Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

BIOLOGY **9700/23**

Paper 2 AS Level Structured Questions **October/November 2019**

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.

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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.

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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

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Question	Answer	Marks
1(a)(i)	haem ; **A** heme / prosthetic group **I** iron / iron ion / Fe / Fe^{2+} **I** porphyrin ring	**1**
1(a)(ii)	*one from* combines with / binds / carries / transports / AW, oxygen (in lungs) ; **R** forms bonds releases / AW, oxygen, in tissues / at low oxygen concentrations ; allows haemoglobin to transport oxygen ;	**1**
1(b)	*two from* **1** spherical / ball-like / rounded / AW ; **R** circular / round **ignore** 3D shape **2** (water) soluble / forms H bonds with water ; **3** hydrophilic R-groups on outside of molecule / hydrophobic R-groups on inside ; **R** *ref. to* 'tails' **4** dynamic / metabolic / physiological / AW, function ;	**2**
1(c)	made of amino acids ; *one from* joined by peptide bonds ; **R** 'peptide bond between two amino acids' **R** 'dipeptide bond(s)' macromolecule / long-chain (molecule) / large molecule ; repeated / many, (sub-)units / monomers ;	**2**

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Question	Answer	Marks
1(d)	*three from* **1** (R-group of) glutamic acid / glu, is polar / hydrophilic **and** (R-group of) valine / val, is non-polar / hydrophobic **;** **2** change in tertiary structure **;** **A** 'change in globular shape / less globular in shape' **3** change in quaternary structure of haemoglobin **; R** of β-globin **4** *ref. to* haemoglobin forms fibres (with other Hb) **; A** 'sticky molecules' **5** haemoglobin is less (water) soluble **; I** insoluble **6** haemoglobin is less efficient at, binding / transporting, oxygen **;** **A** less oxyhaemoglobin **A** haemoglobin / β-globin, has lower affinity for oxygen **A** reduced oxygen carrying capacity **I** haemoglobin, does not / cannot, bind oxygen **7** AVP **;**	**3**

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Question	Answer	Marks
1(e)	*three from* **1** haemoglobin combines with carbon dioxide **;** **2** carbon dioxide reacts with (terminal), amine group(s) / $–NH_2$ / –NH **;** **3** to form carbaminohaemoglobin **;** **R** carboxyhaemoglobin / carbonylhaemoglobin **4** each polypeptide can carry a molecule of carbon dioxide / haemoglobin can carry four molecules of carbon dioxide **;** **5** carbon dioxide remains, bound / AW, to Hb until in, region of low pCO_2 *or* high pO_2 / pulmonary circulation / lungs / alveoli **;** **6** *ref. to* (carbonic acid dissociates to form) hydrogen ions, which bind to / AW, haemoglobin **; A** H^+ forms haemoglobinic acid *or* HHb **I** hydrogen unqualified **7** AVP **;** e.g. hydrogencarbonate ions to plasma	**3**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)</td><td>
<table>
<tr><th>name</th><th>one example of cell from 2.1</th></tr>
<tr><td>interphase</td><td>B / G</td></tr>
<tr><td>prophase</td><td>A</td></tr>
<tr><td>metaphase</td><td>D</td></tr>
<tr><td>anaphase</td><td>E / F / C</td></tr>
<tr><td>telophase</td><td>C / H
R C *if stated for anaphase*</td></tr>
</table>
all five correct = 3 marks
three or four correct = 2 marks
one or two correct = 1 mark
</td><td>**3**</td></tr>
<tr><td>2(b)</td><td>(29 as a percentage of 5000 =) 0.58 (%) **;** **A** 0.6 (%)
(0.0058 × 720 minutes =) 4 (min) / 4.2 / 4.18 / 4.176 **;** *allow ecf*</td><td>**2**</td></tr>
<tr><td>2(c)</td><td>*mark first answer*
one from

1 cell plate forms (across equator of cell) **;**

2 cell wall / cellulose, laid down **;** **A** cell wall forms (between the two)

3 <u>cytoplasm</u> divided (into two) **;**
R cytoplasm, constricts / pinches in
I ‘separates into two daughter cells’
I events at late telophase

4 *idea that* organelles shared out **;**

5 AVP **;** detail of cell plate formation
e.g. *ref. to* vesicles transported to equator / involvement of cytoskeletal structures / *ref. to* phragmoplast</td><td>**1**</td></tr>
</table>

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Question	Answer	Marks
3(a)	*five from* **1** drought-tolerant plants have smaller stomatal aperture **and** lower, transpiration rate / rate of water uptake **; A ora** **2** comparative data quote for, mean stomatal aperture / transpiration rate + mmol m^{-2} s^{-1} / mean water uptake + cm^3 per shoot + time + h **;** *in drought-tolerant plants* **3** smaller (aperture), stomata so less water (vapour) loss **;** **4** water vapour diffuses (out) through stomata **;** **5** less evaporation from (cell walls of) mesophyll **;** **6** so less transpiration pull **;** **7** AVP **;** suggestion of other adaptations of leaves to reduce water loss e.g. sunken stomata / thicker cuticle / hairs / trichomes / lower stomatal density **R** closed stomata	**5**

Question	Answer	Marks
3(b)	**I** *any ref. to mutation* / *inhibition of (RNA) polymerase* **1** microRNA binds to mRNA **;** **A** forms hydrogen bonds with (bases on) mRNA **2** bases in microRNA are <u>complementary</u> to bases on mRNA **;** **3** microRNA makes mRNA too large to leave nuclear pore / mRNA cannot reach ribosomes **;** ***mp4*** *and* ***mp5*** *accept alternatives to bind* **4** mRNA cannot, bind / AW, to (small sub-unit of) ribosome **;** **A** prevents ribosome moving along mRNA **5** anticodons of tRNA cannot, bind / AW, to (some) codons on mRNA **;** **6** no / not all, amino acids are brought to ribosome / AW **;** **7** AVP **;** e.g. complex of microRNA and mRNA recognised for degrading	**3**

Question	Answer	Marks
4(a)	*artery wall* **I** *narrow lumen to maintain high (blood) pressure* **I** *ref. to valves* / *ref. to inner lining being wrinkled or wavy* **1** thick, walled / tunica media, to withstand high (blood) pressure / prevent bursting **;** **2** endothelium / endothelial cells / tunica intima, are smooth, little friction to blood flow / easy flow of blood / no eddies of blood flow / AW **;** **3** elastic, tissue / fibres, stretches to allow surges in blood flow / recoils to maintain blood pressure *or* force blood forward **;** **4** smooth muscle (contracts to), maintains / regulates / controls blood flow **;** **A** smooth muscle distributes blood **5** collagen fibres, avoid rupturing / bursting **;**	**4**
4(b)(i)	red blood cells / erythrocytes **; R** red and white blood cells *one from* biconcave (shape) **;** no nucleus **;** *idea of* uniform, cytoplasm / cell contents **;** *idea of* rouleau / stacked cells **; I** 'clumped' **I** size	**2**

Question	Answer	Marks
4(b)(ii)	*assuming arteriole unless told otherwise, accept alternative terminology for layers of wall of arteriole* **I** *ref. to folding* **1** thicker wall / more than one layer of cells in wall / has tunica intima, tunica media and tunica adventitia whereas capillary has tunica intima **; A** endothelium for tunica intima **2** more cells forming, perimeter / tunica intima **;** **3** wider (vessel) / wider lumen / AW **; A** actual width(s) **4** nucleus / nuclei, present in wall only in arteriole **;** **5** cells lining lumen / endothelial cells, are thicker **;** **6** lumen smaller, relative to the, thickness of the wall / overall width **;** **7** more (red blood) cells (in lumen) **;** **8** nuclei projecting inwards only in arteriole **;** **9** AVP **;** e.g. *ref. to* smooth muscle cells capillaries are surrounded by cells correct calculation of actual sizes using magnifications in Fig. 4.1 arteriole 20–35 μm and capillary 6–7 μm	**4**

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Question	Answer	Marks
4(c)(i)	**1** higher (hydrostatic) pressure of blood (at start of capillary) **;** **2** (pressure / ultra) <u>filtration</u> of blood **;** **3** (causing) leakage / movement out / pushing out, of <u>plasma</u> **;** **R** diffusion **4** *either* glucose / amino acids / salts, (filtered) out *or* (large) plasma proteins not (filtered) out **;** **5** AVP **;** e.g. *ref. to* pores / fenestrations / gaps, within / between, endothelial / lining, cells e.g. molecules smaller than MM ~68 000 (g mol^{-1} / daltons) can pass out	**2**
4(c)(ii)	lymph **; A** lymphatic (fluid) *one from* **I** *any cells* / *waste products* / *toxins* / *antibodies* / *fatty acids and glycerol* no, named / large / plasma, proteins, e.g. albumen no / little / less, oxygen / glucose higher concentration of / more, carbon dioxide AVP **;** e.g. higher concentration of / more, fat / lipids / lipoproteins *if fluid identified as tissue fluid give one mark as an ECF for a difference between plasma and tissue fluid* e.g. no, named / large / plasma, proteins e.g. albumen	**2**

Question	Answer	Marks
5(a)	*two from* protein coat / capsid / capsomeres **;** nucleic acid / <u>DNA or RNA</u> (core) **; I** single- or double-stranded **A** 'DNA/RNA' **I** genetic material size given in nanometres / smaller than prokaryotes **;** **I** small / very small / microscopic **I** acellular	**2**
5(b)	*three from* **1** drugs can be <u>inhibitors</u> (of neuraminidase) **;** *either* **2** (competitive inhibitor) so binds to active site *or* (non-competitive inhibitor) so binds to allosteric site / AW *or* (drugs may act by) breaking down / hydrolysing / denaturing, all / part of neuraminidase **; A** changes active site **3** no / less, enzyme-substrate complexes formed **; A** ESC **A** substrate not able to bind to enzyme **A** neuraminidase cannot bind to (host cell) receptor **4** receptor is (still) complementary to haemagglutinin **;** **5** haemagglutinin becomes attached to, cell receptor / host cell (so newly formed virus does not leave the cells) **;**	**3**

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Question	Answer	Marks
5(c)	*four from* **1** antigen presentation **;** *in correct context* **2** clonal selection / activation, of specific, B-lymphocytes / T-lymphocytes **;** **A** B cells / T cells **3** (lymphocytes) divide by mitosis / undergo clonal expansion **;** **4** B-lymphocytes, differentiate into / mature into / form / AW, plasma cells **;** **5** antibodies secreted by plasma cells **;** **6** T-helper cells secrete cytokines **;** **7** cytokines stimulate / AW, B-lymphocytes / plasma cells / humoral response **;**	**4**

Question	Answer	Marks
5(d)(i)	*max 2 (out of total three marks)* *advantages* *allow references to other pathogen types* **1** antibodies are provided to people immediately / no delay for plasma cells to secrete antibodies **;** **A** immediate, immunity / protection **R** immediate (immune) response **2** antibodies, immediately neutralise toxins / prevent viruses entering cells **;** **3** prevents disease (in the individual) / promotes quicker recovery **;** **4** prevents spread of the pathogen through the population / prevents people dying **;** **5** antibodies can be manufactured quickly in response to mutations that occur in virus / AW **;** *max 2 (out of total three marks)* *disadvantages* **6** short-term / temporary (immunity) **;** **7** no memory cells produced **;** **8** can have infections of <u>same</u> pathogen again **;** **9** allergic reaction / immune response, to the (non-human) antibodies given **;** **10** *ref. to* cost qualified **;** e.g. needs to be repeated / high cost of production of antibodies **11** AVP – for advantage (A) or disadvantage (D) **;** e.g. (A) passive can be used for people who are malnourished / immunosuppressed e.g. (A) *ref. to* using a vaccine with a (live) pathogen that might give person the disease	**3**
5(d)(ii)	across the placenta **;** **A** via umbilical cord in breast milk / colostrum / breast feeding / during lactation **;**	**2**

Question	Answer	Marks
6(a)(i)	nanometres / nm **;**	**1**
6(a)(ii)	**A ora** throughout (presence of) carbohydrate / sugar, chains / residues, on, (glyco)proteins / (glyco)lipids **;** **A** there are no sugar chains on the inner surface **A** (presence of) glycoproteins / glycolipids (on external surface) **A** (presence of) cell surface antigens / receptors (on external surface) **A** (presence of) glycocalyx	**1**
6(b)	**R** **1** cholesterol **;** *one from* **2** maintains / regulates, fluidity of, membrane / phospholipid bilayer *or* at low temperatures, maintain / increase fluidity / prevents close packing **A** prevents hydrophobic 'tails' interacting at low temperatures *or* at high temperatures, stabilises the membrane / decreases fluidity **;** **3** prevents passage (across membrane) of, hydrophilic / polar, substances **;** **S** **4** phospholipid (monolayer) **; R** phospholipid bilayer	**4**

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Question	Answer	Marks
6(b)	*one from* **5** forms a bilayer **;** **6** (bilayer is a) barrier to, water soluble molecules / polar molecules / ions **;** **ora** not a barrier to lipid soluble molecules / allows lipid soluble molecules to cross membranes **A** non-polar / AW **7** (bilayer is a) non-polar barrier between cytoplasm and (aqueous) surroundings **;** **8** hydrophilic 'head' forms hydrogen bonds with water **;**	

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