Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/21**

Paper 2 AS Level Structured Questions **October/November 2022**

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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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.

Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	‘List rule’ guidance For questions that require ***n*** responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked *ignore* in the mark scheme should not count towards ***n***. • Incorrect responses should not be awarded credit but will still count towards ***n***. • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response. • Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

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6 Calculation specific guidance

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

7 Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

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Examples of how to apply the list rule: State three reasons … [3]

A

1. Correct	✓	**2**
2. Correct	✓	
3. Wrong	×	

B

(4 responses)

1. Correct, Correct	✓ ✓	**3**
2. Correct	✓	
3. Wrong	ignore	

C

(4 responses)

1. Correct	✓	**2**
2. Correct, Wrong	✓ ×	
3. Correct	ignore	

D

(4 responses)

1. Correct	✓	**2**
2. Correct, CON (of 2.)	× (discount 2)	
3. Correct	✓	

E

(4 responses)

1. Correct	✓	**3**
2. Correct	✓	
3. Correct, Wrong	✓	

F

(4 responses)

1. Correct	✓	**2**
2. Correct	✓	
3. Correct CON (of 3.)	× (discount 3)	

G

(5 responses)

1. Correct	✓	**3**
2. Correct	✓	
3. Correct Correct CON (of 4.)	✓ ignore ignore	

H

(4 responses)

1. Correct	✓	**2**
2. Correct	×	
3. CON (of 2.) Correct	(discount 2) ✓	

I

(4 responses)

1. Correct	✓	**2**
2. Correct	×	
3. Correct CON (of 2.)	✓ (discount 2)	

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;	separates marking points
/	alternative answers for the same marking point
R	reject
A	accept
I	ignore
AVP	any valid point
AW	alternative wording (where responses vary more than usual)
ecf	error carried forward
underline	actual word underlined 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

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Question	Answer	Marks
1(a)(i)	**A** mitochondrion **;** **B** rough endoplasmic reticulum **; A** ribosome / 80S ribosome	**2**
1(a)(ii)	*any **three** from:* (more efficient) synthesis / metabolism / AW, of named product **;** e.g. lipid / named lipid phospholipid steroid / steroid hormone / named, e.g. oestrogen / testosterone sterol / cholesterol **I** ref. to storage other function **;** e.g. detoxification *max **two** from:* *idea that* synthesis of products / AW, is a pathway / requires more than one enzyme **;** further detail **;** e.g. enzymes of same pathway are, close together / in clusters products of one reaction are substrates of the next *suggestion that* membrane gives enzymes, more stability / greater protection (from degradation) **;** AVP **;** e.g. *idea of* greater efficiency as enzyme held so that active site faces substrates in lumen *suggestion that* allows reactions to occur on cytoplasmic side of membrane *suggestion that* allows reaction to continue / complete, in SER transport vesicles	**3**

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Question	Answer	Marks
1(b)	*any **three** from:* higher magnification (without loss of detail) **;** higher resolution / ability to see object that are close together as separate objects **;** *ref. to* resolution of (up to) 0.5 nm compared to, 200 nm / 0.2 µm (light microscope) **;** **A** ranges, e.g. 0.5–30 nm and 100–300 nm ability to see organelles such as, SER / ribosomes / other named organelle **;** AVP **;** e.g. very thin sections, qualified, e.g. for greater internal detail	**3**

Question	Answer	Marks
2(a)(i)	*closed circulation because* blood is contained within blood vessels **;** *double circulation because* blood flows through the heart twice for one complete, circuit of the body / circulation **;** **A** described **A** pulmonary circulation **and** systemic circulation	**2**
2(a)(ii)	**Q** = vena cava **and** **R** = aorta **;**	**1**

Question	Answer	Marks
2(a)(iii)	**I** *ref to* valves *any **three** from:* ***Q** has a*: thinner wall **;** **A** thinner middle layer wider lumen relative to thickness of wall **;** thinner tunica media **;** (proportionately) less smooth muscle **;** (proportionately) less / very few, elastic fibres **;** *allow* ecf from Q2(a)(ii)	**3**
2(b)(i)	human antibodies, are made of four polypeptides / contain two light chains **and** two heavy chains **;**	**1**
2(b)(ii)	*any **two** from:* more / easier to, pass through gaps in, capillary wall / endothelium **;** (so) more enter tissue fluid (surrounding tumour cells) **;** *idea of* more cancer cells destroyed quickly **;** (smaller so) may not trigger an immune response **;** AVP **;** e.g. easier to, diffuse / move, through tumour to reach, more / all, cells binds more tightly to antigens on (cancer) cell surface(s) *suggestion that* makes macrophage response stronger smaller overall size even when drugs attached	**2**

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Question	Answer	Marks
2(b)(iii)	*any **three** from:* gives (artificial) passive immunity **;** fast acting / quick response / time not needed for immune response **;** antibody binds to (non-self / foreign) antigen (on surface of a pathogen) **;** antibodies bind to toxins, neutralising them / AW **or** antibodies act as antitoxins **;** ref phagocytosis **;** AVP **;** e.g. opsonisation bind to flagella and immobilise pathogen antibodies cause, agglutination / clumping / AW, of pathogen	**3**

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Question	Answer	Marks
3(a)(i)	*any **two** from:* spherical / ball shaped **;** (water-) soluble **;** amino acids with hydrophilic R groups / hydrophilic amino acids, on outside of molecule **;** **A** amino acids with hydrophobic R groups in centre of molecule physiological / metabolic, role **;** carbonic anhydrase is an enzyme, (enzymes are globular proteins) **;**	**2**
3(a)(ii)	*any **two** from:* catalyses / AW, reaction between water and carbon dioxide **;** (to form) carbonic acid **;** catalyses formation of carbon dioxide and water from carbonic acid in lungs **;**	**2**
3(b)(i)	guanine **;** *any **two** from:* double ring (base) / purine (base) **;** forms three hydrogen bonds with complementary base **;** AVP **;** e.g. detail of difference between adenine and guanine	**3**

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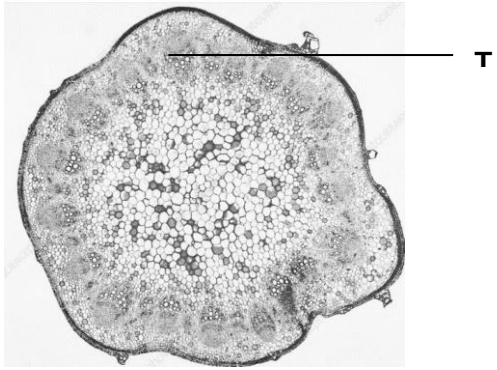
Question	Answer	Marks
3(b)(ii)	*any **four** from:* three bases / triplet of bases / codon, code(s) for one amino acid **;** frameshift mutation **;** change in, triplet of bases / codon **;** *ref. to* every, triplet / codon, after deletion will be different **;** may introduce a stop codon **;** primary structure / sequence of amino acids / AW, will be altered **;** (stop codon results in) formation of, shortened / truncated, polypeptide **;** AVP **;** e.g. *ref. to* errors in RNA splicing *ref. to* affects post-translational modification bonds that form between R groups, will / may, be altered tertiary structure of protein will be altered non-functional protein formed altered function of the protein	**4**
3(b)(iii)	*any **one** valid suggestion e.g.:* no effect on protein structure (because introns are non-coding) **;** non-functional / reduced function of, protein (as intron not spliced after transcription) **;** may affect regulation of gene expression **;** **A** example e.g. reduction in the rate of transcription RNA polymerase does not bind *ref. to* errors in RNA splicing **;** *ref. to* formation of an oncogene **;**	**1**

Question	Answer	Marks
4(a)(i)	no, nucleic acid / genetic material / DNA / RNA **;** no, capsid / protein coat **; A** no capsomeres only some viruses have envelopes **;**	**2**
4(a)(ii)	heads / phosphate, (groups) of phospholipids are hydrophilic **or** fatty acid tails of phospholipids are hydrophobic **;** **A** heads are hydrophilic and tails are hydrophobic heads / phosphates, point towards the centre (of the virosome so, must be aqueous / water present) **; ora** *for tails*	**2**
4(b)	*any **two** from:* acts as a non-self / foreign, antigen **;** triggers / stimulates, primary immune response **or** provides (artificial) active immunity **;** (leads to) formation of antigen presenting cell **;** **A** endocytosis / phagocytosis, to present antigen (by, macrophage neutrophil) activates, B lymphocytes / T lymphocytes **;** **A** clonal selection formation of memory cells **;**	**2**
4(c)	*any **two** from:* no change in, shape / tertiary structure / conformation, of active site **; ora** (same) substrate able to bind to active site **; ora** consequence **;** e.g. so viruses can leave host cell to infect other cells the mutation is not occurring in the, gene / section of gene coding for amino acids in active site for neuraminidase **;** the gene for neuraminidase is essential for survival **;** AVP **;**	**2**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(a)</td><td>one mark for named pathways ;
one mark for outline of apoplastic pathway ;

<table>
<tr><th>name of pathway</th><th>outline of pathway</th></tr>
<tr><td>symplast / symplastic</td><td>movement of water from cell to cell via plasmodesmata</td></tr>
<tr><td>apoplast / apoplastic</td><td>movement of water via, cell walls / intercellular spaces</td></tr>
</table></td><td>2</td></tr>
<tr><td>5(b)</td><td>label line labelled T to any area of xylem tissue ;
e.g.


</td><td>1</td></tr>
</table>

Question	Answer	Marks
5(c)(i)	lysosome **;**	**1**
5(c)(i)i	*any **three** from:* increased permeability to water **;** increased, aquaporins / protein channels (in the tonoplast) **;** water potential in vacuole is lower than that of cytoplasm **;** **A** more ions in vacuole lower water potential more water enters (vacuole) by osmosis **;** vacuole increases, in volume / pressure (until it bursts) **;** AVP **;** e.g. fewer transport proteins for exit of ions	**3**
5(c)(iii)	*allow two suggestions or a suggestion with further detail, for two marks* active site becomes complementary to substrate **;** (because) bonds altered between R groups of amino acids **;** **A** hydrogen / ionic, bonds removal of a portion that blocks the active site **;** AW substrate can enter active site **;** *idea of* cofactor / AW, associates with the enzyme **;** enzymes becomes functional **;** sets off an enzyme cascade / ref. cell signalling **;** AVP **;**	**2**

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Question	Answer	Marks
5(d)(i)	*any **two** from:* caused by a pathogen **;** *idea that* it is transmissible / passed from infected plant to uninfected plant **;** results in harm being caused / AW **;**	**2**
5(d)(ii)	protoctist **;** <u>*Plasmodium falciparum*</u> / <u>*Plasmodium malariae*</u> / <u>*Plasmodium ovale*</u> / <u>*Plasmodium vivax*</u> **;** **A** *Plasmodium knowlesi*	**2**

Question	Answer	Marks
6(a)(i)	anaphase **;**	**1**
6(a)(ii)	*any **two** from:* growth **;** **R** growth of cells repair of tissues (by replacement of cells) **;** replacement of, old / dead /damaged / worn out, cells **;** **R** repair of cells asexual reproduction **;** production of genetically identical daughter cells **;**	**2**

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Question	Answer	Marks
6(b)	*any **four** from:* as concentration of Paclitaxel increases, the ratio of cells in anaphase to those in metaphase reduces / there are a greater proportion of cells in metaphase than in anaphase **;** as the concentration of Paclitaxel increases, the percentage of cells in mitosis is increasing **;** use of data to support a described trend **;** *idea that* as the concentration increases, more cells, stop in metaphase / spend more time in metaphase / fewer cells are able to move into anaphase **;** suggested mechanism for halt in metaphase **;** e.g. centromeres do not divide prevents spindle fibres shortening prevents movement of chromatids to opposite poles (because sister chromatids still held together) cells do not pass the (metaphase) checkpoint AVP **;**	**4**

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7 Guidance for chemical equations

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Examples of how to apply the list rule: State three reasons … [3]

A

1	Correct	✓	**2**
2	Correct	✓	
3	Wrong	×	

C

(4 responses)

1	Correct	✓	**2**
2	Correct, Wrong	✓ ×	
3	Correct	ignore	

E

(4 responses)

1	Correct	✓	**3**
2	Correct	✓	
3	Correct, Wrong	✓	

G

(5 responses)

1	Correct	✓	**3**
2	Correct	✓	
3	Correct Correct CON (of 4.)	✓ ignore ignore	

I

(4 responses)

1	Correct	✓	**2**
2	Correct	×	
3	Correct CON (of 2.)	✓ (discount 2)	

B

(4 responses)

1	Correct, Correct	✓ ✓	**3**
2	Correct	✓	
3	Wrong	ignore	

D

(4 responses)

1	Correct	✓	**2**
2	Correct, CON (of 2.)	× (discount 2)	
3	Correct	✓	

F

(4 responses)

1	Correct	✓	**2**
2	Correct	✓	
3	Correct CON (of 3.)	× (discount 3)	

H

(4 responses)

1	Correct	✓	**2**
2	Correct	×	
3	CON (of 2.) Correct	(discount 2) ✓	

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Question	Answer	Marks
1(a)	pulmonary (circulation) **;** systemic (circulation) **; R** systematic vena cava / inferior vena cava / superior vena cava **; A** venae cavae	**3**
1(b)	venule / venules **;**	**1**
1(c)	label line pointing to, left atrioventricular / tricuspid, valve and labelled **R ;** **R** if pointing to one of the chordae tendinae label line pointing to, pulmonary artery and labelled **L ;** **A** pointing to left or right pulmonary artery	**2**
1(d)	globular **;** intracellular **; R** intercellular water <u>and</u> H_2O **;** carbonic acid **;** hydrogen <u>and</u> H^+ **;**	**5**

Question	Answer	Marks
2(a)	**S** = protein **;** **A** amino acid **R** protein coat **I** capsomere **T** = capsid **;** **A** protein coat **R** capsomere	**2**

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Question	Answer	Marks
2(b)	170 (nm) **;**	**1**
2(c)	replication / synthesis / AW, of (viral) DNA **;** **I** replication of genes **A** *stated function of DNA polymerase* **I** unwinding of DNA e.g. forms phosphodiester bonds joins / AW, (adjacent DNA) nucleotides **R** joins complementary nucleotides **I** joins sugar phosphate backbone	**1**
2(d)	presence of (viral), envelope / (outer) membrane / phospholipid bilayer **;** ref. fluid / flexible **;** ref. to preparation (for electron microscopy) **;** e.g. distortion / squashed / artefact **I** ref. to use of the microscope e.g. electron beam affects AVP **;** e.g. *suggestion of* variation in <u>tegument</u> protein, number / arrangement / organisation / AW	**2**

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Question	Answer	Marks
2(e)	*similarity, one mark:* both have DNA (double stranded, naked / no histones) **;** **A** DNA plus neutral feature e.g. not surrounded by a nuclear envelope **I** both have genes **I** components of DNA e.g. deoxyribose / nucleotides / phosphates **R** both have, single stranded / circular, DNA **R** both have, DNA free in the cytoplasm / DNA and RNA *difference, one mark:* bacterial DNA, circular / closed loop (v HCMV linear) **I** ref. to naked DNA **R** if comparison for HCMV is incorrect e.g. multilayered **or** bacteria (can also) have, plasmid DNA / plasmids **R** if implied that bacterial DNA is only plasmid DNA **or** bacterial DNA (also) has genes for, metabolism / AW **ora** **or** bacterial DNA free in cytoplasm but HCMV DNA surrounded by, capsid / protein coat / **T ;**	**2**

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Question	Answer	Marks
2(f)	**I** transcription and translation stops *any **three** from:* **1** no, S phase / G_2 phase / mitosis / cytokinesis **;** **A** remains in (G_1) interphase **A** synthesis phase *for* S phase **I** named mitotic stages *look for* **CON** e.g. 'no S-phase, so mitosis only has one chromatid' **2** (semi-conservative) DNA, replication / synthesis, does not occur **;** **A** sister / identical, chromatids, do not form **R** if a phase is stated and it is not given as the S-phase **3** failure to pass checkpoints / does not reach checkpoints **;** **A** ref. to no error checking occurs (*in context of checkpoints)* **I** proofreading / error checking, (by DNA polymerase) during DNA replication **4** cell does not, grow / increase in size / increase cytoplasm **;** *(context of preparing for mitosis / cytokinesis)* **A** grows to normal (non-dividing) size **5** *idea that* the cell does not, duplicate / synthesise, organelles / extra materials *(context is for, cytokinesis / new cells)* **;** **A** centrioles do not replicate **A** microtubules not synthesised **R** if stated as occurring in S phase (even if e.g. G_2 given as well)	**3**

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Question	Answer	Marks
2(g)	*allow virus or pathogen for HCMV* *look for ora in context of healthy immune system* *any **four** from:* **1** ref. to time delay in immune response (compared to normal) **;** e.g. takes a longer time for, immune system to respond slower (secondary) immune response immune response similar to primary response **2** more time / easier / AW, for HMCV to infect cells / replicate / spread (so cause damage) **;** AW **R** ref. to HCMV as, cells that reproduce / viruses that carry out mitosis *impact following primary response and after viral activation* **3** few(er), immune system cells / named, (in circulation) **; I** fewer white blood cells e.g. fewer, macrophages / neutrophils **A** phagocytes fewer (B- and T-) memory cells **A** no memory cells *(no longer present from primary response)* fewer, (B/T,-) lymphocytes / T-helper cells / T-killer (or cytotoxic) cells *context for lymphocytes could be reduced number circulating at time of viral activation or owing to poor secondary response(compared to normal)* fewer / no, plasma cells **4,5** consequence of fewer immune system cells **;;** *two marks* e.g. less chance of / AW, encounter with / recognition of / activation by, (non-self / foreign) antigen / HMCV / virus / pathogen / infected cell (fewer memory cells) ref. reduced clonal expansion / AW (so fewer lymphocytes / plasma cells)	**4**

Question	Answer	Marks
2(g)	(fewer plasma cells) lower concentration of antibodies **A** no antibodies (as no plasma cells) **A** longer time for antibody, production / concentration to build up (fewer T-helper cells) less cytokine released **A** effect of cytokine *if spelling of cytokine* rejected (fewer T-killer cells) fewer infected cells killed / **A** perforin / granzymes / hydrogen peroxide, not released (fewer phagocytes) less phagocytosis for antigen presentation	

Question	Answer	Marks
3(a)	protoctist **;**	**1**
3(b)(i)	*any **two** from:* **1** drugs have different, targets / mechanisms of action, **or** drugs, act on different, structures / processes / stages of life cycle **;** **2** unlikely / less likely, for mutations against all drugs to occur **;** **3** unlikely for resistance to occur against all the drugs **;** **I** immune / immunity **A** described example **4** if there is resistance to one, the other drug(s) will, kill / AW, all pathogens **;** AW **I** ref. to effective **5** (so) prevents, gene / allele, from being passed on **;** **6** AVP **;** e.g. low numbers left, so less probability of mutations arising *idea that* if all pathogens are killed, no replication / no mutations, for resistance to develop	**2**

Question	Answer	Marks
3(b)(ii)	*allow, pathogens / parasites, for <u>Plasmodium</u>* **I** increased time when person is infectious *any **two** from:* increased time when person, has *Plasmodium* in, blood / circulation **;** *allow mark if reference to, blood / circulation, not made but reference is made to blood in statements about Anopheles* **A** person acts as a reservoir for *Plasmodium* (so) quantity / concentration / number, of *Plasmodium*, remains high / increases **;** AW **A** ref. to allows *Plasmodium*, to reproduce / replicate **I** ref. to genes passing to offspring increased, time / risk / chance / AW, of, being exposed to, vectors / mosquitoes / *Anopheles* (for blood meal) **;** AW *idea of* more infected, *Anopheles* / mosquitoes available to feed on uninfected people **;**	**2**

Question	Answer	Marks
3(c)(i)	**1** correct use of examples **;** *two of gene, gene mutation, protein, altered protein* *gene* = *kelch13* *gene mutation* = *kelch13* mutation **or** F446I **or** (mutation has) adenine / A, not, thymine / T *protein/polypeptide* = PfK13 a*ltered protein* isoleucine / ile, instead of, phenylalanine / phe **2** (mutation has), changed / altered / AW, sequence / arrangement / order, of nucleotides / bases, (in DNA) **;** *ref. A replacing T still needs stated idea of a changed sequence* **R** *if gene explanation also given and stated as sequence of amino acids* **3** (gene) codes for the production of a, polypeptide / protein AW **or** (gene mutation) produces / results in, altered / changed / non-functioning / reduced function, polypeptide / protein **;** AW **A** produces changed sequence of amino acids **R** *if gene and gene mutation explanations given and one is incorrect*	**3**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(c)(ii)</td><td>
allow correct use of extracted data to help confirm points
allow ideas such as higher survival = greater (partial artemisinin) resistance

Key
20 / lower concentration = 20 nmol dm^3 DHA
700 / higher concentration = 700 nmol dm^3 DHA
survival / survival rate = mean percentage survival rate of trophozoite

any three from conclusions 1 to 5:
<table>
<tr><td>1 zero survival of no mutation</td><td>cultures 1 and 4 / no mutations, no survival / 0% survival rate / all killed, at, higher concentration / 700 ;</td></tr>
<tr><td>2
concentrations compared</td><td>lower concentration / 20, higher survival rate than, higher concentration / 700
ora
higher concentration / 700, lower survival rate than, lower concentration / 20 ;
general statement or can take one culture to compare</td></tr>
<tr><td>3
mutation (C580Y and F446I) v no mutation (control / cultures 1&4)</td><td>(A and B strains with) mutations higher survival rate than no mutation
ora
(A and B strains with) no mutation lower survival rate than mutations ;
general statement for both strains, or A, or B
(if concentrations mentioned, need to refer to both concentrations)</td></tr>
<tr><td>4
compare strain A with strain B</td><td>strain A higher survival rate than strain B
ora
strain B lower survival than strain A ;
general statement or comparing groups e.g. 1 and 4 or 2 and 5 or 3 and 6 (for both or one concentration)</td></tr>
<tr><td>5
C580Y v F4461</td><td>C580Y, higher survival than F446I / highest survival rate
or
F446I lower survival rate than C580Y ;
general statement or compare 2 and 3, or 5 and 6, for both or one concentration</td></tr>
</table>
</td><td>3</td></tr>
</table>

Question	Answer	Marks
4(a)	*any **two** from:* presence of mucus can, hinder / prevent / AW, gas exchange / entry of air (to alveoli) / airflow (to alveoli) **;** **A** named gases detail **;** e.g. (lumens of) airways / respiratory bronchioles, are narrow **or** airways / respiratory bronchioles, are close to alveoli *suggestion that* respiratory bronchioles *have,* few / no, cilia present so difficult to move mucus / AW **;** **R** bronchioles do not have cilia *as a general statement* mucus increases distance for diffusion of (respiratory) gases / oxygen / carbon dioxide **;** **R** if direction of diffusion of gas is incorrect increased risk of infection from trapped pathogens if mucus present **;** AW	**2**
4(b)(i)	*any **three** from:* (bronchioles) have columnar, epithelium / cells **;** **A** columnar and cuboidal, epithelium / cells (bronchioles) have ciliated, epithelium / (epithelial) cells **;** **A** cilia (are present) **ora** (alveoli) have squamous, epithelium / cells **;** **I** endothelium / endothelial cells detail **;** e.g. (bronchiole epithelial cells) longer / wider / thicker **R** if, mucus makes it thicker / stated as more than one layer **or** (alveolar cells) flatter / thinner *allow ideas if stated as epithelium (rather than cells)* AVP **;** e.g. ref. to alveolar type II cells / cells secreting surfactant	**3**

Question	Answer	Marks
4(b)(ii)	smooth muscle **;** *plus any **two** from:* *max 1 for function if stretch and recoil **or** vasoconstriction / vasodilation stated* (muscle) contracts / contraction (and relaxation of bronchiole, lining / wall) **;** **R** contraction of, bronchiole / lungs / other airways change / decrease, diameter of, bronchiole / lumen / airway **;** **A** adjust size of airway **A** constriction of, bronchiole / airway control of air flow (to and from alveoli) / AW **;** e.g. control volume of air, entering / leaving, alveoli *allow ecf **max two marks** if incorrectly stated as elastic fibres* stretch / expand, during inhalation **;** **A** stretch and recoil prevents, overstretching / bursting, during inhalation **;** recoils to help move air out during exhalation**;** *allow ecf to **max one mark** if incorrectly stated as cartilage* prevent collapse of, bronchiole / airway **;** provides support / keeps airway open **;**	**3**

Question	Answer	Marks
5(a)	*any **three** from: accept gly for glycine throughout* glycine every third amino acid **;** glycine, is, small / smallest, amino acid **;** **A** has H as R-group glycine allows tight coiling of polypeptides to form triple helix **;** AW **A** glycine presence allows a, compact / AW, triple helix gly (-NH) can form hydrogen bonds with (C=O in pro of) other polypeptides of triple helix **;** **A** *idea that* H bonds can form with other polypeptides in the triple helix AVP **;** e.g. pro / ala, also small amino acids (for tight coiling) high proportion of smaller amino acids / amino acids with small side chains **A** high proportion of glycine *if mp1 <u>not</u> given and mp2 is* pro can form hydroxyproline for stability ref. insoluble and (some), amino acids with non-polar R-groups (e.g. ala)	**3**

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Question	Answer	Marks
5(b)	*any **three** from:* **1** (Golgi /secretory) vesicles, detail **;** e.g. packaging of / containing, collagen vesicles bud off from Golgi body *context of movement to surface (not movement to other areas within cell)* **2** vesicles moved by, microtubules / cytoskeleton (to cell surface membrane) **;** **3** ATP required **;** **A** energy required / active process **R** active transport **4** fuse / merge / combine, with the <u>cell surface membrane</u> **;** **A** <u>plasma membrane</u> **5** AVP **;** e.g. budding from trans face of Golgi detail of fusion e.g. phospholipid bilayers merge into one	**3**
5(c)(i)	*any **two** from:* collagen, not broken down / not hydrolysed / breakdown prevented **;** **A** ECM *for collagen* **A** less hydrolysis / AW detail **;** e.g. suggestion that, collagen does not fit into active site / active site changes shape no / few, ESC / enzyme substrate complexes, form collagen, continues to be, synthesised / released **;** **A** increase in collagen / maintenance of collagen	**2**
5(c)(ii)	(V_{max}) decreases **;** (K_m) stays the same **;**	**2**

Question	Answer	Marks
6(a)	*any **two** from:* **1** (water is a) solvent, for, assimilates / minerals / ions / polar molecules **A** hydrophilic **A** named **or** substances, in xylem and phloem sap / that are transported, dissolve in water / are in solution **;** **A** (water is a) good / universal / versatile, solvent **2** feature for xylem **;** e.g. water can move up, as part of transpiration stream ref. cohesion between water molecules adhesion between water and, cellulose / wall of xylem / xylem lining hydrogen bonds for cohesion and adhesion **I** for cohesion-tension **3** feature for phloem **;** e.g. water used to build up, hydrostatic pressure / pressure gradient / pressure differences, for, mass flow / translocation / transport / AW *if not gained for mp2 allow similar ref. to cohesion / adhesion, for, phloem sap movement / transport* **4** AVP **;** e.g. (xylem sap) water moving down a water potential gradient contributes to transpiration stream	**2**
6(b)	**A** phloem sieve tube element **;** **B** companion cell **;** **C** companion cell **;**	**3**

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Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/23**

Paper 2 AS Level Structured Questions **October/November 2022**

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 October/November 2022 series for most Cambridge IGCSE™, Cambridge International A and AS Level 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.

Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	<u>'List rule' guidance</u> For questions that require ***n*** responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked *ignore* in the mark scheme should not count towards ***n***. • Incorrect responses should not be awarded credit but will still count towards ***n***. • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response. • Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

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6 Calculation specific guidance

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

7 Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

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Examples of how to apply the list rule: State three reasons … [3]

A

1	Correct	✓	**2**
2	Correct	✓	
3	Wrong	×	

C

(4 responses)

1	Correct	✓	**2**
2	Correct, Wrong	✓ ×	
3	Correct	ignore	

E

(4 responses)

1	Correct	✓	**3**
2	Correct	✓	
3	Correct, Wrong	✓	

G

(5 responses)

1	Correct	✓	**3**
2	Correct	✓	
3	Correct Correct CON (of 4.)	✓ ignore ignore	

I

(4 responses)

1	Correct	✓	**2**
2	Correct	×	
3	Correct CON (of 2.)	✓ (discount 2)	

B

(4 responses)

1	Correct, Correct	✓ ✓	**3**
2	Correct	✓	
3	Wrong	ignore	

D

(4 responses)

1	Correct	✓	**2**
2	Correct, CON (of 2.)	× (discount 2)	
3	Correct	✓	

F

(4 responses)

1	Correct	✓	**2**
2	Correct	✓	
3	Correct CON (of 3.)	× (discount 3)	

H

(4 responses)

1	Correct	✓	**2**
2	Correct	×	
3	CON (of 2.) Correct	(discount 2) ✓	

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;	separates marking points
/	alternative answers for the same marking point
R	reject
A	accept
I	ignore
AVP	any valid point
AW	alternative wording (where responses vary more than usual)
ecf	error carried forward
underline	actual word underlined 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

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Question	Answer	Marks
1(a)(i)	C-N bond shown **;** =O shown on C and -H shown on N of peptide group **;** water shown as a product **;**	**3**
1(a)(ii)	peptide **;** **A** amide **R** polypeptide bond	**1**
1(a)(iii)	ribosome **;** **I** 70S / 80S **A** rough endoplasmic reticulum **I** rough ER / RER	**1**
1(b)(i)	*any **two** from:* alpha- / α-, helix, helices **;** **R** A or a *for alpha* beta- / β-, pleated sheet(s) / pleat(s) **;** **A** beta / β, sheet(s) **R** B or b f*or beta* region of no fixed shape / AW **;** **A** random coil	**2**

Question	Answer	Marks
1(b)(ii)	*any **two** from:* **1** protein is, a single polypeptide / made of one chain of amino acids **or** quaternary structure is two or more polypeptides / more than one polypeptide **;** **2** interactions / bonds, between, R-groups / side chains, (of amino acids) on the same polypeptide **or** **3** quaternary has, interactions / bonds, between, R-groups / side chains, (of amino acids) on different polypeptides **;** **4** AVP **;** e.g. no prosthetic group	**2**
1(b)(iii)	*secondary structure* **1** in alpha-helix each N-H forms hydrogen bond with C=O three or four amino acids apart in same polypeptide **;** **2** in beta-pleated sheet each N-H forms hydrogen bond with C=O on adjacent part of the polypeptide **;** *if mp1 or mp2 not awarded* **3** (by) hydrogen bonds (in secondary structure) **;** *tertiary structure* **4** hydrogen bonds between, R-groups with C=O and HN groups / carboxyl and amine groups **;** **A** between polar R groups **5** ionic bonds between R-groups with NH_3^+ and COO^- groups **;** **A** between charged R groups / AW **6** hydrophobic interactions between non-polar R-groups **;** *if mp4, mp5 or mp6 not awarded* **7** (named) interactions / bonds, between R-groups (in tertiary structure) **;**	**3**

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Question	Answer	Marks
2(a)(i)	*any **three** from:* **1** phagocytosis / endocytosis **;** **2** (antigens on) bacteria, attach / bind, to cell (surface) membrane / receptors **;** **I** 'bonding' / binding sites **A** in context of, opsonins / antibodies, attached to bacteria **3** infolding / invagination / pinching in of membrane / AW **;** **A** pseudopodia / cytoplasm, moves around bacteria **4** fusion of membrane of macrophage (to form vacuole) **;** **5** formation of, vacuole / vesicle / phagosome **;** **6** active process / uses ATP / uses energy **;** **R** active transport **I** lysosomes	**3**

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Question	Answer	Marks
2(a)(ii)	*any **three** from:* *lysosomes contain enzymes* **1** (lysosomes contain enzymes) to, break down / digest / AW, pathogens / bacteria / viruses **;** **2** (lysosomes contain enzymes) to break down, worn out / old / non-functioning, organelles / cell components **;** **A** named organelle / worn out cells / old cells / ref to autolysis **3** using, hydrolytic enzymes / hydrolases **or** any **two** examples of enzymes **;** e.g. nuclease / protease / carbohydrase / lipase / glycosidase / lysozyme **4** isolate harmful enzymes from rest of the cell / membrane-bound to protect rest of cell (from hydrolytic enzymes) **;** **5** AVP **;** e.g. maintaining acid environment / optimum pH, for enzyme action ref. allows antigen presentation	**3**
2(b)(i)	*any **two** from:* *if working and numerical answer shown correctly but no minus sign or decrease stated = 2 marks* (number of new cases in 1993) 25 000 – 25 100 **and** (number of new cases in 2018) 8000 – 10 000 **;** percentage change = $\frac{16\,000}{25\,000}$ x 100 **;** answer = - 64(%) / decrease by 64(%) **;** **A** answer between – 60 and – 68 (%)	**3**

Question	Answer	Marks
2(b)(ii)	*any two from* **1** (number of new cases overall) decrease **;** **2** steep(er) decrease between 1993 and 2001 **;** **3** (number of new cases) constant / stable / plateau, between, 2013 / 2014, to 2018 **;** **4** (number of new cases) increases in 2015 **;** **I** fluctuation for mp3 and mp4	**2**
2(c)	*any **one** from:* **I** references to (more) accurate can make, statistical / valid, comparisons between, years / countries **;** **A** takes into account the population sizes of different countries AVP **;** e.g. can set targets for the control of TB (e.g. keep below *n* per 100 000) ref. to supply of, vaccines / drugs / hospital beds / AW can, monitor / evaluate, success of TB control programmes to find out which countries have high, rates / incidence, of TB **R** 'high numbers'	**1**

Question	Answer	Marks
2(d)	*any **two** from:* **1** *Mycobacterium* / pathogen / TB bacteria, remains dormant in the body **;** **A** ref. to latent TB / bacterium present in the body but no symptoms **2** treatment takes a, long time / minimum of 6 months **;** **3** many people do not complete treatment **;** **4** many people do not have access to treatment **;** **5** drug-resistant / antibiotic resistant, strains of *Mycobacterium* / pathogen / TB bacteria **;** **R** 'immune' **6** HIV/AIDS *or* any other medical condition that increases susceptibility to TB **;** e.g. weakened immune system / increased activation of dormant bacteria **I** TB is opportunistic, infection / disease, without further detail **7** vaccine reluctance **;** **8** movement / migration, of people, infected with TB / from countries with high rates of TB **;** **9** poor housing / overcrowded living conditions / homelessness **;** **10** malnutrition / poor diet **;** **11** transmission from cattle by, drinking unpasteurised contaminated milk / eating meat from contaminated cattle **;** **12** lack of education / AW, about preventing spread of TB **;** **13** AVP **;** e.g. vaccination is not effective for adults / AW TB is difficult to diagnose	**2**

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Question	Answer	Marks
3(a)	*any **four** from:* **1** ref to, difference in water potential / water potential gradient **;** **2** (continuous) columns of water (in xylem of, tree trunk / stem) **;** **I** stream **3** transpiration pull / cohesion-tension **;** **4** hydrogen bonding / cohesion, between water molecules **;** **5** hydrogen bonding / adhesion, between water and, the lining of the xylem / cellulose (in walls of xylem) / hydrophilic parts of lignin **;**	**4**
3(b)	*any **four** from:* **1** cavitation (only) occurs when, light is available / PAR is available / the trees photosynthesise **;** **2** water movement / transpiration, (only) occurs when, light is available / PAR is available / the trees photosynthesise **;** **3** no clear relationship between values for, light energy / PAR, and cavitation rate **;** **4** peaks of cavitation does not coincide with peaks for, PAR / wind speed **;** **A** peaks occur around the time of peak in, PAR / wind speed **5** no cavitation when the wind speed is below 1.25 $\underline{\text{m s}^{-1}}$ **;** **6** PAR affects, cavitation (rate) / water movement / transpiration (rate), more than wind speed **;**	**3**

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Question	Answer	Marks
4(a)(i)	**A** – <u>metaphase</u> **;** **B** – <u>anaphase</u> **;**	**2**
4(a)(ii)	*any **three** from:* *prophase* **1** form spindle, apparatus / fibres **;** **2** attached to, centromere / kinetochore **;** **A** remain attached to centromere during, prophase / metaphase / anaphase *(late) prophase* **3** move / AW, chromosomes / sister chromatids, to, (spindle) equator / metaphase plate **or** *during metaphase / until anaphase* maintain chromosomes at (spindle) equator **;** **A** sister chromatids **R** chromatids unqualified *anaphase* **4** disassembly / shortening, of microtubules / spindle fibres **;** **5** centromeres divide **or** chromatids move to (opposite), poles **;** AW **R** sides **6** daughter nuclei receive, one chromatid of each chromosome **;** **A** daughter nuclei receive a full complement of chromosomes / AW **7** AVP **;** e.g. pole to pole spindle fibres lengthen to extend the cell	**3**

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Question	Answer	Marks
4(a)(iii)	**I** telophase *any **three** from:* **1** nuclear envelope (re)forms around each group of chromosomes **;** **R** nuclear membrane **2** uncoiling / decondensing / AW, of chromosomes **;** **A** ref. to chromatin **3** nucleolus / nucleoli (in each nucleus), reform(s) / reappears / visible **;** **4** organelles distributed between two halves of cell **;** **5** cytokinesis / division of cytoplasm **; A** cytoplasm splits **6** cleavage furrow forms **;** **A** described e.g. 'pinching in' of (cell surface) membrane **A** equator of cell pinches in / cell membrane constricts **R** cell plate **7** AVP **;** e.g. ref to ring of microfilaments / contractile ring, draws membrane closer together / AW **I** microtubules	**3**

Question	Answer	Marks
4(b)	*any **three** from:* **1** semi-conservative replication of DNA **;** **2** *idea that* each new chromatid is identical to old one / sister chromatids are identical **or** each chromosome has two identical DNA molecules **;** **3** alignment of chromosomes on the, (spindle) equator / metaphase plate **;** **4** chromatids separate so each cell receives a (sister / identical) chromatid of each chromosome **;** **5** centromere(s) split / shortening of spindle fibres **;** **6** sister / identical, chromatids move to (opposite), poles **;** AW **A** chromosomes / daughter chromosomes **7** checkpoints occur within cell cycle **;** **8** prevents cells entering next stage if there are errors **;** **9** (so that) errors in replication are repaired (by DNA polymerase) **;** **10** to avoid mutations in daughter cells **;**	**3**

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Question	Answer	Marks
5(a)(i)	*any **two** from:* **1** *idea of* the cells have the, same receptor / specific receptor (for LL-37) **;** **2** on cell (surface) membrane / inside cell **;** **3** (shape of) receptor is complementary to (shape of), cathelicidin / signalling compound / ligand **;** **I** antigen **R** active site	**2**
5(a)(ii)	*any **two** from:* **1** thin cells **;** **A** (they are) squamous **R** 'made of squamous epithelial cells' **I** flat / flattened **R** 'they have thin (cell) walls' **2** smooth / AW, (luminal) surface **;** **3** cells are wider in region of the nucleus **;** **A** nucleus bulges from cell **4** ref to, endothelial pores / fenestrations / pores between cells / gaps between cells **;**	**2**
5(b)(i)	(TTC to TAC) change from phe to tyr (at position 5) **;** **I** 'tyr' unqualified	**1**

Question	Answer	Marks
5(b)(ii)	*allow two marks for* new sequence is leu arg val ile ser ser gly asp leu **;;** *or allow any **two** from:* **I** refs to frameshift **1** sequence after, first amino acid / first leu, is different **;** **R** 'after position 2' **A** 'from position 2 onwards' **2** any example **;** e.g. amino acid (at position 2) is arg **3** shortened polypeptide / early chain termination **;**	**2**
5(b)(iii)	*any **two** from:* peptide is 3 amino acids in length / shortened polypeptide **;** stop codon in position 4 **;** (third) amino acid is still, gly(cine) / the same **;**	**2**
5(c)	(genetic code) is the, same / similar, in all organisms AW **or** *idea that* each triplet codes for the same amino acid in all living organisms **;**	**1**
5(d)	*any **two** from:* **1** (most) amino acids have more than one, triplet / codon **;** **2** any correct example(s) from Table 5.2 **;** *if award this then award mp1 as well* **3** genetic code is, degenerate / redundant **;** **R** degenerative / degenerated **4** *idea that* 64 / 61, possible codons for 20 different amino acids **;**	**2**

Question	Answer	Marks
6(a)	*any **one** from:* **1** (ions) cannot pass through, phospholipid bilayer / hydrophobic core (of membrane) **; ora** **I** 'ions cannot pass through the membrane' **2** (transport proteins provide a) hydrophilic pathway for ions **;** **3** for facilitated diffusion (of the two ions) **;** **A** to act as an anion exchanger	**1**
6(b)	to maintain electrical neutrality (inside cytoplasm / cell) **;** **A** balance the charges (either side of membrane) **A** to prevent build up of negative charge (in cytoplasm) **I** 'because HCO_3^- are moving in' **I** ref to pH	**1**

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Question	Answer	Marks
6(c)	*any **one** from:* **1** concentration of carbon dioxide is lower than concentration in red blood cell **or** carbon dioxide, diffuses / AW, down a concentration gradient **;** **A** partial pressure **2** so carbon dioxide can be, excreted / expelled from lungs / breathed out **;** **3** to enter the alveolus / alveolar (air) space **;** **4** as part of gas exchange, at the alveolar surface / in the lungs **;**	**1**
6(d)	**X** = haemoglobinic acid **; I** HHb	**1**

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