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**BIOLOGY**

**9700/23**

Paper 2 AS Level Structured Questions

**May/June 2019**

MARK SCHEME

Maximum Mark: 60

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**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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This document consists of **16** printed pages.

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

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Question	Answer	Marks
1(a)	one nucleotide circled ;	1
1(b)	cytosine <u>and</u> guanine ; three hydrogen bonds between the base pairs ;	2
1(c)	(3) 5,4,1,2 ;	1
1(d)	I maintains length of chromosomes / prevents chromosome shortening  <i>any two from:</i> permit continued replication ; prevent loss of genes ; I prevents gene damage <b>A</b> genetic / coded, information <b>A</b> protein coding regions of DNA  protect ends of chromosomes from being, degraded / AW ; AVP ; e.g. prevents ends of chromosomes from being attached to each other not mistaken for a break in DNA that needs repairing	2

Question	Answer	Marks
2(a)	correctly stated formula ; e.g. actual diameter = image length / magnification magnification = image length / actual diameter allow a magnification triangle  1750 ( $\mu\text{m}$ ) ; (for 70 mm) credit also measurements made to 0.5 mm <b>A</b> 1700 ( $\mu\text{m}$ ) (for 68 mm) <b>A</b> 1725 ( $\mu\text{m}$ ) (for 69 mm) <b>A</b> 1775 ( $\mu\text{m}$ ) (for 71 mm) <b>A</b> 1800 ( $\mu\text{m}$ ) (for 72 mm)	2
2(b)(i)	squamous epithelial (tissue) ; <b>A</b> pavement epithelial (tissue)	1

Question	Answer	Marks
2(b)(ii)	<p><i>any two from:</i></p> <p>(alveoli have) thin wall / wall is one cell thick ; <b>A</b> wall composed of thin cells <b>R</b> thin membrane <b>R</b> thin cell wall</p> <p><i>idea of short diffusion distance ;</i> <i>in context of between alveolar space and, blood / capillary</i></p> <p>elastic tissue, qualified ; <b>A</b> elastin / elastic fibres e.g. stretch and recoil for, ventilation / inhalation and exhalation maintaining steep, diffusion / partial pressure, gradient</p> <p>(many) alveoli provide a large surface area (for diffusion) ; <b>I</b> <i>idea that a single alveolus has a large surface area</i></p> <p>AVP ; surfactant, prevents alveolar collapse / maintains inflation <b>I</b> <i>ref. to moist lining</i></p>	2
2(c)	<p><i>any three from:</i></p> <p>1 loosely packed spongy mesophyll cells / spongy mesophyll cells surround air spaces / air spaces between spongy mesophyll cells ;</p> <p>2 large, surface / area, for evaporation (of water to air space) ; <i>In context of spongy mesophyll cells, surfaces / cell walls</i></p> <p>3 (cells arranged so that), air spaces above the stomata / sub-stomatal air spaces ;</p> <p>4 <i>ref. to</i> evaporation creates saturated air spaces / water vapour collects in air spaces ;</p> <p>5 <i>idea of</i> creates water potential gradient between air in air spaces and air in external environment ;</p> <p>6 AVP ; e.g. guard cells situated in epidermis to form stomatal pore <i>ref. to</i> xylem, close proximity to spongy mesophyll cells for passage of water / passes on water to spongy mesophyll cells</p>	3

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Question	Answer	Marks
2(d)(i)	<p><i>accept au for arbitrary units and first hour etc. for 08.00 etc.</i></p> <p><i>any three from:</i></p> <p>1 between 08.00 and 09.00, steep increase / increase from 2.5 au to 5 au ;</p> <p>2 highest rate / peak, at 09.00 ; <b>A</b> maximum rate is at 09.00</p> <p>3 fluctuates / AW, between 10.00 and 15.00 ;</p> <p>4 (continued) decrease between 15.00 and 19.00 ;  <b>A</b> steep /steepest, decrease between 15.00 and 16.00  <b>A</b> less steep (than 15.00 to 16.00) decrease between 16.00 and 19.00</p> <p>5 comparative data quote for decrease ; e.g.  3.8 au at 15.00 to 0.5 au at 19.00  <b>or</b>  3.8 au at 15.00 to 2.00 au at 16.00  <b>or</b>  2.0 au at 16.00 to 0.5 au at 19.00</p>	<b>3</b>
2(d)(ii)	<p><i>any two from:</i></p> <p><i>change in external environmental factor</i></p> <p>decrease in light intensity / AW ; <b>A</b> (less sunlight because it was) cloudy</p> <p>decrease in temperature / AW ; <i>temperature decreased because it was cloudy is mp2 only</i></p> <p>decrease in, wind speed / air movement / AW ;</p> <p>increase in humidity / raining / AW ;</p> <p>stomata, decrease in (aperture) size / open less wide ;</p> <p>decreased evaporation (rate) ;</p> <p>water vapour diffuses out less rapidly / less steep water potential gradient ; AW</p> <p>AVP ; e.g. suggestion of xerophytic feature occurring in response to increased, temperature / light intensity (to 09.00)</p>	<b>2</b>

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Question	Answer			Marks																		
3(a)	<p><i>one mark each row</i></p> <table border="1" data-bbox="647 248 1626 715"> <thead> <tr> <th data-bbox="647 248 1099 349">cell structure</th> <th data-bbox="1099 248 1288 349"><i>V. cholerae</i></th> <th data-bbox="1288 248 1626 349">epithelial cell from the human intestine</th> </tr> </thead> <tbody> <tr> <td data-bbox="647 349 1099 416"><i>cell wall</i></td> <td data-bbox="1099 349 1288 416">✓</td> <td data-bbox="1288 349 1626 416">✗</td> </tr> <tr> <td data-bbox="647 416 1099 483"><i>cell surface membrane</i></td> <td data-bbox="1099 416 1288 483">✓</td> <td data-bbox="1288 416 1626 483">✓;</td> </tr> <tr> <td data-bbox="647 483 1099 550"><i>ribosomes</i></td> <td data-bbox="1099 483 1288 550">✓</td> <td data-bbox="1288 483 1626 550">✓;</td> </tr> <tr> <td data-bbox="647 550 1099 617"><i>large permanent vacuole</i></td> <td data-bbox="1099 550 1288 617">✗</td> <td data-bbox="1288 550 1626 617">✗;</td> </tr> <tr> <td data-bbox="647 617 1099 715"><i>organelles surrounded by a double membrane</i></td> <td data-bbox="1099 617 1288 715">✗</td> <td data-bbox="1288 617 1626 715">✓;</td> </tr> </tbody> </table>			cell structure	<i>V. cholerae</i>	epithelial cell from the human intestine	<i>cell wall</i>	✓	✗	<i>cell surface membrane</i>	✓	✓;	<i>ribosomes</i>	✓	✓;	<i>large permanent vacuole</i>	✗	✗;	<i>organelles surrounded by a double membrane</i>	✗	✓;	<b>4</b>
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Question	Answer	Marks
3(b)	<p>I better sanitation unqualified I <i>ref. to</i> unclean water</p> <p><i>any five from :</i></p> <p><i>ref. to</i> treat drinking water ;  <b>A</b> clean / sterilised / chlorinated / safe / bottled / boiled  <b>A</b> <i>ref. to</i> water treatment plants  provide sewage treatment plants ; <b>A</b> treat waste water / containment of sewage / provide latrines (in temporary camps) ;  <i>ref. to</i> keeping sewage and (drinking) water sources separate ;  <b>A</b> examples e.g. avoid swimming downstream of sewage outlets  avoid defaecating near rivers used for washing  water treatment plants upstream of sewage disposal  bury faeces</p> <p><i>ref. to</i> vaccination / providing vaccines ;</p> <p><i>ref. to</i> education in ways to prevent spread ;</p> <p><i>ref. to</i> (encourage) hand washing ;</p> <p><i>ref. to</i> food hygiene ; e.g. use of clean cooking utensils / covering food to prevent flies landing / washing food in treated water / cook food thoroughly / peel fruit and vegetable washed in (suspected) contaminated water</p> <p>discourage use of human faeces for fertiliser / use fertiliser other than human faeces / do not irrigate plant food with contaminated water;  control breeding of, vectors / flies ;</p> <p>rapid diagnosis ;  rapid treatment (for earlier recovery to minimise risk of spreading) ;  <i>ref. to</i> oral rehydration, salts / therapy ;  use of antibiotics ;  <i>ref. to</i> isolation / quarantine ;</p>	5

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Question	Answer	Marks
3(c)(i)	<p>to, bind / attach / AW, HIV / virus / pathogen, to, host cell / T-lymphocyte / T-cell ;            (because it) binds / is complementary, to, CD4 receptor proteins / AW ;</p> <p><i>ref. to binding leads to, entry of virus into cell / endocytosis / fusion of viral envelope with host cell (surface) membrane ;</i></p>	<b>2</b>
3(c)(ii)	<p><i>ref. to less cytokine (released) ; in context of fewer helper T-lymphocytes</i></p> <p><i>any one from:</i></p> <p>(so) fewer B-lymphocytes divide by mitosis / AW ; <b>A</b> humoral response decreased</p> <p>(so) fewer B -lymphocytes stimulated to differentiate into plasma cells / AW ;</p> <p>(so) fewer plasma cells to, produce / secrete antibodies ;</p>	<b>2</b>

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Question	Answer				Marks																												
4(a)	<p><i>any two from:</i></p> <p><i>note that some mark points must have both xylem and phloem mentioned ('v') and some mark points only need xylem or phloem ('or' – below the line)</i></p> <table border="1" data-bbox="456 384 1816 1182"> <thead> <tr> <th data-bbox="456 384 987 448"><i>xylem</i></th> <th data-bbox="987 384 1061 448"></th> <th data-bbox="1061 384 1740 448"><i>phloem</i></th> <th data-bbox="1740 384 1816 448"></th> </tr> </thead> <tbody> <tr> <td data-bbox="456 448 987 751">no cytoplasm / hollow / no contents</td> <td data-bbox="987 448 1061 751">v</td> <td data-bbox="1061 448 1740 751">(peripheral / little / some) cytoplasm   protoplasm <b>R</b> full of cytoplasm / AW <b>or</b> has (a few) organelles <b>A</b> examples of organelles mitochondria or ER <b>I</b> has SER / RER / ribosomes <b>R</b> has nucleus</td> <td data-bbox="1740 448 1816 751">;</td> </tr> <tr> <td data-bbox="456 751 987 852">lignified <b>R</b> <i>idea of lignin</i> within element</td> <td data-bbox="987 751 1061 852">v</td> <td data-bbox="1061 751 1740 852">no lignin / (only) cellulose</td> <td data-bbox="1740 751 1816 852">;</td> </tr> <tr> <td data-bbox="456 852 987 952">no end wall(s) / no sieve plate(s) <b>A</b> end walls have broken down</td> <td data-bbox="987 852 1061 952"><b>or</b></td> <td data-bbox="1061 852 1740 952">sieve plate(s) / perforated end wall (s) <b>A</b> (end walls) have sieve pores</td> <td data-bbox="1740 852 1816 952"></td> </tr> <tr> <td data-bbox="456 952 987 1053">(side walls) contain pits <b>R</b> piths</td> <td data-bbox="987 952 1061 1053"><b>or</b></td> <td data-bbox="1061 952 1740 1053">no pits ;</td> <td data-bbox="1740 952 1816 1053">;</td> </tr> <tr> <td data-bbox="456 1053 987 1117">no plasmodesmata</td> <td data-bbox="987 1053 1061 1117"><b>or</b></td> <td data-bbox="1061 1053 1740 1117">plasmodesmata (to companion cells) ;</td> <td data-bbox="1740 1053 1816 1117">;</td> </tr> <tr> <td data-bbox="456 1117 987 1182">thick(er), cell wall / walled</td> <td data-bbox="987 1117 1061 1182"><b>or</b></td> <td data-bbox="1061 1117 1740 1182">thin(ner), cell wall / walled</td> <td data-bbox="1740 1117 1816 1182">;</td> </tr> </tbody> </table> <p><i>thicker lignified wall = thicker wall mark only (for lignin mark need to state what phloem has)</i></p>				<i>xylem</i>		<i>phloem</i>		no cytoplasm / hollow / no contents	v	(peripheral / little / some) cytoplasm   protoplasm <b>R</b> full of cytoplasm / AW <b>or</b> has (a few) organelles <b>A</b> examples of organelles mitochondria or ER <b>I</b> has SER / RER / ribosomes <b>R</b> has nucleus	;	lignified <b>R</b> <i>idea of lignin</i> within element	v	no lignin / (only) cellulose	;	no end wall(s) / no sieve plate(s) <b>A</b> end walls have broken down	<b>or</b>	sieve plate(s) / perforated end wall (s) <b>A</b> (end walls) have sieve pores		(side walls) contain pits <b>R</b> piths	<b>or</b>	no pits ;	;	no plasmodesmata	<b>or</b>	plasmodesmata (to companion cells) ;	;	thick(er), cell wall / walled	<b>or</b>	thin(ner), cell wall / walled	;	2
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4(b)	<p><i>any two from:</i></p> <p>to hydrolyse / break, glycosidic bonds ;</p> <p>to produce, reducing sugars / fructose and glucose ;  <b>A</b> to make reactive groups (to Benedicts) available</p> <p>to be able to test with Benedict's solution to obtain a positive result ;  <b>A</b> description of positive result</p> <p>sucrose, is a non-reducing sugar / has no reactive groups when tested with Benedict's solution ;</p>	2
4(c)(i)	<p>(large number of mitochondria) provide ATP, for active transport / for protein synthesis ;</p> <p>(large number of ribosomes) to synthesise the, proton pumps / carrier proteins / AW ;</p>	2
4(c)(ii)	<p><i>any three from:</i></p> <p>H<sup>+</sup>, pumped / actively transported (out of companion cell into cell wall)  <b>or</b>  <i>ref. to</i> higher concentration of H<sup>+</sup> (in cell wall) / H<sup>+</sup> gradient builds up (between cell wall and cytoplasm of companion cell) ;</p> <p>H<sup>+</sup> move back (into companion cell) by facilitated diffusion ; <b>I</b> sucrose</p> <p>through, <u>co-transporter protein</u> / <u>cotransporter</u> ; <b>A</b> symporter</p> <p>H<sup>+</sup> cotransports sucrose / sucrose moves (into cell) with H<sup>+</sup> ;</p> <p>sucrose is transported against the concentration gradient ;  <b>A</b> sucrose transported by secondary active transport</p>	3

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
5(a)(i)	phagocytosis (of, dead cells / pathogens / AW) ; <b>A</b> endocytosis of pathogens	<b>1</b>
5(a)(ii)	(sodium chloride) solution has lower water potential (than cytoplasm) ; ora <b>A</b> $\Psi$ for water potential water, leaves / AW, cell by <u>osmosis</u> ;	<b>2</b>
5(b)(i)	13.56 ; <b>A</b> 13.6 / 14	<b>1</b>

Question	Answer	Marks
5(b)(ii)	<p><i>allow (red) blood cell count for mean red blood cell count</i>  <i>allow ora</i></p> <p><i>any four from:</i></p> <p>1 description of data ; e.g.  lowest mean red blood cell count for, (population) <b>A</b> / lowest altitude  (populations) <b>B, C</b> and <b>D</b> / all other altitudes, have a higher mean red blood cell count than <b>A</b> / 695m altitude  (population) <b>B</b> has highest mean red blood cell count  (population) <b>B</b> has higher mean red blood cell count than <b>C</b> <u>and</u> <b>D</b></p> <p><i>physiological explanation population A compared to B/C/D</i></p> <p>2 decrease in partial pressure of oxygen in the atmosphere with increase in altitude / AW  <b>or</b>  lower partial pressure of / less, oxygen in, inhaled air / lungs / alveoli AW</p> <p>3 <i>ref. to haemoglobin ;</i>  e.g. lower saturation of haemoglobin with oxygen (in lungs)  lower affinity of haemoglobin for oxygen (in lungs)  more haemoglobin required to carry sufficient oxygen to tissues</p> <p>4 suggestion of increase in count at 1676 m and above ;  e.g. rate of production of red blood cells increases  higher erythropoietin (EPO) levels  <i>ref. to changed proportion of plasma to red blood cells / plasma volume decreases</i></p> <p>5 little difference between <b>B, C</b> and <b>D</b> / AW ;</p> <p>6 differences in altitude are not great / AW ; <i>in context of B, C, D</i></p> <p>7 <i>ref. to genetic differences / adaptation to environment ;</i>  <i>allow if general statement includes population A</i></p> <p>8 AVP ; e.g. <i>ref. to differences in demographics</i></p>	4

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Question	Answer	Marks
5(c)	<p>less haemoglobin acid is formed / fewer hydrogen ions to bind to haemoglobin (to cause dissociation of oxygen) ;</p> <p><i>any one from:</i>            binds to allosteric site / site other than active site (of enzyme), qualified ;                e.g. causes change in shape of active site                substrate cannot bind to active site                fewer / no, enzyme-substrate / ES, complex formation</p> <p>prevents / reduces / AW, carbonic acid / H<sub>2</sub>CO<sub>3</sub>, formation / AW ; <b>A</b> fewer hydrogen ions produced from carbonic acid dissociation</p>	<b>2</b>

Question	Answer		Marks								
6(a)	<table border="1"> <thead> <tr> <th data-bbox="687 695 1126 762">structure in the heart</th> <th data-bbox="1126 695 1588 762">letter</th> </tr> </thead> <tbody> <tr> <td data-bbox="687 762 1126 863">valves preventing back flow of blood into the ventricle</td> <td data-bbox="1126 762 1588 863"><b>S ;</b></td> </tr> <tr> <td data-bbox="687 863 1126 963">blood vessel carrying blood under highest pressure</td> <td data-bbox="1126 863 1588 963"><b>P ;</b></td> </tr> <tr> <td data-bbox="687 963 1126 1064">chamber that pumps blood to the lungs</td> <td data-bbox="1126 963 1588 1064"><b>N ;</b></td> </tr> </tbody> </table>		structure in the heart	letter	valves preventing back flow of blood into the ventricle	<b>S ;</b>	blood vessel carrying blood under highest pressure	<b>P ;</b>	chamber that pumps blood to the lungs	<b>N ;</b>	<b>3</b>
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Question	Answer	Marks
6(b)	<p><i>treat as neutral effects of nicotine on the brain and ref. to adrenaline</i></p> <p><i>any three from:</i></p> <p>increased heart rate ; I increased heart beat            increased blood pressure ;            increases risk of, blood clotting / thrombus formation ;                <b>A</b> increases risk of thrombosis                <b>A</b> increases stickiness of platelets            damages the endothelium ;            AVP ; e.g. stimulates vasoconstriction / reduces the diameter of blood vessels                <b>A</b> named blood vessel types</p>	<b>3</b>
6(c)(i)	<p><i>any one from:</i></p> <p>two nuclei vs one ;  <i>ref. to, DNA / chromosome, content ;</i>            cytokinesis has not occurred ;                <b>A</b> cytoplasm has not divided (into two cells)</p>	<b>1</b>
6(c)(ii)	<p><i>any two from:</i></p> <p><i>in context of cardiac myocyte or overall heart function</i>            unable to replace, damaged / worn out / old, cardiac myocytes ;                <b>R</b> repair myocytes</p> <p>unable to repair (damaged) cardiac, muscle / tissue ; <b>A</b> heart tissue</p> <p>repair (to cardiac muscle may be) with, unspecialised cells / scar tissue ;</p>	<b>2</b>