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**CO-ORDINATED SCIENCES**

**0654/43**

Paper 4 Theory (Extended)

**October/November 2019**

MARK SCHEME

Maximum Mark: 120

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**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.

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This document consists of **16** 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.

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
1(a)(i)	$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ correct LHS ; correct RHS ;	<b>2</b>
1(a)(ii)	lactic acid ;	<b>1</b>
1(a)(iii)	alcohol ; carbon dioxide ;	<b>2</b>
1(b)	<i>any two from</i> movement ; reproduction ; sensitivity ; growth ; excretion ; nutrition ;  <b>max 2</b>	<b>2</b>

Question	Answer	Marks
2(a)	$\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$ formulae ; balancing ;	<b>2</b>
2(b)	any named base ;	<b>1</b>
2(c)(i)	the (net) movement of particles from a region of their higher concentration to a region of their lower concentration / down a concentration gradient ; as a result of their random movement ;	<b>2</b>
2(c)(ii)	collisions between molecules (which slows progress through tube) ;	<b>1</b>
2(c)(iii)	$14 + (3 \times 1) (= 17) ;$	<b>1</b>
2(c)(iv)	white ring closer to $\text{HCl}$ / right of centre / $\text{NH}_3$ diffuses further than $\text{HCl}$ (in the same time) ; $\text{NH}_3$ diffuses faster than $\text{HCl}$ ; rate of diffusion decreases with increasing molecular mass ;  <b>max 2</b>	<b>2</b>

Question	Answer	Marks
3(a)	voltage <u>induced</u> as coil cuts magnetic field / <u>induced</u> as magnetic field in coil changes ; voltage reverses when magnet changes direction ;	<b>2</b>
3(b)(i)	micrometer screw gauge ;	<b>1</b>
3(b)(ii)	doubling diameter quadruples CSA / evidence of dividing by 4 ; 0.075 ( $\Omega$ ) ;	<b>2</b>
3(c)	$1 \times 10^{12}$ atoms undecayed ; 3 half-lives ; (3 $\times$ 2.7) = 8.1 (years) ;	<b>3</b>
3(d)(i)	(incident energy / energy gained, makes) atoms <u>vibrate</u> more ;  this <u>vibration</u> is passed through metal ;	<b>2</b>
3(d)(ii)	atoms have greater (amplitude of) vibration ; about a fixed point so take up more space / (average) distance between particles increases / owtte ;	<b>2</b>

Question	Answer				Marks												
4(a)(i)	<table border="1"> <thead> <tr> <th></th> <th>stem A</th> <th>stem B</th> <th>stem C</th> </tr> </thead> <tbody> <tr> <td>translocation occurs</td> <td>✓</td> <td></td> <td></td> </tr> <tr> <td>transpiration occurs</td> <td>✓</td> <td>✓</td> <td></td> </tr> </tbody> </table>		stem A	stem B	stem C	translocation occurs	✓			transpiration occurs	✓	✓					<b>2</b>
	stem A	stem B	stem C														
translocation occurs	✓																
transpiration occurs	✓	✓															
4(a)(ii)	transpiration (only) occurs, upwards / up the plant / from root to leaf ; translocation occurs up and down the plant / AW ;				<b>2</b>												
4(b)(i)	sucrose ; amino acids ;				<b>2</b>												
4(b)(ii)	support (the stem / the plant) ;				<b>1</b>												

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
5(a)(i)	flash / (bigger) flame / explosion ;	<b>1</b>
5(a)(ii)	white to blue ;	<b>1</b>
5(a)(iii)	heat ; blue to white / colour change reversed ;	<b>2</b>
5(b)(i)	H—H AND O=O ;	<b>1</b>
5(b)(ii)	O—H / H—O ;	<b>1</b>
5(b)(iii)	covalent ;	<b>1</b>
5(c)(i)	thermal energy is given out ;	<b>1</b>
5(c)(ii)	products have less (chemical) energy than reactants ;	<b>1</b>
5(c)(iii)	minimum energy for particles / reactants to react ;	<b>1</b>
5(c)(iv)	reactant energy to peak identified and labelled ;	<b>1</b>



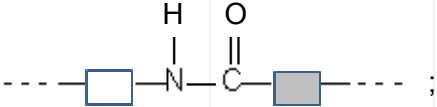
Question	Answer	Marks
6(a)(i)	acceleration section ; constant speed section ;	<b>2</b>
6(a)(ii)	acceleration = change in speed / time <b>OR</b> 2 / 9 ; = 0.2 (m / s <sup>2</sup> ) ;	<b>2</b>
6(b)	$f_1 d_1 = f_2 d_2$ <b>OR</b> $50 \times d = 21 \times 20$ ; $d = 8.4$ (cm) ;	<b>2</b>
6(c)	volume = 1728 (cm <sup>3</sup> ) / use of 12 <sup>3</sup> ; mass = 20.5 / 10 <b>OR</b> 2.05 kg ; 2.05 × 1000 <b>OR</b> 2050 g ; (density = ) 1.2 (g / cm <sup>3</sup> ) ;	<b>4</b>
6(d)	evaporation can occur at any temperature / boiling only happens at the boiling point ; evaporation happens at the surface / boiling occurs throughout the liquid ; during boiling all / most molecules have enough energy to leave / evaporation lets only the molecules with most kinetic energy out ; evaporation can occur using the internal energy of the system / boiling a(n external) source of heat ; evaporation produces cooling / boiling does not produce cooling ; evaporation is a slow process / boiling is a rapid process ;  <b>max 2</b>	<b>2</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
7(a)	<b>A</b> enamel ; <b>B</b> dentine ; <b>C</b> pulp ;	<b>3</b>
7(b)	bacteria (and food coat teeth) ; ref to respiration ; acids (produced by bacteria) dissolve enamel and dentine ;	<b>3</b>
7(c)	break food into smaller pieces ;	<b>1</b>
7(d)	ref to (salivary) amylase ; breaks down starch ; to (simple) sugars ; large insoluble to smaller soluble <u>molecules</u> ;  <b>max 3</b>	<b>3</b>

Question	Answer			Marks																
8(a)(i)	<table border="1"> <thead> <tr> <th data-bbox="349 225 629 357">halogen solutions</th> <th colspan="3" data-bbox="636 225 1384 288">colour of products with halide solutions</th> </tr> <tr> <th data-bbox="349 293 629 357"></th> <th data-bbox="636 293 893 357">sodium chloride</th> <th data-bbox="900 293 1158 357">sodium bromide</th> <th data-bbox="1164 293 1384 357">sodium iodide</th> </tr> </thead> <tbody> <tr> <td data-bbox="349 362 629 426">chlorine</td> <td data-bbox="636 362 893 426"></td> <td data-bbox="900 362 1158 426"><b>orange / yellow</b></td> <td data-bbox="1164 362 1384 426"><b>brown</b></td> </tr> <tr> <td data-bbox="349 430 629 488">bromine</td> <td data-bbox="636 430 893 488">(pale orange)</td> <td data-bbox="900 430 1158 488"></td> <td data-bbox="1164 430 1384 488">(brown)</td> </tr> </tbody> </table>			halogen solutions	colour of products with halide solutions				sodium chloride	sodium bromide	sodium iodide	chlorine		<b>orange / yellow</b>	<b>brown</b>	bromine	(pale orange)		(brown)	<b>1</b>
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8(a)(ii)	bromine is less reactive than chlorine ORA ; bromine more reactive than iodine ORA ;			<b>2</b>																
8(b)(i)	reduction and oxidation are occurring ; (oxidation is) loss of electrons AND (reduction is) gain of electrons ; bromine reduced / gains electrons AND iodide ions oxidised / lose electrons ;			<b>3</b>																
8(b)(ii)	<u>bromine</u> ;			<b>1</b>																

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
9(a)(i)	current = power / voltage <b>OR</b> 3000 / 36 ; 83 (A) ;	<b>2</b>
9(a)(ii)	charge = current × time <b>OR</b> 83 × 5 × 60 ; 25 000 (C) ;	<b>2</b>
9(a)(iii)	split ring commutator correctly labelled (X) ;  coil correctly labelled (C) ;	<b>2</b>
9(b)	$E = \frac{1}{2}mv^2$ <b>OR</b> $v = \sqrt{2 E / m}$ <b>OR</b> $\sqrt{2 \times 22.5 / 0.05}$ ; = 30 (m / s) ;	<b>2</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
10(a)	167 – 155 <b>OR</b> 12 ; (12 / 155 × 100 = ) 7.7 (%) ;	<b>2</b>
10(b)(i)	change in the, gene / chromosome ;	<b>1</b>
10(b)(ii)	bacteria without the resistance die ; bacteria with the resistance survive and breed ; resistant <u>allele</u> passed onto offspring ;	<b>3</b>
10(c)	offspring are genetically identical / have no genetic variation, to parent ; offspring will not have the resistant allele ;	<b>2</b>

Question	Answer	Marks
11(a)(i)	$C_nH_{2n}$ ;	1
11(a)(ii)	ethane correctly drawn ; ethene correctly drawn ;	2
11(b)(i)	$1000 / 24 = 41.7$ ; $41.7 \times 3 = 125.1$ ; $125.1 \times 24 = 3000 \text{ (dm}^3\text{)}$ ;	3
11(b)(ii)	greenhouse, effect / gas / description of greenhouse effect ; climate change / global warming / other environmental effect ; AVP ;  <b>max 2</b>	2
11(c)	(named) addition reaction ;  (both have) double bond / are unsaturated ;	2
11(d)(i)	condensation polymerisation gives (small molecular) waste product / owtte ;	1
11(d)(ii)		1
11(d)(iii)	HCl ;	1

Question	Answer	Marks
12(a)	tape repair may let in water / short circuit / fire / electrocution ;	<b>1</b>
12(b)(i)	region of high pressure / region of a high concentration of molecules ;	<b>1</b>
12(b)(ii)	distance between two successive compressions ;	<b>1</b>
12(b)(iii)	transverse waves – direction of propagation perpendicular to direction of oscillation ; longitudinal – direction of propagation parallel to direction of oscillation ;	<b>2</b>
12(c)	<i>Any 3 from</i> laterally inverted ; same size ; virtual ; not upside down ;  <b>max 2</b>	<b>2</b>
12(d)	shiny / light surface will reflect <u>more</u> thermal energy / dull / dark surface will absorb <u>more</u> thermal energy ;	<b>1</b>

Question	Answer	Marks												
13(a)(i)	insulin ;	1												
13(a)(ii)	exercise ;	1												
13(a)(iii)	pancreas releases glucagon ; glycogen (stored) in liver ; glycogen converted to glucose ;	3												
13(b)	negative feedback ;	1												
13(c)	<table border="1"> <tbody> <tr> <td data-bbox="344 544 781 609">type of control system</td> <td data-bbox="781 544 1081 609">hormonal</td> <td data-bbox="1081 544 1346 609">nervous</td> </tr> <tr> <td data-bbox="344 609 781 675">method of information transfer</td> <td data-bbox="781 609 1081 675">chemical hormones</td> <td data-bbox="1081 609 1346 675">electrical impulse</td> </tr> <tr> <td data-bbox="344 675 781 740">speed of information transfer</td> <td data-bbox="781 675 1081 740">slow</td> <td data-bbox="1081 675 1346 740">fast</td> </tr> <tr> <td data-bbox="344 740 781 805">longevity of action</td> <td data-bbox="781 740 1081 805">long-lasting / AW</td> <td data-bbox="1081 740 1346 805">short-lived</td> </tr> </tbody> </table>	type of control system	hormonal	nervous	method of information transfer	chemical hormones	electrical impulse	speed of information transfer	slow	fast	longevity of action	long-lasting / AW	short-lived	2
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