Cambridge International AS & A Level

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BIOLOGY **9700/21**

Paper 2 AS Level Structured Questions **May/June 2018**

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.

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.

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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.

Mark scheme abbreviations

;	separates marking points
/	alternative answers for the same point
R	reject
A	accept (for answers correctly cued by the question, or by extra guidance)
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	Answer	Marks
1(a)(i)	*answers must be comparative* *one from:* *idea that* the sections are orientated differently / cut in different planes / cut at different angles / AW **;** **A** is a cross section / AW, and **B** is a longitudinal section / AW mitochondria show a variety of, sizes / shapes **;** mitochondria, are flexible / change shape **;** **A** and **B** are of, different ages / stages of development **;**	**1**
1(a)(ii)	*two from:* replace, old / worn out / damaged, mitochondria **;** require more mitochondria as cells, enlarge / grow **;** more mitochondria are needed, for new cells / when cell divides **;** **A** so numbers remain the same in the new cells / after cell division **A** *idea that* mitochondria are shared out (between daughter cells) (mitochondria) provide (most), energy / ATP **;** **I** cell needs (much) energy without stating mitochondria provide energy **R** energy production **I** uses of energy	**2**
1(b)	*two from:* nuclear envelope shown as two membranes with closed ends and a gap **;** label to nuclear pore **;**	**2**

Question	Answer	Marks
1(c)	*four from:* 1 contains / AW, chromosomes / chromatin / DNA / genes / genetic material / inherited material / genetic information **;** 2 (coded) information for synthesis of, polypeptides / proteins **;** **A** controls protein synthesis 3 ref. to sequence(s) of bases (in DNA) **;** 4 transcription (of genes) / production of mRNA **;** 5 contains nucleolus **;** 6 manufacture of ribosomal sub-units **;** **A** makes ribosomes 7 *idea that* DNA is protected from degradation / enzymes / AW **;** 8 AVP **;** e.g. responds to signals that control, gene expression / AW post-transcription modification / modifies mRNA / any example repairs DNA **I** controls cell's activities **I** sends mRNA to cytoplasm / mRNA travels through nuclear pores	**4**

Question	Answer	Marks
2(a)(i)	**A** – (α-) glucose **;** **R** any qualification of glucose other than α, e.g. β-glucose **B** – fructose **;** **I** hexose sugar **I** any qualification of fructose, e.g. α	**2**
2(a)(ii)	glycosidic **;** **R** glucosidic **I** any qualification of glycosidic, e.g. 1–2, 1–6	**1**
2(a)(iii)	hydrolysis **;** **A** acid hydrolysis	**1**

Question	Answer	Marks
2(b)	*two from:* sucrose is, a non-reducing sugar / non-reducing / not a reducing sugar **;** **A** no reducing sugars present no (hydrochloric) acid used (to break down sucrose to reducing sugars) **;** **A** sucrose not hydrolysed (to monomers / monosaccharides / reducing sugars) AVP **;** (sucrose will not reduce) (blue) copper II ions to (red) copper I ions cannot donate electrons *idea that* reactive groups are not available (to react with Benedict's solution / copper ions) no (free), aldehyde / ketone, group	**2**
2(c)	*hydrostatic required once only in the answers* *four from:* 1 diffusion, into phloem sieve tube (element), from companion cell (through plasmodesmata) **;** 2 presence of sucrose (in phloem sieve tube element), lowers water potential / makes water potential more negative **;** **R** if in context of xylem vessels or companion cells 3 water enters (sieve tubes), by osmosis / down water potential gradient (into sieve tubes) **;** 4 increase in, hydrostatic, pressure (in sieve tube elements) **;** **A** turgor pressure 5 low hydrostatic pressure in, storage tissues / root / sink, by removal of sucrose **;** 6 movement of, (phloem) sap / sucrose (in solution), down hydrostatic pressure gradient / from high to low hydrostatic pressure **;** 7 mass flow **;**	**4**

Question	Answer	Marks
3(a)	*four from:* activity increases and decreases / activity peaks, for both **;** **A** both have maximum activity / optimum temperature, at 60 °C activity is 76% at 40 °C for both **;** (overall) activity decreases more steeply for free enzyme after, optimum / maximum / 60 °C **;** **A** ora at 80 °C free enzyme is inactive / (fully) denatured / 0%, but immobilised enzyme, is still active / is partially denatured / 27% **;** for immobilised enzyme, activity is higher (than free enzyme) at all temperatures above 60 °C **;**	**4**
3(b)	*two from:* (alginate / immobilisation), is protective / has stabilising effect **;** **A** enzyme, less / not, exposed (to solution) hydroxide ions do not penetrate the alginate beads **;** shape of active site (of immobilised enzyme) is, less / not, disrupted / AW **;** **A** active site is (more) complementary to substrate **A** few(er) active sites are, altered / changed few(er) bond(s) within (immobilised) enzyme break **;** **A** hydrogen / ionic **R** peptide / disulfide at pH 8 immobilised enzyme is not fully denatured **;** **A** pH 7 / 7.5	**2**

Question	Answer	Marks
3(c)	*explanation must match variable stated* *standardised variable* concentration / volume, of, enzyme / substrate, solution **;** *explanation for standardised variable* *idea that:* concentration / volume, of, enzyme / substrate, influences the probability of collisions between enzyme and substrate molecules / formation of enzyme/substrate complexes **;** **A** number of / frequency of, collisions between substrate and enzyme **or** *standardised variable* use the same method for determining enzyme activity **;** e.g. time when samples are taken *explanation for standardised variable 3* ref. to how enzyme activity is measured by conversion of substrate to product **;**	**2**

Question	Answer	Marks
3(d)	*two from:* 1 (may be able to) obtain more product (per unit time) **;** 2 can use higher temperatures (to obtain more product) / still active at higher temperatures **;** **A** thermostable 3 does not denature (as easily as free) if temperatures increase / AW **;** 4 immobilised enzyme can be reused / immobilised enzyme can be recovered **;** 5 enzyme does not contaminate product **;** **A** no effect on quality of product, e.g. taste 6 less, purification (of product) / downstream processing, needed **;** **A** idea that downstream processing less, complex / difficult 7 longer shelf-life of enzyme / AW **;** **A** durability 8 AVP **;** e.g. allows continuous production (rather than batch) some enzymes are difficult to extract **I** ref. to cost / cost effective unqualified **R** reduces effect of end product inhibition	**2**

Question	Answer	Marks
4(a)	**E** – haem / porphyrin (ring) **;** **I** iron / iron-containing group **A** conjugated group / prosthetic group **F** – α helix **; R** a helix **G** – tertiary structure **;** **A** 3° structure **H** – primary structure **;** **A 1°** structure **J** – quaternary structure / 4° structure / 2α and 2β globins **;** **A** polypeptides for globins	**5**
4(b)(i)	98 (%) **;**	**1**
4(b)(ii)	*four from:* 1 Bohr, shift / effect **;** 2 (at any pO_2 on the left of graph) percentage saturation of haemoglobin decreases / haemoglobin releases more oxygen (to muscle tissue) / increases dissociation of oxyhaemoglobin **;** **A** any comparative data quote for any one value of pO_2 between 1 and 5 kPa 3 (increase in carbon dioxide) increases production of carbonic acid **;** 4 increase in hydrogen ions (in red blood cells) **;** 5 haemoglobin accepts hydrogen ions / formation of haemoglobinic acid (HHb) **;** **A** haemoglobin has an affinity for hydrogen ions 6 decreases the affinity between haemoglobin and oxygen **;**	**4**

Question	Answer	Marks
5(a)	*five from:* **A** 'cells' for 'lymphocytes' throughout 1 ref. to antigen presentation **;** **A** macrophage presents antigen 2 recognition / binding (in context of B-, or T-lymphocytes) **;** e.g. cell surface receptor specific to toxoid / clonal selection **A** immunoglobulin / antibody on surface of B-lymphocytes 3 T-lymphocytes or B-lymphocytes, divide by mitosis / clonal expansion **;** 4 (some) plasma cells, formed / AW **;** **R** if in context of T-lymphocytes 5 antibody molecules / antibodies, secreted / produced / released **;** **R** if in context of T-lymphocytes 6 T helper cells secrete, cytokines / interleukins **;** 7 ref. to action of cytokines / interleukins **;** e.g. to stimulate, humoral response / B-lymphocytes / to stimulate macrophages / angry macrophages 8 formation of memory cells **;** *only in context of B- / T-lymphocyte activation*	**5**

Question	Answer	Marks
5(b)(i)	*three from:* 1 failure to distinguish between self and non-self / AW **;** 2 specific B-,lymphocytes / cells, are not destroyed (during development) **;** 3 antibodies are produced against, cell surface / ACh, receptors on, muscle cell / neurones / nerve cells **;** 4 antibodies, bind to / block, receptors **;** **A** antibody–antigen, binding / complex *if receptors already given* 5 AVP **;** any detail related to the disease e.g. (chemical) transmitter molecules / acetylcholine, cannot bind (to receptor) impulses are not transmitted across synapse / neurones cannot send impulses ref. to causing, muscle weakness / muscle fatigue ref. to neuromuscular junction does not function	**3**
5(b)(ii)	*two from:* so immune response, occurs all the time / recurs **;** (defective) B-lymphocytes still being produced / AW **;** **I** T (helper) cells **A** not destroyed / remain plasma cells / B-lymphocytes, continue to release antibodies against receptors **;** memory cells / immunological memory, present **;** receptors are always present (on neurones / nerve cells) **;** AVP **;** e.g. no cure	**2**

Question	Answer	Marks
6(a)	**A** – endodermal (cell) **;** **A** endodermis / passage cell **B** – apoplast(ic) **;**	**2**

Question	Answer	Marks
6(b)	*five from:* 1 water potential gradient, between leaves and roots ; **A** water potential gradient across the root (root hair to xylem / across cortex) 2 diffusion out (via stomata) of water vapour ; 3 evaporation of water from mesophyll cell, surfaces / walls / membranes ; 4 (transpiration from leaves) creates transpiration pull ; 5 tension is, set up / present, in xylem vessels ; 6 cohesion between water molecules (*in xylem or in roots)* ; 7 hydrogen bonding between water molecules ; 8 adhesion of water molecules to cellulose (in wall of xylem vessels) ; **A** to hydrophilic parts of lignin 9 movement of water from apoplast through endodermis by osmosis ; 10 AVP ; e.g. *idea that* water columns extend from centre of root to root hairs (and to soil water)	**5**
6(c)	*two from:* *pathway C is slower* ***accept ora*** *for pathway B is faster* greater resistance ; water passes across membranes ; water flows through, cytoplasm / plasmodesmata ; **A** ora ref. to intercellular spaces **A** protoplast osmosis occurs ; **R** through plasmodesmata ref. to water passes through vacuoles ;	**2**
6(d)	*assume answer is about facilitated diffusion unless told otherwise – accept* ***ora*** *for active transport* *two from:* movement is, down a concentration gradient ; passive / ATP not required / (metabolic) energy not required ; carrier and channel proteins are involved ;	**2**