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BIOLOGY **9700/21**

Paper 2 AS Level Structured Questions **May/June 2017**

MARK SCHEME

Maximum Mark: 60

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.

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Mark scheme abbreviations

;	separates marking points
/	alternative answers for the same point
A	accept (for answers correctly cued by the question, or by extra guidance)
R	reject
AW	alternative wording (where responses vary more than usual)
underline	actual word given must be used by candidate (grammatical variants accepted)
max	indicates the maximum number of marks that can be given
ora	or reverse argument
mp	marking point (with relevant number)
ecf	error carried forward
I	ignore
AVP	alternative valid point

Question	Answers	Marks
1(a)	**A** chloroplast / mitochondrion **;** **B** chromosome(s) / chromatid / chromatin **;** **C** Golgi (body / apparatus / complex) **;** **D** nucleolus **;**	**4**
1(b)	*max 1 if only written about prokaryote wall or only about plant wall* **1** prokaryote cell wall has, peptidoglycan / murein **;** **2** plant cell wall has, cellulose / polymer of β glucose **; I** lignin **3** AVP **;** e.g. prokaryote wall is made of chains crossed linked by, peptides / amino acids hydrogen bonds between cellulose molecules (within microfibrils) in plant cell wall **A** cellulose chains other components such as pectins / hemicelluloses in plant cell walls	**max 2**

Question	Answers	Marks
2(a)	half V_{max} / AW, = 7 (μmol dm^{-3} min^{-1}) / take half of V_{max} of 14 (μmol dm^{-3} min^{-1}) **;** **A** description of using the graph to find ½ V_{max} without reference to figures read (substrate concentration) from *x*-axis / AW **;** *alternative* plot 1 / [S] = x	**2**

Question	Answers	Marks
2(b)	***allow*** *phosphate group(s) / organic compound for substrate* *if affinity not used, accept idea of ability to form ESC* *check for* ***ora*** **I** *ref. to* competitive inhibition **1** enzyme **B** has a lower affinity for its substrate (than enzyme **A**) **or** the higher the K_m the lower the affinity of the enzyme for its substrate **;** **R** if substrate has affinity for the enzyme **2** enzyme **B** needs a higher concentration of substrate to reach, V_{max} / ½V_{max} / K_m (than enzyme **A**) **;** **3** AVP **;** e.g. enzyme **B** forms fewer ESC in the same unit of time enzyme **B** active site is a less good fit for substrate *idea that* in normal cell enzyme **A** is saturated (with substrate) so works at a constant rate variations in substrate concentration will have less effect on the rate of formation of product by enzyme **A** **I** *ref. to* turnover number(s)	**max 2**
2(c)	*marks can be taken from a sketch graph* **1** competitive inhibitor, occupies / competes with substrate for / AW, <u>active site</u> (of the enzyme) **;** **2** reduces frequency of collisions (with substrate) / fewer ESCs form **;** **R** no ESCs form **3** reduces reaction rate at low substrate concentrations **;** ***4*** *idea that* curve with inhibitor is to the right of the curve without inhibitor **;** **5** at high substrate concentration / with increasing substrate concentration, the inhibitor has, no / less, effect **;** **A** *idea that* substrate outcompetes inhibitor at high substrate concentration **6** therefore V_{max} is the same as it is determined by the enzyme concentration / AW **;** **A** explanation in terms of active sites, saturated / fully occupied ***7*** *idea of* intercept to curve gives a higher value for K_m **;**	**max 4**

Question	Answers	Marks
3(a)	(antibody has) more than <u>one polypeptide</u> **;** **A** <u>four polypeptides</u> **R** two / two or more / two types of / many / AW, polypeptides	**1**
3(b)(i)	*allow epitope for antigen* **1** (two) antigen-binding, site(s) / region(s) **;** **A** binds to / AW, antigens **R** active site **2** (shape / structure is) <u>complementary</u> to antigen **;** ***3*** *idea of* specificity / AW **;** **4** *ref. to*, primary structure / sequence of amino acids **;** **5** *ref. to* R-groups / (amino acid) side chains, and interactions with antigen / giving specific shape **;**	**max 3**
3(b)(ii)	binds to (receptors on), phagocytes / macrophages / neutrophils **;** **A** other correct named cell of the immune system AVP **;** e.g. gives class of antibody (e.g. IgM, IgG, IgA, IgE)	**max 1**
3(c)(i)	**1** <u>antigen</u>, introduced / AW, into, (small) mammal **;** **A** named small mammal **2** B-lymphocytes / B cells / plasma cells / splenocytes / antibody-producing lymphocytes, are taken / are isolated (from the spleen / lymph nodes) **;** **3** (these) cells are fused / AW, with, myeloma / cancer, cells **;** **4** <u>hybridoma</u> cells / <u>hybridomas</u>, formed **;** **R** hybridised cells / hybrid cells **5** hybridoma cell, is cloned / AW **;** **6** screening / testing, for hybridoma that produces desired antibody **;** **7** *ref. to* scaling up / large-scale production / grow in a fermenter **;** **8** AVP **;** e.g. fusion using, fusogen / polyethylene glycol / PEG / electric current (electrofusion) / (Sendai) virus HAT medium, for, hybridoma growth / inhibiting myeloma growth humanisation of monoclonal antibody	**max 4**

Question	Answers	Marks
3(c)(ii)	**I** *suggestions for treatment* **1** monoclonal antibodies used all have the same specificity **;** **R** 'are specific' unqualified **2** detect only one, antigen / epitope **;** **3** can distinguish between different, pathogens / strains of, pathogens **; A** types of cancer cells **4** can be, labelled / tagged / marked / AW **;** e.g. with fluorescent label **5** monoclonal antibodies can detect location of, tissues expressing antigen / cancer cells / blood clots **; A** *idea of* locating areas of infection **6** fast(er) (diagnosis) **;** **7** can detect antibody levels (e.g. HIV) **;** **8** AVP **;** e.g. some pathogens cannot be cultured **I** *ref. to* cost	**max 2**

Question	Answers	Marks
4(a)	*mRNA* **1** single-stranded **;** **2** no hydrogen bonding / only DNA has hydrogen bonding **;** **3** no base pairs / only DNA has base pairs **;** **4** uracil and not thymine / DNA has thymine instead of uracil **;** *treat as neutral T and U, look for complete term* **5** ribose not deoxyribose **;** **6** detail, e.g. –H and not –OH on C2 **;** **7** short(er) / DNA is longer **; A** smaller / bigger **8** not a helix **;**	**max 4**
4(b)(i)	*third triplet is a stop codon so* only two amino acids are joined by peptide bonds / chain only 2 amino acids long **;** **A** will still have Val-His as the first two amino acids very short molecule is produced / chain stops after His(tidine) **;** **R** frameshift / description of frameshift	**max 1**

<table>
<tr><th>Question</th><th>Answers</th><th>Marks</th></tr>
<tr><td>4(b)(ii)</td><td>a triplet is deleted so
(polypeptide / sequence / β chain) has one less amino acid ;
polypeptide does not have Leu (as the third amino acid) ;
I Leu is not, produced / made / synthesised</td><td>max 1</td></tr>
<tr><td>4(c)</td><td><table>
<tr><th>feature</th><th>DNA replication</th><th>transcription</th></tr>
<tr><td>a single-stranded molecule is produced</td><td>×</td><td>✓</td></tr>
<tr><td>hydrogen bonds are broken</td><td>✓</td><td>✓ ;</td></tr>
<tr><td>both strands of DNA act as templates</td><td>✓</td><td>× ;</td></tr>
<tr><td>phosphodiester bonds are formed</td><td>✓</td><td>✓ ;</td></tr>
<tr><td>DNA polymerase is used</td><td>✓</td><td>× ;</td></tr>
</table></td><td>4</td></tr>
<tr><td>4(d)</td><td>I functions of telomerase
permits continued replication (in stem cells / meristematic cells) ; A ora
prevents loss of, genes / genetic material / DNA ; A ora
A prevents shortening of, chromosomes / DNA
length of telomere determines lifespan of, cells / cell lineage ;
AVP ; e.g. prevents ends of chromosomes attaching to each other prevents apoptosis / cell death / cell destruction</td><td>max 2</td></tr>
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Question	Answers	Marks
4(e)	**1** translation / construction of polypeptide(s) **;** **2** provide binding site for mRNA / mRNA attaches to ribosome / AW **;** **A** entering ribosome **3** provides binding sites for (two) tRNA molecules **;** **A** entering ribosome **4** two amino acids are held close together **;** **5** formation of peptide bond(s) **; R** dipeptide / polypeptide, bond **6** (allows) assembly of amino acids into, sequence / primary structure **;** **7** AVP **;** e.g. P and A site (and E site) bond between amino acids catalysed by peptidyl transferase	**max 4**

Question	Answers	Marks
5(a)	sugar (molecules) / glucose / fructose, is polar / is water soluble / not lipid soluble / hydrophilic **;** cannot pass through, (phospho)lipid bilayer / hydrophobic core / fatty acid 'tails' / hydrocarbon 'tails' **; A** non-polar regions	**2**
5(b)	*accept H^+ for proton throughout* **1** (*at **Y***) protons, pumped out (of companion cell) / moved out by active transport / move out through proton pump **;** **A** protons are moved out against concentration gradient **2** creates a, proton gradient / electrochemical gradient **;** **3** protons go into the, cell wall / apoplast **; R** mesophyll cell **4** (*at **X***) protons enter cell by facilitated diffusion **;** **5** (**X** is) cotransporter / cotransport protein **;** **6** sucrose transported into (companion) cell together with protons **;** **7** (sucrose enters) against concentration gradient **;** **8** sucrose concentration, increases / maintained, in companion cell **;** **9** sucrose diffuses into sieve tube (element) **;** **10** through plasmodesmata **;** **11** AVP **;** e.g. *ref. to*, secondary / indirect, active transport	**max 5**

Question	Answers	Marks
5(c)	*look for names of plant organs other than leaves, ignore names such as potato, iris, onions* **R** leaves unqualified *any two for max 1* root / root tip stem / stem tip / shoot / shoot tip tubers bulbs corms rhizomes buds flowers fruits seeds young / maturing / developing / infected, leaves AVP	**max 1**

Question	Answers	Marks
6(a)(i)	*Vibrio cholerae* **;**	**1**
6(a)(ii)	faecal-oral route **;;** *description of faecal / oral route* *infected person* faeces / sewage / stool, contaminating (drinking) water **R** (human) waste unqualified **or** poor hygiene so transferring, faecal material / sewage, onto utensils / food / AW **or** defaecating / putting sewage, onto vegetable plots **;** **or** flies in contact with contaminated faeces landing on food and contaminating / AW *uninfected person* eating contaminated food / using contaminated utensils **or** drinking contaminated water **;**	**max 2**
6(b)	1 ganglioside is the receptor for choleragen **;** 2 choleragen is complementary to ganglioside **;** 3 any interaction between molecules **;** e.g. (hydrogen / ionic) bonding	**max 2**
6(c)	endocytosis **; A** phagocytosis / pinocytosis	**1**
6(d)	1 loss of water / dehydration **;** 2 by osmosis **;** 3 (water moves out) down water potential gradient / from high to low water potential / high Ψ to low Ψ **;** 4 Loss of cations / positively-charged ions (as well as chloride ions) **;** 5 change in potential (difference) / change in charge across membrane **;** 6 AVP **;** e.g. disruption of absorption (of products of digestion / vitamins / mineral ions) disruption of digestion	**max 2**

Question	Answers	Marks
6(e)	1 rehydration therapy, is effective / can treat cholera / reduces death rate **;** 2 any detail **;** e.g. solution of glucose and salts 3 antibiotic is a selection pressure / described **;** 4 *ref. to*, antibiotic / tetracycline, resistance **;** 5 *ref. to*, vertical transmission / horizontal transmission, of resistance **;** **A** described, **A** transfer for transmission 6 antibiotics will become, ineffective / less effective / AW **;** 7 keep antibiotics for use 'as last resort' **;** AW 8 *ref. to* cost **;** 9 antibiotics kill gut bacteria **;** 10 *idea that* disrupts functions of digestive system **;** 11 AVP **;** e.g. antibiotics going into the environment / food chain antibiotics can cause mutation decreases need to develop new drugs prevents development of active immunity *idea of* transmission between bacterial species plasmids with resistance genes	**max 3**