Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

BIOLOGY **9700/21**

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

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Generic Marking Principles

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GENERIC MARKING PRINCIPLE 1:

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- 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
AVP alternative valid point

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Question	Answer	Marks
1(a)	*any three from:* *secondary structure* **I** α-helix **1** (many) β-pleated / beta-pleated, sheets **;** **R** 'B' **2** random structure / irregular structures / loops / beta turns / AW **;** *tertiary structure* **3** folding / coiling, of, (each) polypeptide chain(s) / secondary structure **;** **R** *idea of* polypeptide chains interacting (quaternary structure) **4** *ref. to* globular **A** description, e.g. spherical **I** circular / round **or** *ref. to* 3D, shape / structure **; A** 3D arrangement	**3**
1(b)(i)	**X** – site of synthesis of, (light and heavy) polypeptides **; A** protein(s) **A** transport / modification, of, polypeptides / proteins **A** assembly of polypeptides / translation **R** answers that name the Golgi body **Y** – production of ATP **;** **R** 'produce / create / AW, energy' **A** release of energy / provide energy	**2**
1(b)(ii)	cell / membrane, fusion / AW **; I** 'mix' (named) fusogen / hybridogen used **;** e.g. polyethylene glycol / electrofusion / electric current **A** PEG for polyethylene glycol (between) plasma cell / (activated) B-lymphocyte / (activated) B-cell / splenocyte, **and**, tumour / cancer / myeloma, cell **;** **R** β cells	**3**

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Question	Answer	Marks
1(b)(iii)	*any three from:* **1** some mAbs act **directly** on target cells / some mAbs work **indirectly** to kill cells / mAbs do not damage other (non-target) cells **;** **2** by binding to, specific / complementary, antigens/cell surface receptors **;** **3** (named), drugs / radioactive isotopes, can be attached to mAbs **;** **A** 'tagged' **I** labelled **4** enzymes can be attached to mAbs **;** **5** so drug can be activated at site of action (linked to mp4) **;** **6** bispecific mAbs attach two cells together **;** **7** *ref. to* interrupting cell signalling **;** **8** use of mAbs for passive immunity **;** **A** described *in context of therapeutic antibody for treatment of disease* **9** stimulating / AW, immune system / phagocytes / macrophages / T-lymphocyes, to kill, cancer cells **;** **10** name of a cancer or autoimmune disease that is treated with mAbs **;**	**3**
2(a)	*any two from:* ('kinks') prevents close packing of, phospholipids / membrane components, (at low temperature) **;** keeps / maintains, fluidity **;** **A** increases **A** ora - prevents becoming too rigid *idea of* preventing damage to membranes by preventing freezing **;** maintains movement of (named) substances across membranes **;** **A** any named example of movement across membrane **R** increases AVP **;** e.g. maintains movement of proteins within membrane	**2**

Question	Answer	Marks
2(b)(i)	*idea that triglycerides and phospholipids* are not composed of, monomers / repeating (sub-)units **;**	**1**
2(b)(ii)	*any two from:* *phospholipids have* two fatty acids (residues / tails) not three **;** **A** hydrocarbon chains / aliphatic chains **A** one less fatty acid (residue / tail) **A** ora two ester bonds rather than three **;** a phosphate (group / head) **; A** ora **R** 'phosphate not glycerol' AVP **;** e.g. may have a (named) additional group, such as choline / AW e.g. triglycerides do not have nitrogen / phospholipids may have nitrogen	**2**
2(c)	*any four from:* **1** thromboxane is a (cell) signalling molecule **;** **A** 'thromboxane acts as a signal' **I** 'messenger' / hormone **2** released into / circulates in / AW, blood / plasma **;** **3** (smooth) muscle, cell / tissue, is <u>target</u> **;** **4** thromboxane binds to <u>receptors</u> **;** **5** *ref. to* thromboxane is complementary to receptor **;** **6** (specific) response is smooth muscle (cell) contraction **;** **R** smooth muscle constricts **7** AVP **;** e.g. detail of change, such as activating G proteins / secondary messenger / enzyme cascade / chain of reactions / AW	**4**

Question	Answer	Marks
3(a)(i)	*any two from:* (Neutrase® breaks down / hydrolyses) protein to, peptides / amino acids / smaller molecules **;** **A** idea of increase in solubility during the reaction / AW, more light passes through / more light is transmitted / less light is absorbed **;** *idea that* 100 s is long enough to see the progress of the reactions **;** **I** 'the rate of reaction can be calculated' **I** 'allow time for reaction to complete'	**2**
3(a)(ii)	*accept **ora** where appropriate* **1** copper sulfate, decreases / AW, the activity of Neutrase (*ref. to* **A** or **B**) **;** **2** 0.01 (mol dm^{-3}) / low concentration, $CuSO_4$ has less of an effect than, 0.05 (mol dm^{-3}) / high concentration (*ref. to* **A** and **B**) **;** **3** potassium sulfate has, little / no, effect on activity (*ref. to* **C**) **;** **4** data quote to show absorbance for two different lines at the same time **;** *one time and two absorbance readings from different lines on the graph with the unit for time used once anywhere in answer, allow 'at the end' for 100 s* **5** copper sulfate is an inhibitor of Neutrase **;** **6** potassium sulfate is not an inhibitor **;** **A** 'less of…' **7** copper sulfate binds to Neutrase **;** **A** anywhere **8** substrate cannot enter active site / ESCs do not form (so protein not hydrolysed) **;** **A** fewer ESCs	

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Question	Answer	Marks
3(b)	*higher productivity / higher yield and fewer costs because* enzyme can be re-used **;** enzyme can be easily recovered **;** downstream processing is easier **;** product, not / less, contaminated **;** **A** less purification needed longer shelf-life of enzyme **;** reduces product inhibition **;** enzyme is, more stable / less likely to denature *or* described **;** **A** thermostable / can work at high temperatures **A** in context of change in pH **I** 'can withstand changes in temperature'	**2**

Question	Answer	Marks
4(a)	*any one from:* *idea that* to provide cells that can, differentiate / divide **;** for (continued) growth of the, shoot tip / (named) tissues **;** **I** 'to produce more meristematic cells'	**1**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(b)</td><td>one mark per row

<table>
<tr><th>stages</th><th>description</th></tr>
<tr><td>F and G</td><td>cell, elongates / enlarges / grows and, a vacuole forms / makes a tonoplast ;</td></tr>
<tr><td>G and H</td><td>cell divides (longitudinally) and one of the cells has a vacuole ;</td></tr>
<tr><td>H and J</td><td>developing sieve tube cell, elongates / enlarges / grows and loses its nucleus
or
one (developing companion) cell divides (transversely) to form (two) companion cells ;

A companion cell divides</td></tr>
</table></td><td>3</td></tr>
<tr><td>4(c)</td><td>any four from:

1 elongated cells to form, long tubes / AW ;

2 little, cytoplasm / cell contents / fewer organelles, to reduce resistance to flow ;
A peripheral cytoplasm / no nucleus, to allow transport of maximum volume of, (named) assimilates / sap / nutrients
A ‘more space for …..’
R no organelles R ‘no cell contents’

3 sieve (plates have) pores, so little barrier to flow from cell to cell / easy (for phloem sap) to pass from cell to cell / allows mass flow ;
4 sieve plates, support / stop collapse of / stop bulging of, sieve tube elements ;
A become plugged with, P-protein / callose, to prevent losses / after damage
A maintain hydrostatic pressure (in sieve tubes)

5 <u>plasmodesmata</u> between sieve tube and companion cell for ease of, loading / unloading / AW ;
6 AVP ; e.g. membrane around sieve tube for osmosis to occur / prevent loss of (named) assimilates</td><td>4</td></tr>
</table>

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Question	Answer	Marks
4(d)	*allow assimilates / AW for sucrose* **1** movement of sucrose from, mesophyll / parenchyma / source, cells **;** **A** movement of sucrose to (named) sink cells **2** move sucrose, into / out of, sieve tubes (through plasmodesmata) **;** **3** pump, protons / hydrogen ions / H^+, out of cell / into cell wall/into apoplast **;** **A** *ref. to* secondary active transport **4** provides, ATP / proteins, for sieve tubes **;** **A** maintain metabolism of sieve tubes	**2**

Question	Answer	Marks
5(a)	*closed* blood flows through, (blood) vessels**;** **A** three of heart, arteries, veins, capillaries *double* blood flows through the heart twice in one complete circulation (of the body) / AW **;** **A** *ref. to* pulmonary and systemic circuits / to lungs and rest of body	**2**
5(b)(i)	pulmonary vein **;** semi-lunar / AW, valve **; A** pulmonary valve **R** aortic valve right, atrium / auricle **;**	**3**

Question	Answer	Marks
5(b)(ii)	*any three from:* **1** left ventricle / chamber **Y**, pumps blood into, systemic circulation / described ***or*** right ventricle / chamber **X** pumps blood into, pulmonary circulation / described ***or*** distance travelled by blood in systemic circulation is greater than distance travelled by blood in pulmonary circulation / AW**;** **2** to overcome great(er) resistance to flow in systemic circulation **; ora** **3** high (blood) pressure is required for blood to travel around the systemic circulation **;** **4** high pressure requires more muscular force **; ora** **5** pulmonary capillaries, rupture easily / damaged by high pressure **;** **I** more cardiac muscle	**3**
5(c)	*any four from:* **1** impulse / wave of excitation / AW, passes from SAN to atria (muscles) **;** **R** nervous impulse / signal *once only* **2** atria both contract, together / at the same time **;** **A** atrial systole *if not contradicted by one contracting before the other* **3** atria contract before ventricles **;** **4** fibrous / non-conducting, tissue prevents impulse travelling to ventricles **;** **5** impulse delayed at AVN **;** **6** AVN passes impulse to, bundle of His / Purkyne fibres **;** **7** Purkyne fibres conduct impulses to <u>muscle</u> in wall of ventricles **;** **8** ventricles contract together (if mp2 not awarded) **;** **A** ventricular systole if not contradicted as for atria **9** ventricles contract from the bottom upwards **;**	**4**

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Question	Answer	Marks
6(a)(i)	30% **;** **A** anywhere in the answer bases, are paired / are complementary **;** **A** with *ref. to* binding **A** hydrogen bonds between, A and T / C and G **A** thymine *or* T pairs with adenine *or* A / cytosine or C pairs with guanine or G calculation / explanation for 30% **;** e.g. A+T = 40%, C+G = 60%, half of 60% = 30%	**3**
6(a)(ii)	mitochondria / mitochondrion (in cytoplasm) **;** **R** whole answer if anything else is first or second in answer **R** 'mitochondria and / or cytoplasm'	**1**
6(b)(i)	G G U C **;**	**1**
6(b)(ii)	anticodon **;** *any two from:* **Q** / anticodon, binds / AW, to, <u>codon on mRNA</u> **;** **I** *ref. to* complementary bases alone *idea that* specificity ensures correct primary structure (of polypeptide / protein) **;** **A** correct amino acid sequence (of polypeptide / protein)	**3**
6(b)(iii)	site of attachment of (specific) amino acid (to tRNA) / amino acid binding site **;**	**1**

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AW	alternative wording (where responses vary more than usual)
ora	or reverse argument (for answers which are written as the opposite to the expected answer)
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max	indicates the maximum number of marks that can be given
ecf	error carried forward
mp	marking point (with relevant number)

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Question	Answer	Marks
1(a)	stem / not a root, because, transport tissue / vascular bundles / vascular tissue(s) / xylem and phloem / xylem / phloem, around the edges / not in the centre / AW **;** **A** stem because, pith / parenchyma tissue, is in the centre	**1**
1(b)	*any two from:* (hydrostatic) support / described **;** **R** *if incorrect context e.g. support because of thick cell walls* **A** packing tissue (cells), turgid / store <u>water</u> **;** storage **;** *in context of substances other than water e.g. sucrose / starch / waste*	**2**
1(c)(i)	vascular bundle **;**	**1**
1(c)(ii)	0.65 (<u>mm</u>) **;**	**1**

Question	Answer			Marks
1(d)	*mp1-3 must have statements for both xylem and phloem* *mp4-7 need statements for either xylem or phloem* *three from:*			**3**
	xylem		*phloem*	
	1 no cytoplasm / hollow / no contents		(peripheral / little / some) cytoplasm **;** **I** protoplasm **R** full of cytoplasm / AW	
	2 no organelles / hollow / no contents		(a few) organelles **;** **A** examples of organelles mitochondria or ER **I** has SER / RER / ribosomes **R** has nucleus	
	3 lignified **R** idea of lignin within element		no lignin / (only) cellulose **;**	
	4 no end wall(s) / no sieve plate(s) **A** end walls have broken down	**or**	sieve plate(s) / perforated end wall(s) **;** **A** (end walls) have sieve pores	
	5 (side walls) contain pits	**or**	no pits (in side walls) **;**	
	6 no plasmodesmata	**or**	plasmodesmata (to companion cells) **;**	
	7 thick(er), cell wall / walled	**or**	thin(ner), cell wall / walled **;**	

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<tr><td>2(a)</td><td>mucous gland cells / mucous gland(s) ; I mucosa
goblet cell(s) ;
list containing trachea and / or bronchus and / or bronchioles I and allow to two max
BUT if alveoli stated or incorrect cell types (e.g. ciliated cells) max 1</td><td>2</td></tr>
<tr><td>2(b)</td><td>any one from:

Golgi (body / complex / apparatus) ;
rough endoplasmic reticulum ; A rough ER / RER R SER I ER</td><td>1</td></tr>
<tr><td>2(c)</td><td>two marks to complete table
<table><tr><td>first process</td><td>transcription</td></tr><tr><td>second process</td><td>translation</td></tr><tr><td>third process</td><td>glycosylation</td></tr><tr><td>fourth process</td><td>exocytosis</td></tr></table>allow one mark if transcription first process and exocytosis last process but other two wrong way round
allow one mark if transcription and translation wrong way round and other two correct</td><td>2</td></tr>
<tr><td>2(d)</td><td>accept symbol Ψ for water potential
three from:
1 chloride presence outside cell causes water potential (outside cells) to, decrease / become more negative / become lower
or
chloride leaving cell causes water potential (in cell) to increase / AW ;
2 water potential gradient, created / present (between inside and outside of cell) ;
3 water leaves cell by osmosis (to be taken up by mucin to form mucus) ;
4 from higher to lower water potential / AW ; R if term gradient included</td><td>3</td></tr>
</table>

Question	Answer	Marks
2(e)	*any three from:* *to produce, new / daughter, cells…* **1** that are genetically identical **;** **2** to replace, old / damaged / dead, cells **; A** named cells **3** to repair (damaged / injured / diseased) tissue **;** **A** named tissue *if mp 2 and 3 not gained, allow 1 mark for replacing damaged tissue* **4** *ref.to* function **;** *in context* **5** AVP **;** *idea of* increase in number of cells / growth, to accommodate increase in size of gas exchange system in growing infants / AW	**3**

Question	Answer	Marks
3(a)	**C** =neutrophil **; A** polymorphonuclear leucocyte **A** basophil **A** eosinophil **D** = lymphocyte **;** B / T *is neutral* **E** = monocyte **; A** macrophage ***I*** *leucocyte / white blood cell, throughout*	**3**
3(b)(i)	*any two from:* lymphocytes / blood cells, produced in / originate from, bone marrow **;** *ref. to* stem cell(s) **;** *ref. to* cell division **;** e.g. bone marrow has cells that can carry out, mitosis / cell division **A** (stem cells are) multipotent	**2**

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Question	Answer	Marks
3(b)(ii)	*any three from:* *measles* immune response stimulated **;** detail **;** e.g. **either** antigen recognition / presence / binding **or** lymphocyte / white blood cell, stimulated / triggered **plus** clonal, expansion / proliferation / cell division / mitosis } **or** clonal selection / AW **R** incorrect pathogen name **R** bacteria *CLL* result of, uncontrolled mitosis **;** **A** uncontrolled, division / cell cycle **I** rapid mitosis detail **;** owing to, mutation / named mutation **or** cell cycle checkpoints not working **or** cells don't respond to signals to control division	**3**
3(c)(i)	*any two from:* (passive / simple) diffusion (of oxygen) across the phospholipid bilayer **;** **A** movement from a higher to a lower concentration *for diffusion* **A** between phospholipids / between fatty acid chains / across hydrophobic core / across bilayer / AW, *for phospholipid bilayer* small size **;** non-polar / uncharged **;**	**2**

Question	Answer	Marks
3(c)(ii)	*any three from:* less oxygen in inhaled air / AW **;** **A** less oxygen taken up from alveoli low(er) saturation of haemoglobin (with oxygen) **;** **A** Hb for haemoglobin **A** haemoglobin carries less oxygen *must be the context of oxygen* **R** saturation, with air / carbon dioxide haemoglobin has lower affinity for oxygen **;** (so) <u>more</u> haemoglobin required (so more red blood cells) / (more red blood cells) so <u>more</u> haemoglobin **;** AW compensation / compensates **;** **A** so same, volume / quantity / amount, of oxygen reaches body cells (compared to lower altitude)	**3**

Question	Answer	Marks
3(d)	*any four from:* **1** (alleles have) different nucleotide sequences **; A** different base sequences **2** base substitution / substitution of a base **; A** T replaced by A **3** (alleles have) different mRNA codons **; A** altered mRNA codon **R** altered genetic code **4** (results in) one amino acid change **or** change from, glutamic acid / glutamate / glu, to, valine / val **or** changed primary structure **; A** changed sequence of amino acids **R** *if implies whole sequence changes* **5** AVP **;** e.g. Hb^A = CTC and Hb^S = CAC (on template strand) **A** Hb^A = GAG and Hb^S = GTG (on non-template strand**)** **or** Hb^A = CTT and Hb^S = CAT (on template strand) **A** Hb^A = GAA and Hb^S = GTA (on non-template strand) *this is **not** also mp2* *ref. to* amino acid substitution at position 6 (*this is **not** also mp4*) **A** 6th, codon / triplet, changed **6** changed, (β-globin / Hb) tertiary structure **; A** polypeptide / (Hb molecule) quaternary structure **R** β-globin / polypeptide **7** *ref. to* loss of globular structure / hydrophobic amino acid faces outside (instead of towards centre) **;** **A** described e.g. (val) amino acid with hydrophobic R-group instead of (glu) amino acid with hydrophilic R-group *accept hydrophilic / polar, amino acid* *accept hydrophobic / non polar, amino acid*	**4**

Question	Answer	Marks
3(d)	**8** sticky (haemoglobin) molecule formed / forms fibres with other haemoglobin molecules **;** **9** oxygen taken up less easily / less oxygen carried by haemoglobin / AW **;** **A** β-globin takes up oxygen less easily / AW **10** AVP **;** (sickle cell) haemoglobin / β-globin, less soluble / AW **I** insoluble	

Question	Answer	Marks
4(a)	*max 3* if any membrane-bound organelles drawn inside cell e.g. nucleus, Golgi body, mitochondrion, lysosome, ER, a large vacuole BUT **I** vesicle / small vacuoles **I** detail of cell wall / cell surface membrane around flagellar area *four from:* cell wall **;** *must add another line to diagram* **R** cellulose cell wall cell (surface) membrane **; A** plasma membrane *label line to the inside of cell wall* **I** if outer line labelled as cell membrane DNA **;** **A** bacterial chromosome / nucleoid *as label* *allow one or two circular molecules* (*circle, loop, ball of string, tangled)* **R** *if obviously linear* **R** if label includes, histones / histone proteins / chromatin **R** if nuclear, envelope / membrane, shown **R** if nucleolus shown or labelled ribosomes **;** **R** 80S ribosomes *shown as, dots / small spheres* cytoplasm / cytosol **;** plasmid **;** *smaller than DNA, circular* AVP **;** e.g. 70S / smaller / 17–20 nm, *for ribosome* murein / peptidoglycan (for cell wall – allow even if cell wall label not added) pilus /pili *drawn as external hair-like structure(s)* basal granule *at base of flagellum* capsule drawn to outside *(some do have a capsule)*	**4**
4(b)(i)	0.8 % **; R** 0.80 %	**1**

Question	Answer	Marks
4(b)(ii)	*any two from:* delay in / no, diagnosis **;** delay in / no, treatment / therapy **;** **A** feature of, oral rehydration, treatment /solution **A** ORT / ORS e.g. lack of supply of ORT unwillingness by health workers to give ORT greater belief in herbal remedies thinking drug treatment is sufficient lack of clean water to make up ORT solution no rehydration programmes **I** improper treatment / treatment not effective *ref. to* no / lack of, antibiotic therapy **;** e.g. lack of supply of / less efficacious (AW) antibiotics used / less supervision in taking full dose *ref. to* antibiotic resistant strains **;** *idea that* already have a weak immune system / malnourished **;** **A** may have HIV/AIDS (hence weak immune system)	**2**
4(c)(i)	*any one from:* damaged sanitation system / poor sanitation following earthquake **;** **I** poor sanitation unqualified damage to, sewage treatment plants / water purification plants **;** AW (contaminated) sewage contaminates drinking water **; I** pollution **A** water becomes contaminated lack of purified drinking water**; A** lack of, clean / treated / safe / bottled, water AVP **;** no, proper / safe, disposal of sewage	**1**

Question	Answer	Marks
4(c)(ii)	*any three from:* **1** 2011, peak in / highest / AW, number of, cases / countries / countries and cases **;** **A** decrease, increase in 2011, decrease *for countries* **A** increase to 2011 and decrease *for cases* **2** (2010 outbreak in) *ref. to* Haiti and epidemic (so high number of 2011 cases) **;** **3** *ref. to* spread of disease to countries neighbouring Haiti (hence increase in countries in 2011) **;** **4** overall / generally / AW, decrease in number of countries with cases of cholera **or** 2008 54–56 countries and 2015 41–43 countries, with ref. to decrease **;** *decrease, peak at 2011 / increase in 2011, decrease is mp1 only* **5** suggestion for trend in decrease in number of countries **;** e.g. improved infrastructure for sewage / water treatment improved health education to prevent spread providing piped (treated) water **6** 2008–2010 number of cases increased and number of countries decreased **;** **7** AVP **;** e.g. lowest / AW, number of cases in 2013 **R** if also state that 2013 is lowest for countries similar number of countries in 2008 and 2011 but, approx 3× / much higher / stated values, number of cases in 2011	**3**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(a)</td><td>glycine in monomer column <u>only</u> ;

<table>
<tr><th>monomer</th><th>polymer</th><th>monosaccharide</th><th>polysaccharide</th></tr>
<tr><td>thymine
(nucleotide)
α-glucose
β-glucose } ;</td><td>cellulose
messenger RNA
glycogen
α-globin } ;

I glycine</td><td>β-glucose
α-glucose } ;

I glycine</td><td>cellulose
glycogen } ;

I glycine</td></tr>
</table>
I incorrect spellings
if α-globin appears once and is in monomer column instead of polymer column, and the monomer and polymer columns are otherwise correct, allow one mark (ecf)</td><td>5</td></tr>
<tr><td>5(b)</td><td>any three from:

allow points from an annotated diagram
1 phosphate head = hydrophilic / polar ;
2 fatty acid / hydrocarbon, tail / chains = hydrophobic / non-polar ;
if mps 1 and 2 not gained, allow one mark for, hydrophilic / polar, heads and, hydrophobic / non-polar, tails

3 (so) heads face, watery environment / tissue fluid / cytoplasm / cytosol / aqueous environment ;

4 (fatty acid) tails, form hydrophobic core / form area away from water / face each other / AW ;

5 ref. tails and hydrophobic interactions ;</td><td>3</td></tr>
</table>

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Question	Answer	Marks
6(a)(i)	*any two from:* correct ref. to time **;** correct ref. to volume of oxygen **; A** gas for oxygen **A** volume of water displaced by oxygen **A** measuring height of water level (decreasing) **A** cm^3 instead of volume AVP **;** subtract volume of gas displaced by H_2O_2 addition	**2**
6(a)(ii)	*any two from:* greater surface area (over which catalase released) **;** greater number of cells, damaged / cut open, to release catalase **;** higher concentration of, catalase / enzyme **; A** more, catalase / enzyme **A** more active sites available *must be linked to idea of more enzyme (i.e. must get mp 2 or 3)* so, higher rate of reaction / more enzyme-substrate complexes / more oxygen released **;** AW	**2**
6(b)	increase to optimum and steeper decrease **;** **A** if curve does not touch one or both axes	**1**

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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 **May/June 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.

Cambridge International is publishing the mark schemes for the May/June 2019 series for most Cambridge IGCSE™, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

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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.

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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
AVP	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 *any two from:* permit continued replication **;** prevent loss of genes **;** **I** prevents gene damage **A** genetic / coded, information **A** 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 (μm) **;** (*for 70 mm*) *credit also measurements made to 0.5 mm* **A** 1700 (μm) (*for 68 mm*) **A** 1725 (μm) (*for 69 mm*) **A** 1775 (μm) (*for 71 mm*) **A** 1800 (μm) (*for 72 mm*)	**2**
2(b)(i)	squamous epithelial (tissue) **; A** pavement epithelial (tissue)	**1**

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

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

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(a)</td><td>one mark each row
<table>
<tr><th>cell structure</th><th>V. cholerae</th><th>epithelial cell from the human intestine</th></tr>
<tr><td>cell wall</td><td>✓</td><td>✗</td></tr>
<tr><td>cell surface membrane</td><td>✓</td><td>✓;</td></tr>
<tr><td>ribosomes</td><td>✓</td><td>✓;</td></tr>
<tr><td>large permanent vacuole</td><td>✗</td><td>✗;</td></tr>
<tr><td>organelles surrounded by a double membrane</td><td>✗</td><td>✓;</td></tr>
</table></td><td>4</td></tr>
</table>

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Question	Answer	Marks
3(b)	**I** better sanitation unqualified **I** *ref. to* unclean water *any five from :* *ref. to* treat drinking water **;** **A** clean / sterilised / chlorinated / safe / bottled / boiled **A** *ref. to* water treatment plants provide sewage treatment plants **; A** treat waste water / containment of sewage / provide latrines (in temporary camps) **;** *ref. to* keeping sewage and (drinking) water sources separate **;** **A** 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 *ref. to* vaccination / providing vaccines **;** *ref. to* education in ways to prevent spread **;** *ref. to* (encourage) hand washing **;** *ref. to* 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 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 **;** rapid diagnosis **;** rapid treatment (for earlier recovery to minimise risk of spreading) **;** *ref. to* oral rehydration, salts / therapy ; use of antibiotics ; *ref. to* isolation / quarantine **;**	**5**

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

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(a)</td><td>
any two from:

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)
<table>
<tr><th>xylem</th><th></th><th>phloem</th><th></th></tr>
<tr><td>no cytoplasm / hollow / no contents</td><td>v</td><td>(peripheral / little / some) cytoplasm I protoplasm
R full of cytoplasm / AW
or
has (a few) organelles
A examples of organelles
mitochondria or ER
I has SER / RER / ribosomes
R has nucleus</td><td>;</td></tr>
<tr><td>lignified
R idea of lignin within element</td><td>v</td><td>no lignin / (only) cellulose</td><td>;</td></tr>
<tr><td>no end wall(s) / no sieve plate(s)
A end walls have broken down</td><td>or</td><td>sieve plate(s) / perforated end wall (s)
A (end walls) have sieve pores</td><td></td></tr>
<tr><td>(side walls) contain pits
R piths</td><td>or</td><td>no pits ;</td><td>;</td></tr>
<tr><td>no plasmodesmata</td><td>or</td><td>plasmodesmata (to companion cells) ;</td><td>;</td></tr>
<tr><td>thick(er), cell wall / walled</td><td>or</td><td>thin(ner), cell wall / walled</td><td>;</td></tr>
</table>
thicker lignified wall = thicker wall mark only (for lignin mark need to state what phloem has)
</td><td>2</td></tr>
</table>

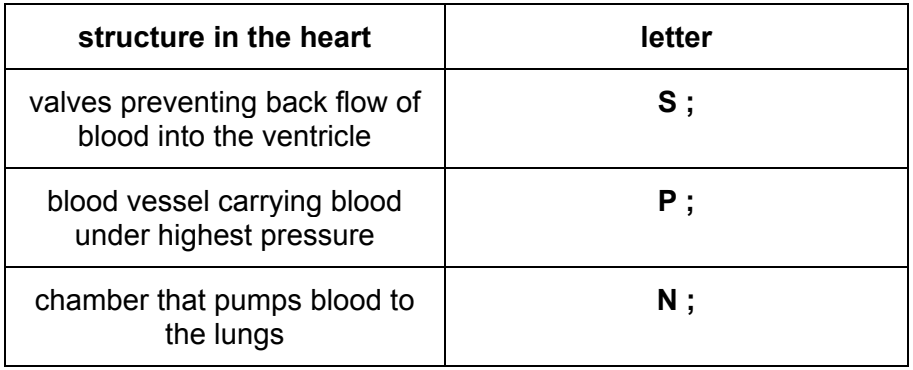
Question	Answer	Marks
4(b)	*any two from:* to hydrolyse / break, glycosidic bonds **;** to produce, reducing sugars / fructose and glucose **;** **A** to make reactive groups (to Benedicts) available to be able to test with Benedict's solution to obtain a positive result **;** **A** description of positive result sucrose, is a non-reducing sugar / has no reactive groups when tested with Benedict's solution **;**	**2**
4(c)(i)	(large number of mitochondria) provide ATP, for active transport / for protein synthesis **;** (large number of ribosomes) to synthesise the, proton pumps / carrier proteins / AW **;**	**2**
4(c)(ii)	*any three from:* H^+, pumped / actively transported (out of companion cell into cell wall) **or** *ref. to* higher concentration of H^+ (in cell wall) / H^+ gradient builds up (between cell wall and cytoplasm of companion cell) **;** H^+ move back (into companion cell) by facilitated diffusion **; I** sucrose through, co-transporter protein / cotransporter **; A** symporter H^+ cotransports sucrose / sucrose moves (into cell) with H^+ **;** sucrose is transported against the concentration gradient **;** **A** sucrose transported by secondary active transport	**3**

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

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

Question	Answer	Marks
5(c)	less haemoglobinic acid is formed / fewer hydrogen ions to bind to haemoglobin (to cause dissociation of oxygen) **;** *any one from:* 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 prevents / reduces / AW, carbonic acid / H_2CO_3, formation / AW **;** **A** fewer hydrogen ions produced from carbonic acid dissociation	**2**

Question	Answer	Marks
6(a)		**3**

structure in the heart	letter
valves preventing back flow of blood into the ventricle	**S ;**
blood vessel carrying blood under highest pressure	**P ;**
chamber that pumps blood to the lungs	**N ;**

Question	Answer	Marks
6(b)	*treat as neutral effects of nicotine on the brain and ref. to adrenaline* *any three from:* increased heart rate **;** **I** increased heart beat increased blood pressure **;** increases risk of, blood clotting / thrombus formation **;** **A** increases risk of thrombosis **A** increases stickiness of platelets damages the endothelium **;** AVP **;** e.g. stimulates vasoconstriction / reduces the diameter of blood vessels **A** named blood vessel types	**3**
6(c)(i)	*any one from:* two nuclei vs one **;** *ref. to*, DNA / chromosome, content **;** cytokinesis has not occurred **;** **A** cytoplasm has not divided (into two cells)	**1**
6(c)(ii)	*any two from:* *in context of cardiac myocyte or overall heart function* unable to replace, damaged / worn out / old, cardiac myocytes **;** **R** repair myocytes unable to repair (damaged) cardiac, muscle / tissue **;** **A** heart tissue repair (to cardiac muscle may be) with, unspecialised cells / scar tissue **;**	**2**

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