Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

BIOLOGY (US) **0438/41**

Paper 4 Theory (Extended) **October/November 2017**

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.

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Mark schemes will use these abbreviations

- **;** separates marking points
- / alternatives
- **I** ignore
- **R** reject
- **A** accept (for answers correctly cued by the question, or guidance for examiners)
- AW alternative wording (where responses vary more than usual)
- AVP any valid point
- **ecf** credit a correct statement / calculation that follows a previous wrong response
- **ora** or reverse argument
- ( ) the word / phrase in brackets is not required, but sets the context
- underline actual word given must be used by candidate (grammatical variants excepted)
- max indicates the maximum number of marks that can be given

Question	Answer	Marks	Guidance
1(a)(i)	absorption (of digested food / water) / movement of (small) molecules (from small intestine) into blood **;**	**1**	
1(b)	**1** goblet cells labelled **P ;** **2** shaped described **/** produces mucus **;** **3** lacteal / lymph vessel / lymphatic vessel, labelled **Q ;** **4** description / transports fatty acids / fats**;** **5** capillaries / blood vessel, labelled **R ;** **6** thin / one cell thick, walls **/** carries products of digestion **;** **7** microvilli / epithelia labelled **S ;** **8** *for microvilli accept* – large surface area / thin, for diffusion / absorption **;**	**4**	
1(c)(i)	watery faeces / AW **;** dehydration / described **;** loss of, salts / ions / electrolytes **;** cramps / stomach pain **;** death **;**	**2**	**A** water not absorbed from faeces **I** nutrients
1(c)(ii)	oral rehydration therapy **;**	**1**	**A** antibiotics
1(d)(i)	(blood) plasma **;**	**1**	
1(d)(ii)	assimilation **;**	**1**	
1(d)(iii)	protein **;** named proteins **;;**	**2**	**A** (poly)peptides e.g. (named) enzymes, antibodies, insulin, fibrinogen, haemoglobin, glucagon **I** hormones

Question	Answer	Marks	Guidance
2(a)	watch chest / abdomen, rise and fall / use a spirometer ; ref. to time / in one minute ;	**2**	
2(b)	exercise will increase breathing rate ; after exercise the breathing rate, will start decreasing / levels off ;	**2**	
2(c)	*description* carbon dioxide constant / at 4.7% , before exercise ; carbon dioxide highest / higher, at 6.0% / (immediately) after exercise ; decreases; falls below resting level / AW ; comparative data quote ; *explanation* removal of excess carbon dioxide ; more energy used during exercise means higher rates of respiration ; aerobic respiration releases carbon dioxide ; oxygen not supplied fast enough (from lung / heart) / more oxygen required by muscles ; oxygen debt ; anaerobic respiration (in muscles) ; (produces) lactic acid / lactate; lactic acid is, broken down / respired / converted to glucose / converted to carbon dioxide ;	**6**	**A** 4.6%.
2(d)(i)	safety risk (not to over exercise) ; CHD could change the expected result (for healthy people) ; she does not show (named) risk factor ;	**1**	**A** suitable suggestion related to CHD **I** 'danger' unqualified
2(d)(ii)	prevents blocked arteries / prevents thrombus formation ; lowers blood pressure ; lowers cholesterol / lowers fats / reduces risk of atheroma ; weight loss / using fats / avoids obesity ; lowers stress ; (heart) muscle stronger / lower (resting) pulse ;	**3**	**A** increased stroke volume

Question	Answer	Marks	Guidance
3(a)	scent ; nectar ; 'honey' guides ; colourful petals ; large petals ; pollen (as source of food) ;	**3**	**I** sticky pollen / stigma **I** stigma / anther, inside flower **A** mimicry
3(b)	pollen lands on stigma ; pollen tube grows ; through style ; to ovary ; *(pollen nucleus / male gamete)* enters ovule ; through micropyle ; pollen and ovule / egg, nuclei fuse ;	**5**	
3(c)(i)	a version / type, of a gene ;	**1**	***A*** alternative form *of a gene*
3(c)(ii)	test cross ;	**1**	
3(c)(iii)	*parental phenotypes* tall x dwarf *parental genotypes* **TT ;** x **tt ;** *gametes* **T T** x **t t ;** *offspring genotype* **Tt ;** *offspring phenotype* (100%) tall		**A** ecf from parental genotypes.
3(c)(iv)	**tt ;** so that no dominant allele is present / all alleles are recessive / AW ; recessive alleles only expressed if no dominant allele present ;	**2**	**A** homozygous recessive

Question	Answer	Marks	Guidance
4(a)(i)	stem (cells) ;	1	
4(a)(ii)	nucleus / nucleolus / nuclear membrane ; cell membrane ; cytoplasm ; ribosomes ; mitochondria ; endoplasmic reticulum / ER ; vesicle / vacuole ;. AVP ;	2	**R** large permanent vacuole **A** Golgi apparatus, lysosome, centrioles
4(a)(iii)	(transmit impulses) from one (distant) part of the body to another / AW; so (impulse) is fast / AW ;	1	
4(b)(i)	motor (neurones) ;	1	
4(b)(ii)	muscle ; gland ;	1	

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>4(c)(i)</td><td>
<table>
<tr><th>letter from Fig. 4.1</th><th>name</th><th>description</th></tr>
<tr><td>E</td><td>mitochondrion / mitochondria ;</td><td>component of the cell that releases energy during aerobic respiration</td></tr>
<tr><td>H</td><td>neurotransmitters</td><td>chemicals that transmit signals from one neurone to the next neurone</td></tr>
<tr><td>J</td><td>synapse ;</td><td>the gap between two neurones</td></tr>
<tr><td>F/G</td><td>vesicle ;</td><td>the sac in which neurotransmitters are transported to the cell membrane</td></tr>
<tr><td>K</td><td>receptors ;</td><td>the molecules that the neurotransmitters bind to</td></tr>
<tr><td>M</td><td>nucleus ;</td><td>the structure that controls the activities in the cell</td></tr>
</table>
</td><td>5</td><td>one mark per correct row</td></tr>
<tr><td>4(c)(ii)</td><td>brain / spinal cord / central nervous system / CNS ;</td><td>1</td><td></td></tr>
<tr><td>4(d)</td><td>diffusion ;
from high concentration to low concentration / down a concentration gradient ;
direction described ;
AVP ;</td><td>3</td><td></td></tr>
<tr><td>4(e)</td><td>nerves faster / hormones slower ;
nerve impulses are a short lived response / ora ;</td><td>1</td><td></td></tr>
</table>

Question	Answer	Marks	Guidance
5(a)	$C_6H_{12}O_6 + 6O_2 \rightarrow$; $6H_2O + 6CO_2$;	**2**	max one mark if not balanced
5(b)(i)	sugar beet ; (one of three crops that) falls with appropriate temperature range / **ora** ; sugar beet / corn requirement for rainfall, is in the range ; wheat requires more rainfall ; corn / wheat, has a lower productivity / energy yield ; appropriate use of data ;	**3**	wheat and corn also grow in suitable temp.(ecf) **A** sugar beet has a higher energy yield than wheat (or corn).
5(b)(ii)	stunted / reduced / no, growth / yield ; used to make amino acids / proteins ; amino acids converted to proteins ; named molecule containing nitrogen ;	**3**	e.g. DNA, enzymes, chlorophyll
5(b)(iii)	$200 \div 0.0001$ $2\,000\,000 \div 2 \times 10^6$;	**1**	
5(b)(iv)	less land required ; crops can be used as food (rather than fuel) ; less habitat destruction / less deforestation ; less disruption to food chains / greater diversity maintained ; comparison of algae yield with any crop from Table 5.1, with units ; AVP ;	**3**	
5(c)	development that provides for the needs of an (increasing) human (population) ; without harming the natural environment / ecosystems / habitat ;	**2**	

Question	Answer	Marks	Guidance
6(a)(i)	genetic material ; protein coat ; parasitic / pathogenic ; only reproduce in a host / do not show (other) features of living organisms / AW ; very small ; they are not cellular / absence of named organelle; AVP ; cannot be killed / cannot be treated, with antibiotics.	**2**	**A** DNA / RNA **A** virus are non-living.
6(a)(ii)	active immunity ; harmless / dead / weakened / attenuated pathogen / microorganisms ; injected / ingested ; ref. to antigens ; (antigen) triggers antibody production ; by lymphocytes ; memory cells (are produced) ; rapid response to reinfection ; long-term immunity ; prevention of spread person to person e.g. no host for pathogen / herd ref to programmes of mass vaccination ; AVP ;	**5**	.
6(b)	shape / size / AW ; genetic material (sequence / type) ; host species / type of disease it causes ; AVP ;	**1**	