41

Paper 4 Extended Theory

October/November 2019

MARK SCHEME

Maximum Mark: 80

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.

This document consists of **12** printed pages.



Cambridge Assessment
International Education

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.

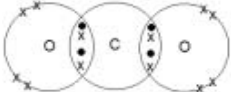
GENERIC MARKING PRINCIPLE 5:

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)	<i>any two of the following correctly labelled:</i> nucleus ; chloroplast ; cell wall ; vacuole ;	2
1(b)	for (rapid) absorption of water ;	1
1(c)(i)	for movement ;	1
1(c)(ii)	acrosome containing enzymes used in fertilisation / many mitochondria to release energy for swimming ;	1
1(d)(i)	glucose ;	1
1(d)(ii)	haemoglobin ; red blood cells ; diffusion ;	3
1(d)(iii)	capillary <u>walls</u> are thin ;	1

Question	Answer	Marks
2(a)	covalent ; bond between two non-metals ;	2
2(b)(i)	heat / <u>high</u> temperature ; catalyst ;	2
2(b)(ii)	(4) C ₂ H ₄ ;	1
2(c)(i)	 one carbon atom and two oxygen atoms shown and correct electron distribution for carbon atom ; correct electron distribution for both oxygen atoms/lone pairs on both oxygen atoms ;	2
2(c)(ii)	<u>enhanced</u> greenhouse effect / global warming / climate change / consequence of climate change ;	1

Question	Answer	Marks
3(a)(i)	lake surface ;	1
3(a)(ii)	<i>any 2 from:</i> penstock (pipe from dam to turbine) ; turbine ; generator ;	1
3(b)	<i>advantage:</i> no emissions / can be used for flood control ; <i>disadvantage:</i> creating reservoirs can flood useful land / destroy local ecosystems ;	2
3(c)(i)	3×10^8 m/s ;	1
3(c)(ii)	use of $v = f\lambda$; ($\lambda = v \div f = 3 \times 10^8 \div 600 \times 10^6$) = 0.5 m ;	2
3(c)(iii)	microwaves ;	1
3(d)	vibrations / oscillations of particles / air molecules or compressions and rarefactions ; longitudinal / vibration (direction) is parallel to direction of wave propagation / energy propagation ;	2

Question	Answer	Marks
4(a)(i)	$6 \text{ CO}_2 + 6 \text{ H}_2\text{O} \longrightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{ O}_2$ LHS ; RHS ;	2
4(a)(ii)	respiratory substrate / for respiration / to release energy ; to make starch (for storage) ;	2
4(b)(i)	B ;	1
4(b)(ii)	greatest number of chloroplasts / large amounts of chlorophyll present ; to absorb light / needed for photosynthesis ;	2
4(c)	(less transpiration means) less <u>diffusion</u> of water (vapour through the stomata / out of leaf) ; due to increased concentration of water vapour in the air / due to reduced difference in water potential ;	2

Question	Answer	Marks
5(a)	high density / high melting point / acts as catalyst ;	1
5(b)(i)	cathode ;	1
5(b)(ii)	gains electrons ; two electrons ;	2
5(c)(i)	carbon ;	1
5(c)(ii)	aluminium is too reactive / aluminium more reactive than carbon ;	1
5(d)	(aqueous) sodium hydroxide ; (pale) blue ppt ; or flame test ; blue–green / turquoise colour ;	2

Question	Answer	Marks
6(a)	Earth ;	1
6(b)	use of $d = m/V$; $(3.29 \times 10^{23} / 0.608 \times 10^{20}) = 5.41 \times 10^3$ (3sf) ; kg/m ³ ;	3
6(c)	Earth ; greatest mass / highest gravitational field strength ;	2
6(d)	darker colour / duller surface ;	1
6(e)	(on Venus) pressure of atmosphere much higher so molecules more concentrated ; so (atmospheric) resistance is greater / more work done by probe pushing molecules aside / owtte ; ORA	2

Question	Answer	Marks
7(a)(i)	(a unit containing) all the organisms and their environment ; interacting together ;	2
7(a)(ii)	light ; chemical (potential) energy ;	2
7(b)	<i>any two from:</i> death of organisms ; (excretion of) waste products from organisms ; respiration ; heat ;	2
7(c)	die / become extinct ; source of food/energy has gone / loss of habitat ;	2

Question	Answer	Marks
8(a)(i)	30 to 55 °C inclusive ;	1
8(a)(ii)	violent / very fast ;	1
8(b)(i)	RbOH ;	1
8(b)(ii)	in range 8–14 ; the solution is an alkali ;	2
8(c)	RbOH is ionic attractive forces between ions are strong more thermal energy (heat) needed to separate ions or water is covalent ; attractive forces between molecules are weak ; less thermal energy (heat) needed to separate molecules ;	3
8(d)	temperature increases / thermal energy released ; chemical energy is changed into thermal energy ;	2

Question	Answer	Marks
9(a)(i)	use of $1/R = 1/R_2 + 1/R_3$; ($1/3 + 1/6$ or $3/6 \rightarrow$) combined $R = (6/3) = 2 \Omega$; total $R = 8 + 2 = 10 \Omega$;	3
9(a)(ii)	$2.7 - 1.8 = 0.9 \text{ (A)}$;	1
9(a)(iii)	current from the source (ammeter reading) is the sum of the currents in the separate branches (in R_2 and R_3) of a parallel circuit / owtte ;	1
9(a)(iv)	must be resistance inside the battery / resistance of connecting wires / the idea of greater resistance ;	1
9(b)	use of $P = VI$ or $P = I^2R$; (45×9 or $9^2 \times 5$) = 405 W ;	2



COMBINED SCIENCE

0653/42

Paper 4 Extended Theory

October/November 2019

MARK SCHEME

Maximum Mark: 80

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.

This document consists of **12** printed pages.

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.

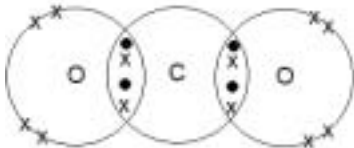
GENERIC MARKING PRINCIPLE 5:

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)(i)	$(1.5 - 0.6 =) 0.9 \text{ (dm}^3\text{)} ;$	1
1(a)(ii)	(increase in breaths) = 2 breaths (over 12 seconds) ; $\times 60 / 12 = 10 ;$	2
1(b)	increase ; (aerobic) <u>respiration</u> increases during exercise ;	2
1(c)	combines with haemoglobin / reduces the amount of oxygen able to combine with haemoglobin ; reduces amount of oxygen being transported (by blood / red cells) ;	2
1(d)	lung cancer / COPD / emphysema / bronchitis ;	1

Question	Answer	Marks
2(a)(i)	molecules contain carbon and hydrogen (only) / are hydrocarbons / are covalent ;	1
2(a)(ii)	fraction A molecules are smaller / have fewer carbon atoms / have lower intermolecular forces ;	1
2(b)(i)	family of compounds with the same general formula ; similar chemical properties ;	2
2(b)(ii)	<pre> H H H H — C — C — C — H H H H </pre> 3 carbon atoms in chain ; all else correct ;	2
2(c)(i)	$\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$; correct formulae ; correctly balanced ;	2
2(c)(ii)	global warming / climate change / consequence of climate change / <u>enhanced</u> greenhouse effect ;	1
2(c)(iii)	 two shared pairs of electrons between oxygen and carbon ; all else correct ;	2

Question	Answer	Marks
3(a)(i)	The extension (of an elastic object) is (directly) proportional to the force (applied to it) ;	1
3(a)(ii)	correct calculation of extension $x = 0.04$ or spring constant $k = 50$; ($F = kx = 50 \times 0.06 = 3.0$ (N) ;	2
3(a)(iii)	use of work done = force $\times$ distance ; ($W = Fx = 0.75 \times 0.015 = 0.011$ (J) ;	2
3(b)(i)	use of conservation of energy ($mgh = KE = 2$) ; $0.125 \times 10 \times h = 2$; $= 1.6$ (m) ;	3
3(b)(ii)	friction / air resistance ;	1

Question	Answer	Marks
4(a)(i)	nucleus correctly labelled ; cell membrane correctly labelled ;	2
4(a)(ii)	large surface area ; increases <u>rate</u> of water uptake ;	2
4(b)(i)	needed to make amino acids ;	1
4(b)(ii)	across root cortex ; up stem ; in xylem ;	Max. 2
4(c)(i)	rickets / soft (and deformed) bones ;	1
4(c)(ii)	butter / margarine / egg (yolks) / milk ;	1

Question	Answer	Marks
5(a)(i)	bauxite ;	1
5(a)(ii)	Al_3^+ ;	1
5(a)(iii)	(positive) aluminium ions move to / are attracted to (negative) cathode ; and gain (three) electrons ;	2
5(a)(iv)	aluminium is too reactive / aluminium above carbon in reactivity series / aluminium is more reactive than carbon ;	1
5(b)	(alloys are) stronger / more resistant to corrosion ;	1

Question	Answer	Marks
6(a)	Use of $P = IV$; (750 / 240 =) $I = 3.1$ (25) (A) ; 5 A fuse just higher than required operating current so appropriate / 3 A fuse too low and would blow under normal working conditions / 13 A fuse too high and would not blow until much higher than operating current ;	3
6(b)	(when the switch is down) additional resistor (in motor branch of circuit) ; potential difference across motor decreases (because some p.d. across resistor) ; current (in motor) decreases (so motor speed is slow) ; ora	3
6(c)	hairdryer blows evaporated water molecules away so they cannot fall back onto the hair again ; hairdryer heats the water molecules on the hair so they have increased KE and can evaporate faster ;	2

Question	Answer	Marks
7(a)(i)	(lipase) breaks down fats (in the milk) ; to produce fatty acids ;	1
7(a)(ii)	the breakdown of large insoluble molecules ; into small soluble molecules that can be absorbed ;	2
7(a)(iii)	pancreas / small intestine ;	1
7(b)	enzyme is <u>denatured</u> ; enzyme (molecule) has changed shape / destroyed or active site shape has changed ; substrate no longer fits active site substrate no longer fits enzyme (molecule) ;	3
7(c)	food is broken down into smaller pieces ; without chemical change / without action of enzymes / it is a physical change ;	2

Question	Answer	Marks
9(a)	visible light in correct position ; ultraviolet in correct position ;	2
9(b)	use of distance = speed $\times$ time ; (330 $\times$ 10) = 3300 m ;	2
9(c)	use of $Q = I t$; (30 000 $\times$ 0.00005) = 1.5 ; coulombs / C ;	3
9(d)(i)	electron(s) ;	1
9(d)(ii)	hair becomes (electrostatically) charged (due to transfer of electrons) ; like charges repel (causing hair to stand on end) ;	2



COMBINED SCIENCE

0653/43

Paper 4 Extended Theory

October/November 2019

MARK SCHEME

Maximum Mark: 80

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.

This document consists of **10** printed pages.

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)(i)	X fossilisation ; Y feeding / eating / ingestion ;	2
1(a)(ii)	green plants ;	1
1(b)(iii)	starch ;	1
1(b)	(oxygen concentration decreases because) O ₂ used up during combustion ; fewer trees so less photosynthesis ; so less oxygen produced ;	3

Question	Answer	Marks
2(a)(i)	(methanol contains oxygen and) hydrocarbons contain only carbon atoms and hydrogen atoms ;	1
2(a)(ii)	all hydrogen atoms correctly located ; correct electron distribution around carbon atom ; correct electron distribution around the oxygen atom ;	3
2(b)(i)	<u>enhanced</u> greenhouse effect / global warming / climate change ;	1
2(b)(ii)	2CH ₃ OH + 3O ₂ → 2CO ₂ + 4H ₂ O correct formulae on LHS ; correct formulae on RHS ; correctly balanced ;	3

Question	Answer	Marks
3(a)(i)	(child A because) child A holding close(r) to eye / child B eye is too far from the lens ;	1
3(a)(ii)	image that cannot be projected onto a screen ;	1
3(b)	compressions longitudinal amplitude any 2 correct = 1 mark all 3 correct = 2 marks	2
3(c)(i)	use of area under graph or $d = s \times t$; correct use of data from graph ; = 116 ;	3
3(c)(ii)	constant acceleration (0–10 s) ; non-constant deceleration (150–180 s) ;	2
3(d)	use of gravitational PE gained = mgh ; (= $40 \times 10 \times 50$) = 20 000 (J) ;	2

Question	Answer	Marks
4(a)	a protein ; (that functions as) a biological catalyst ;	2
4(b)(i)	enzyme amylase lipase protease substrate fats protein starch product amino acids fatty acids and glycerol simple sugars 2 or 3 connections correct ; 4 or 5 connections correct ; 6 connections correct ;	3
4(b)(ii)	stomach / pancreas / small intestine ;	1
4(c)	(no enzyme activity / enzyme activity greatly reduced because) enzyme is <u>denatured</u> ; enzyme (molecule) has changed shape or active site has changed shape ; substrate no longer fits the active site substrate cannot bind to enzyme molecule ;	3
4(d)	killing bacteria ; optimum pH for enzymes ;	2

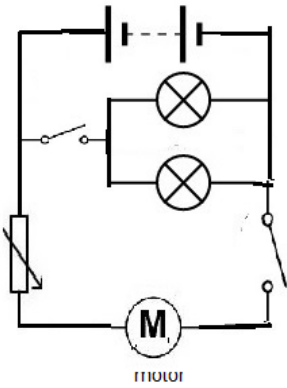
Question	Answer	Marks
5(a)(i)	8 ;	1
5(a)(ii)	the greater the number of outer shell electrons, the less metallic the elements become ;	1
5(b)(i)	damp litmus paper ; bleaches ;	2
5(b)(ii)	sterilises water / kills harmful microorganisms ;	1
5(c)	yellow / orange colouration ; chlorine displaces bromine / chlorine is more reactive than bromine / chlorine oxidises bromide ions ;	2
5(d)(i)	anode ;	
5(d)(ii)	chloride ion loses electrons ; one electron (per ion) ;	2
5(d)(iii)	potassium ;	1

Question	Answer	Marks
6(a)(i)	<i>any two from:</i> blood passes through the heart twice (for each complete circulation) ; circulation (from heart) to lungs / pulmonary circulation ; circulation (from heart) to body / systemic circulation ;	2
6(a)(ii)	more carbon dioxide in P / less carbon dioxide in Q ; less oxygen in P / more oxygen in Q ;	2
6(b)(i)	phloem ;	1
6(b)(ii)	food is made in the leaves (so has to be transported to the roots) ;	1
6(b)(iii)	(less transpiration because) increased concentration of water vapour in the air / reduced difference in water potential ; (so) less <u>diffusion</u> of water vapour through the stomata ;	2

Question	Answer	Marks
6(b)(iv)	support ;	1

Question	Answer	Marks
7(a)(i)	faster / more energetic molecules escape ; (average) speed / KE of remaining molecules is lower (results in lower temperature) ;	2
7(a)(ii)	molecules in air moving faster / more KE ; transfer more energy to water molecules by collision (so more escape) ;	2
7(a)(iii)	collisions of faster milk molecules with slower glass molecules causes glass molecules to gain energy and vibrate faster ; energy then passed from molecule to molecule through glass ;	2
7(b)	use of $P = V \times I$; 12 V circuit current = $90 / 12 = 7.5$ A ; 240 V circuit current = $80 / 240 = 0.33$ A ; 10 A fuse appropriate for 12 V circuit, 1 A fuse for 240 V circuit ;	4

Question	Answer	Marks
8(a)(i)	(at higher concentrations) more hydrogen ions / acid particles / reactant particles present ; increased rate of collisions ; so higher frequency of successful collisions ;	3
8(a)(ii)	increase temperature / use a catalyst / increase surface area of magnesium ;	1
8(a)(iii)	(thermal) energy is absorbed for bond breaking and released during bond formation ; more thermal energy is released than taken in ;	2
8(b)	magnesium is too reactive / magnesium is above carbon in reactivity series ;	1

Question	Answer	Marks
9(a)	 use of correct symbols ; lamps in parallel with motor and variable resistor ; lamps in parallel with each other and in series with switch ;	3
9(b)	use of $R = V / I$; identification of emf of battery as 12 V and total current as 3 A ; ($R = 12 / 3$) = 4 (Ω) ;	3