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Cambridge International General Certificate of Secondary Education

BIOLOGY **0610/43**

Paper 4 Theory (Extended) **May/June 2017**

MARK SCHEME

Maximum Mark: 80

Published

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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

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Question	Answer	Marks	Guidance
1(a)(i)	arrow / (s) from a vena cava through atria and into right ventricle **;**	**1**	
1(a)(ii)	**C**, aorta **;**	**1**	
1(b)(i)	ventricles relax **;** increased volume of ventricles **;** higher blood pressure in, the arteries / **C**, **D** and **E** / aorta and pulmonary artery (than in the ventricles) **; ora**	**1**	
1(b)(ii)	stop back-flow (of blood) / ensure (blood) flows one way **;**	**1**	**I** pressure changes
1(c)	1 (right) ventricle contracts **;** 2 blood pressure increases (in heart) **;** 3 higher blood pressure in ventricles than in arteries **;** 4 semilunar valve / valve **1**, opens **;** 5 blood flows into, **D** / **E** / pulmonary artery **;** 6 semilunar valve closes (when blood in pulmonary artery) **;** 7 **D** / **E**, is a pulmonary artery **;** 8 valve **1** is a semilunar valve **;**	**4**	sequence of events must be in the correct order
1(d)	1 septum **;** *either* 2 separates oxygenated and deoxygenated blood **;** *or* 3 to allow a double circulation **;**	**2**	

Question	Answer	Marks	Guidance
2(a)	two cotyledons **;** broad leaves **;** leaves with branching veins **;** petioles **;** flower parts in multiples of four or five / flower parts not in threes **;** pollen with three furrows or pores **;** stem vascular bundles in a ring **;** roots, develop from radicle **;** AVP **;**	**1**	**A** seed leaves **A** not adventitious e.g. secondary growth often present
2(b)(i)	a length of DNA **;** that codes for a protein **;**	**2**	
2(b)(ii)	different sequences of amino acids **;** composed of different amino acids **;** different shapes / folded differently / AW **;**	**2**	
2(c)	*mRNA to max 1* 1 mRNA carries copy of, gene / DNA / base pair sequence **;** 2 goes from nucleus to, ribosome / cytoplasm **;** 3 determines the specific, order / sequence, of amino acids **;** *ribosome to max 1* 4 site of, protein synthesis **;** ('protein synthesis' is in question) 5 ribosome assembles amino acids into proteins **;** 6 passes through the ribosome ***/*** reads mRNA **;**	**2**	
2(d)(i)	1 temperature **;** 2 surface area of substrate **;** 3 concentration / volume / amount / number, of enzyme (solution) **;** 4 concentration / volume / amount, of (named) substrate (solution) **;** 5 type of enzyme **;** 6 type of substrate **;**	**2**	

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Question	Answer	Marks	Guidance
2(d)(ii)	1 increases and decreases **;** 2 peaks at / optimum, at pH 4.0 / 0.55 (au) **;** 3 no activity beyond pH 6.5 **;** 4 curve is symmetrical / AW **;** 5 any data quote, e.g. activity is 0.55 (au) at pH 4.0 **;**	**3**	**A** works best / AW **I** denatured
2(d)(iii)	1 pH 4 is the optimum (pH) **;** 2 pH 7 enzyme is denatured **;** 3 enzyme / protein / active site, has changed shape at pH 7**;** 4 shape of active site is complementary to substrate (4) / not (7) **;** 5 enzyme-substrate complexes form (4) / not (7) **;** 6 (most) effective collisions (between enzyme and substrate) (4) / none (7) **;**	**4**	

Question	Answer	Marks	Guidance
3(a)	*description* 1 (stem) cells divide **;** 2 by mitosis **;** 3 to form, daughter / genetically identical, cells **;** 4 nucleus buds off / AW **;** 5 digested / broken down, mitochondria **;** 6 only one of stem cells specialises / others continue to be stem cells **;** *adaptations* 7 haemoglobin made prior to, mitochondria / nucleus removed / maturation **;** 8 (loss of structures) gives space for, oxygen transport / haemoglobin **;** 9 haemoglobin, transports / AW, oxygen **;** 10 biconcave shape / described **;** 11 large surface area (to volume ratio) ; 12 for diffusion of oxygen / gas(es) **;** 13 AVP **;**	**6**	**MP1 I** reproduce **MP4 A** no nucleus (in mature red blood cell) **MP5 A** no mitochondria (in mature red blood cell) **MP7** must be in correct place in sequence of events **MP8 A** volume for space, **I** area **MP12 I** ref to gas exchange
3(b)	plasma **;**	**1**	

Question	Answer	Marks	Guidance
3(c)	replacement / repair / wound healing **;** cells die / are, rubbed off / exfoliated / AW **;** growth **;**	**2**	
3(d)(i)	iron / Fe / Fe^{2+} / Fe^{3+} **;**	**1**	**R** ion unqualified **A** vitamin B_{12}
3(d)(ii)	tired / lethargic / 'no energy' / weakness / AW **;** shortness of breath **;** chest pain **;** fast heartbeat **;** frequent infections **;** headache / dizziness / light-headedness **;** cold, hands / feet **;** inflammation / soreness, of tongue **;** brittle nails **;** unusual cravings for non-nutritive substances, such as ice, dirt or starch **;** poor appetite **;** tingling or crawling feeling in legs **;**	**2**	**A** pale skin
3(e)	1 mutation **;** 2 change in, base sequence / DNA **;** 3 in gene / allele, for haemoglobin **;** 4 inherit the allele (for sickle cell anaemia / mutated haemoglobin / Hb^S) **;** 5 having the recessive allele(s) / being, homozygous recessive / Hb^SHb^S / heterozygous / Hb^SHb^A **;** 6 produce, abnormal / AW, haemoglobin **;** 7 red blood cells have, sickle shape / described **;** 8 AVP **;**	**4**	**I** references to malaria **MP4 A** allele passed down from, a carrier / parent with sickle-cell anaemia

Question	Answer	Marks	Guidance
4(a)	birds / *Aves* **;** *Any two features for max 1* ; • feathers • beak / bill • hard-shelled eggs • scaly legs • no teeth • air sacs • light-weight skeletons • AVP	**2**	**I** wings / four-chambered heart
4(b)	1 (isolated) group of individual animals / AW **;** 2 of, one / the same, <u>species</u> **;** 3 living in the same, habitat / ecosystem / environment / area / place / location **;** 4 at the same time **;**	**3**	
4(c)	1 killed by predators / not able to evade predators / new predators **;** 2 not able to find food **;** 3 more prone to disease / AW **;** 4 poaching **;** 5 ref to, low genetic variation **;** 6 competition with new species **;** 7 idea of no survival instinct /AW **;** 8 AVP **;** e.g. techniques not as advanced in 1980	**2**	**MP 7 A** captive animals unable to 'cope' in wild / too docile / ref to artificial selection / not integrated with wild population of parrots

Question	Answer	Marks	Guidance
4(d)	1 inbreeding / described **;** 2 less / little, (genetic) variation **;** 3 reduced number of alleles **;** 4 increased risk of genetic disease **;** 5 cannot reproduce / sterile **;** 6 not enough animals to breed **;** 7 less likely to, adapt / to evolve to / cope with, (named) change in environment **;** 8 cost **;** 9 AVP **;;**	**3**	
4(e)	1 to prevent extinction (of many species) / maintain (bio)diversity **;** 2 ref to preventing disruption of food, chains / web **;** 3 provide, habitats (for shelter / breeding grounds / AW) for many species **;** 4 and 5 ecosystems provide, 'service', for humans **; ;** 6 idea of areas for, recreation / (eco)tourism / education **;** 7 ethical reasons / aesthetic reasons / AW **;**	**3**	**MP 1 A** saves many species **MP 4** examples • ref to flooding / natural disasters • ref to nutrients cycle • ref to maintenance of water cycle • ref to greenhouse gas / carbon storage / carbon sink waste disposal • provide, resources / food / fuel / drugs / raw materials / building materials • provide genes (for selective breeding / genetic engineering)

Question	Answer	Marks	Guidance
5(a)(i)	72 (%) **;;**	**2**	difference = 724 g m^{-2} $year^{-1}$ = 724 / 1009 × 100
5(a)(ii)	1 (fertiliser provides) nutrients / salts / ions / minerals (required by plants) **;** 2 (nitrogen / nitrate) needed for making, amino acids / proteins / RNA / DNA / AW **;** 3 proteins are used in growth **;** 4 (magnesium for) making chlorophyll **;** 5 (chlorophyll for) photosynthesis **;** 6 AVP **;**	**3**	**A** original soil lacked minerals
5(a)(iii)	eutrophication **;**	**1**	
5(b)	1 fertiliser decreases species diversity **;** 2 at 21 weeks the difference is greater (than other weeks) **;** 3 species diversity increases and decreases **;** 4 peak at 6 weeks **;** 5 week 24 with fertiliser not following the trend / AW **;** 6 any data quote including data for both plots with units **;**	**3**	**I** anomaly **A** increases
5(c)	1 some species compete much better than others / better at obtaining (named) resource(s) **;** 2 competition for, light / water / nutrients / space / AW **;** 3 some species grow faster **;** 4 example of grassland, adaptions / fast growth **;** 5 better at using ions released by fertiliser **;** 6 more 'robust' / less successful at combating disease *or* pests **;** 7 some cannot survive grazing by grassland herbivores / AW **;** 8 ref to adaptations **;**	**2**	**MP 2 I** competition for mates **MP 4** examples: taller stems / larger leaves **/** longer roots

Question	Answers	Marks	Guidance
6(a)	(disease is caused by) a pathogen **;** passes from one host to another **;**	**2**	
6(b)	1 electrical signal **;** 2 passes along / AW, a, nerve cell / neurone **;** 3 in one direction **;**	**2**	**I** impulse
6(c)(i)	1 (vaccine contains) harmless / attenuated / dead / AW, form of, (named) pathogen / antigen **;** 2 (antigens / vaccine) stimulate an immune response **;** 3 ref to lymphocytes **;** 4 lymphocytes / white blood cells, make antibodies **;** 5 ref to specificity **;** 6 production of memory cells **;** 7 rapid, immune response / AW, if exposed to same, pathogen / antigen **;** 8 gives long-term immunity **;** 9 AVP **;**	**4**	
6(c)(ii)	1 bacteria may still be present (in the population) **;** 2 in carriers / in people who have no symptoms **;** 3 infected people moving into the, country / area / AW **;** 4 if few people are, immune / vaccinated, bacterium is more likely to be transmitted **;** 5 idea of herd immunity **;** 6 some people cannot respond to, antigens / vaccines **;** 7 protects people who travel to other countries **;** 8 booster vaccinations are sometimes required) / AW **;**	**2**	**MP5 A** new people arriving in a country (who are not vaccinated) **MP6** e.g. people with HIV / babies / elderly
6(d)(i)	1 antibodies are made of protein **;** 2 proteins / antibodies, are digested / denatured, in the alimentary canal **;** 3 direct route to site of infection **;**	**2**	

Question	Answer	Marks	Guidance
6(d)(ii)	1 no (active) immune response **;** 2 no memory cells **;** 3 antibodies are broken down in the body **;** 4 antibodies are not made by body's own lymphocytes **;**	**2**	

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