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**CO-ORDINATED SCIENCES**

**0654/42**

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.

**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)	6 ;	1																				
1(a)(ii)	<p><i>any two from</i>  there is an optimum temperature ;  above which rate decreases ;  as enzyme denatured ;</p> <p><b>max 2</b></p>	2																				
1(a)(iii)	increase the concentration of glucose / nutrients / sugar or more yeast ;	1																				
1(b)	<table border="1" data-bbox="280 616 1357 946"> <thead> <tr> <th data-bbox="280 616 736 746">type of respiration</th> <th data-bbox="736 616 909 746">carbon dioxide is produced</th> <th data-bbox="909 616 1077 746">lactic acid is produced</th> <th data-bbox="1077 616 1216 746">oxygen is required</th> <th data-bbox="1216 616 1357 746">releases energy</th> </tr> </thead> <tbody> <tr> <td data-bbox="280 746 736 815">aerobic</td> <td data-bbox="736 746 909 815">✓</td> <td data-bbox="909 746 1077 815"></td> <td data-bbox="1077 746 1216 815">✓</td> <td data-bbox="1216 746 1357 815">✓</td> </tr> <tr> <td data-bbox="280 815 736 884">anaerobic respiration in animals</td> <td data-bbox="736 815 909 884"></td> <td data-bbox="909 815 1077 884">✓</td> <td data-bbox="1077 815 1216 884"></td> <td data-bbox="1216 815 1357 884">✓</td> </tr> <tr> <td data-bbox="280 884 736 946">anaerobic respiration in yeast</td> <td data-bbox="736 884 909 946">✓</td> <td data-bbox="909 884 1077 946"></td> <td data-bbox="1077 884 1216 946"></td> <td data-bbox="1216 884 1357 946">✓</td> </tr> </tbody> </table> <p data-bbox="280 986 309 1018">...</p>	type of respiration	carbon dioxide is produced	lactic acid is produced	oxygen is required	releases energy	aerobic	✓		✓	✓	anaerobic respiration in animals		✓		✓	anaerobic respiration in yeast	✓			✓	3
type of respiration	carbon dioxide is produced	lactic acid is produced	oxygen is required	releases energy																		
aerobic	✓		✓	✓																		
anaerobic respiration in animals		✓		✓																		
anaerobic respiration in yeast	✓			✓																		

Question	Answer	Marks
2(a)(i)	same general formula ; similar chemical properties ;	<b>2</b>
2(a)(ii)	<u>alkenes</u> ;	<b>1</b>
2(b)	correct arrangement of atoms ; 2 carbon atoms sharing 2 bonding pairs ; 2 hydrogen atoms sharing bonding pair with each carbon atom ;	<b>3</b>
2(c)(i)	$C_2H_4 + H_2 \rightarrow C_2H_6$ LHS ; RHS ;	<b>2</b>
2(c)(ii)	to make propane ; same homologous series / similar or same reactions / ref. to double bond / it is also an addition reaction ;	<b>2</b>

Question	Answer	Marks
3(a)(i)	X rays to right of UV ; gamma in far right box ;	<b>2</b>
3(a)(ii)	cancer treatment / sterilising medical instruments / radioactive tracers ;	<b>1</b>
3(b)(i)	chemical energy to thermal energy ; thermal to kinetic energy ; kinetic energy to electrical energy ;	<b>3</b>
3(b)(ii)	25% of energy input is transferred to, useful output / electrical energy ;	<b>1</b>
3(c)	$^{89}_{39}\text{Y}$ ; ; $^0_0\text{e}$ ; -1 ;	<b>2</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
4(a)	<i>any three from</i> best horses selected ; these horses allowed to breed ; (offspring observed and) best offspring selected ; process repeated (over many generations) ;  <b>max 3</b>	<b>3</b>
4(b)	<i>similarity</i> features are inherited ; <i>difference</i> humans select the feature in selective breeding / the environment selects the feature in natural selection ;	<b>2</b>
4(c)	adaptation results from natural selection not artificial selection / AW ;	<b>1</b>

Question	Answer	Marks
5(a)(i)	$\text{CH}_4 + 2\text{H}_2\text{O} \rightarrow 4\text{H}_2 + \text{CO}_2$ ;	<b>1</b>
5(a)(ii)	oxygen ;	<b>1</b>
5(b)	catalyst ; speeds up reaction ; lowers activation energy ;  <b>max 2</b>	<b>2</b>
5(c)(i)	product stores less energy than reactants ; (surplus) energy released (from system) ;	<b>2</b>
5(c)(ii)	high temperature provides molecules with more (kinetic) energy / increases speed of molecules ; more molecules have the activation energy / sufficient energy to react ; increased frequency of (successful) collisions ;	<b>3</b>
5(d)	$14 + 3(1) (=17)$ ;  $(\frac{3.4 \times 10^9}{17} =) 2.0 \times 10^8$ ;  $(\frac{3 \times 2.0 \times 10^8}{2}) = 3.0 \times 10^8$ ;  $3.0 \times 10^8 \times 24 = 7.2 \times 10^9 \text{ (dm}^3\text{)}$ ;	<b>4</b>



Question	Answer	Marks
6(a)	20 (Hz) to 20 000 (Hz) ;	1
6(b)(i)	(time =) distance / speed or 40 / 1500 ; = 0.027 (s) ;	2
6(b)(ii)	(wavelength =) velocity / frequency or 1500 / 50 000 ; = 0.03 (m) ;	2
6(b)(iii)	time remains the same because wave velocity doesn't change ;	1
6(c)	any speed lower than 1500 m / s (no mark) ultrasound waves travel slower in a gas compared to a liquid ;	1
6(d)	<i>transverse waves</i> – direction of propagation perpendicular to direction of oscillation / vibration ; <i>longitudinal</i> – direction of propagation parallel to direction of oscillation / vibration ;	2
6(e)	stronger forces of attraction between water molecules in ice ; water molecules are able to move / ice molecules can only vibrate ;	2

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
7(a)(i)	liver ; correctly labelled ;	<b>2</b>
7(a)(ii)	centre of X drawn on the pancreas ;	<b>1</b>
7(a)(iii)	mouth / stomach ;	<b>1</b>
7(b)(i)	fatty acids ;	<b>1</b>
7(b)(ii)	41 (seconds) ;	<b>1</b>
7(b)(iii)	bile <u>emulsifies</u> fats ; increasing the surface area ; <u>lipase / enzyme</u> , break down fat at a faster rate / faster production of fatty acids ;	<b>3</b>

Question	Answer	Marks
8(a)	diagram, does not have / should have, a regular arrangement ; diagram, does not have / should have, alternating ions ; diagram, does not have / should have, equal number of $\text{Na}^+$ and $\text{Cl}^-$ ;  <b>max 2</b>	<b>2</b>
8(b)(i)	reactant salts must be soluble ; to provide lead ions and chloride ions ;	<b>2</b>
8(b)(ii)	lead nitrate + sodium chloride $\rightarrow$ sodium nitrate + lead chloride ;	<b>1</b>
8(c)(i)	bleached / turns colourless ;	<b>1</b>
8(c)(ii)	$\text{Cl}^-$ / chloride ions ; lose electrons / are oxidised ;	<b>2</b>

Question	Answer	Marks
9(a)(i)	radiation ;	1
9(a)(ii)	black surfaces absorb, heat / thermal energy / infra-red more than white surfaces / ORA ;	1
9(a)(iii)	white train would be hotter (than previously) because dull surfaces are poorer reflectors of radiation ;	1
9(b)	force = mass $\times$ acceleration or $450\,000 \times 0.6$ ; = 270 000 (N) ;	2
9(c)(i)	(current =) power / voltage ; = $350 / 75$ ; (= 4.67 / 4.7 A )	2
9(c)(ii)	(resistance of lamp =) voltage / current or $75 / 4.7 = 16.0 (\Omega)$ ; $1 / R_T = 1 / R_1 + 1 / R_2$ or $1 / 16.0 + 1 / 16.0$ ; = $8.0 (\Omega)$ ; <b>OR</b> use of $R = V / I$ ; (combined resistance =) voltage / total current or $75 / (2 \times 4.7)$ ; = $8.0 (\Omega)$ ;	3

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
10(a)(i)	molecules ; dilute ; membrane ;	<b>3</b>
10(a)(ii)	long and thin / elongated / have a large surface area ;	<b>1</b>
10(b)	cohesion ;	<b>1</b>
10(c)(i)	mm / min ;	<b>1</b>
10(c)(ii)	increase in concentration of water (vapour) outside leaf ; less, diffusion / evaporation, of water ; less transpiration pull / movement of water, through the shoot ;	<b>3</b>

Question	Answer	Marks												
11(a)(i)	melts ; bubbles ; flame ; moves across surface / floats ;  <b>max 2</b>	<b>2</b>												
11(a)(ii)	more vigorous / owtte ; reactivity increases down the group ;	<b>2</b>												
11(b)(i)	<table border="1" data-bbox="286 651 1989 847"> <thead> <tr> <th data-bbox="286 651 714 715">isotope</th> <th data-bbox="714 651 1137 715">number of protons</th> <th data-bbox="1137 651 1563 715">number of neutrons</th> <th data-bbox="1563 651 1989 715">number of electrons</th> </tr> </thead> <tbody> <tr> <td data-bbox="286 715 714 778">potassium-39</td> <td data-bbox="714 715 1137 778">19</td> <td data-bbox="1137 715 1563 778">20</td> <td data-bbox="1563 715 1989 778">19</td> </tr> <tr> <td data-bbox="286 778 714 847">potassium-41</td> <td data-bbox="714 778 1137 847">19</td> <td data-bbox="1137 778 1563 847">22</td> <td data-bbox="1563 778 1989 847">19</td> </tr> </tbody> </table> protons ; neutrons ; electrons ;	isotope	number of protons	number of neutrons	number of electrons	potassium-39	19	20	19	potassium-41	19	22	19	<b>3</b>
isotope	number of protons	number of neutrons	number of electrons											
potassium-39	19	20	19											
potassium-41	19	22	19											
11(b)(ii)	no difference ; because of same number of electrons ;	<b>2</b>												

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
12(a)	weight ;	<b>1</b>
12(b)(i)	slip rings labelled correctly ;	<b>1</b>
12(b)(ii)	induced voltage changes every half turn ; same side of coil remains connected to same slip ring ;	<b>2</b>
12(b)(iii)	approx. sine curve ; regular frequency and amplitude ;	<b>2</b>
12(c)	(charge =) current $\times$ time or $20 \times 1 \times 60 \times 60$ ; 72 000 ; C ;	<b>3</b>
12(d)	ray drawn correctly through first prism and through second prism ;	<b>1</b>

Question	Answer	Marks
13(a)	in the, blood / plasma ;	<b>1</b>
13(b)(i)	(glucose needed) for respiration / to release energy ; for, flight / fight / AW ;	<b>2</b>
13(b)(ii)	<i>any two from</i> pupil dilation ; increase in pulse rate ; increase in breathing rate ; avp ;  <b>max 2</b>	<b>2</b>
13(c)(i)	<u>negative feedback</u> ;	<b>1</b>
13(c)(ii)	pancreas produces insulin ; glucose converted to glycogen ; glycogen stored in the liver ;	<b>3</b>